Research Topics

Innovations in the mental health applications of interRAI assessments

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Innovations in the mental health applications of interRAI assessments

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Editorial: Innovations in the mental health applications of interRAI assessments

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Editorial on the Research Topic
Innovations in the mental health applications of interRAI assessments

What is interRAI?

Mental health issues concern individuals and populations in all stages of life and pose unique challenges to healthcare systems. People with mental health conditions are exposed to complex interactions between psychological, biological, social, and environmental influences that are unlikely to be mitigated by one-dimensional assessment and screening systems. The interRAI research collaborative—www.interrai.org—aims to improve the quality of life of people of all ages, particularly those who are vulnerable due to some combination of age-related or developmental health problems, disability, medical complexity, or mental health challenges. The collaborative does this by designing and implementing comprehensive systems that cross the continuum of health and social care settings. Since Morris et al. (1) first described the deployment of a single-sector *Resident Assessment Instrument* (RAI) for geriatrics in response to the US Omnibus Reconciliation Act of 1987, interRAI instruments have evolved to become a fully integrated suite of measures spanning populations of all ages. Researchers and health professionals use interRAI systems in more than 35 countries for care planning, outcome measurement, resource allocation, quality improvement, and policy development.

This Frontiers in Psychiatry special issue presents a compilation of research to illustrate the novel *mental health* (MH) applications of the interRAI suite in psychiatric and non-mental healthcare settings. Today, more than a billion people experience mental health disorders, accounting for 19% of years lived with disability (2). While persons living with mental health disorders or addictions have diverse needs throughout their lives, healthcare services are frequently uncoordinated; often failing to holistically meet the needs of community. InterRAI instruments provide a highly validated mental health information system with a whole-of-person approach to mental health assessment (3). Emergency departments, inpatient psychiatry units, community mental health services, mobile crisis teams, police officer screening, and long-term care settings internationally use interRAI systems for all persons across the life span (4).

Measuring the mental health impacts of COVID-19

The sudden uncertainties of the COVID-19 pandemic intensified the existing challenges faced by strained mental healthcare systems worldwide. Betini et al. assessed the mental health impact of the pandemic on a general population survey in Canada. Using interRAI's self-reported mood scale, the authors gathered data on 3,127 individuals about their mental health in four online surveys spanning April to July 2020. The number of study participants feeling anxious and depressed increased more than two-fold compared with a pre-pandemic survey iteration. Nevertheless, the authors emphasize that these sobering statistics are dynamic and can change rapidly in response to social change.

Research from Stewart, Vasudeva, et al. indicates that neither adults nor children were spared from the life-changing consequences of the COVID-19 pandemic. Stewart, Vasudeva, et al. examined longitudinal routine care data collected from 35,000 children using interRAI's *Child and Youth Mental Health Assessment* (ChYMH). Paradoxically, the researchers found sharp declines in the number of children and youth referred to mental health services during lockdowns. This disparity exposes a need to increase children's access to mental healthcare in times of crisis.

In a subsequent paper, Stewart, Celebre, Semovski, et al. highlight the versatility and applicability of interRAI's ChYMH in a fragmented children's mental healthcare system unable to supply the demand for child mental health services. The review elucidates that the lack of coordination between the numerous mental health professionals involved drives inefficiency. The authors state that by taking an integrated approach to assessing a child's strengths, needs, and preferences, interRAI's suite of child and mental health assessment instruments provides an evidence-informed solution to these problems across sectors (Stewart, Celebre, Semovski, et al.).

A paper by Hirdes et al. focused on the development of new measures of mood disturbance with a sample of about half a million individuals. The contexts ranged from the general community-based population to persons in long-term care and palliative care programs. The paper demonstrates the feasibility of large-scale consistent measurement of mood across populations with differing levels of health, functional ability, and cognition. A remarkable result was that the level of severely distressed mood during the pandemic was seven times greater in the general population compared with a pre-pandemic sample. This level of distress approached what was seen in clinical populations receiving community mental health services.

Mental health problems in the workplace are prevalent worldwide, but the needs of injured workers who receive psychiatric services remain elusive (5). A Canadian observational study by Herring et al. used the richness of data collected between 2006 and 2016 from the interRAI MH instruments to provide a unique insight into the needs of this distinct population. Concerningly, the authors found that workers experienced more trauma, pain, depression, sleeping issues, and substance use disorders than other psychiatric inpatients. Herring et al. emphasize the importance of ongoing interRAI measurements to capture and respond to the symptoms and needs of a growing patient population.

Mental health and quality of life

A major focus of interRAI assessment addresses quality of life (QoL). Persons with mental health disorders typically have a lower QoL. Hence, a deeper understanding of this multidimensional concept could generate new avenues for targeted interventions to improve the lives of vulnerable persons. Celebre et al. investigated determinants of QoL in children and youth receiving mental health services. Using a combination of the ChYMH and the innovative QoL-ChYMH, the authors found that specific mental state indicators had a disproportionate influence on QoL scores. For instance, participants who experienced anhedonia and depressive symptoms scored significantly lower on the social domain of QoL. In addition, individuals experiencing heightened depressive symptoms also reported having lower QoL at the individual (e.g., autonomy) and basic needs (e.g., food) levels.

Research by Luo et al. and de Almeida Mello et al. examined QoL of adults in mental health settings with a seven-nation study including low, mid, and high resource countries using the *Self-Reported QoL Survey for Mental Health and Addictions* (SQoL-MHA). Given interRAI's seamless integration of items and scales across all its assessment tools—including those for inpatient and community-based mental health services—the study was able to measure QoL's objective and subjective realms. Participants from Canada and Finland scored particularly high for the hope and activities dimension. On the other hand, patients from Rwanda, Belgium, and Brazil reported good relationships with staff. The findings suggest that strength-based international collaboration could benefit patient's quality of life.

Instruments for an aging population across the continuum of care

Older adults constitute the fasted growing age group, with the estimated number of people aged 65 years and over exceeding 727 Million (6). Older adults constitute a vulnerable population with elevated levels of mental health or substance use disorders. Home care has emerged as a viable strategy to reduce hospital or long-term care institutionalization. Poss et al. examined how many community-dwelling older adults had psychiatric diagnoses and other mental health symptoms and what proportion of these patients visit a psychiatrist. Responses to the interRAI Home Care data showed that only a quarter of participants visited a psychiatrist, despite more than half having psychiatric diagnoses. The authors highlight important questions about differential access to psychiatry services by site of care, geographical location, and age.

Once institutionalized, frail older adults become exposed to institution-acquired complications and interventions such as infection, malnutrition, and control interventions with adverse physical and psychological effects. Using routinely collected data from 200,000 interRAI MH assessments, Cheung et al. examined determinants of control interventions (e.g., physical or chemical restraint) in inpatient psychiatry. Their research highlights that people with functional impairment, psychosis, aggressive behavior, cognitive impairment, and delirium were at risk of controlled interventions in non-emergency situations. Considering that these can have negative health effects, the authors advocate for other strategies to support older adults in these situations.

On an optimistic note, research from Howard et al. shows that long-term care settings provide person-centered care to an increasingly inclusive population of disabled and medically complex persons. Their study analyzed longitudinal data from the third-generation interRAI Minimum Data Set to determine if the nursing home transition toward person-centered care continues in today's diverse patient landscape. Although less conducive to social wellbeing, the authors conclude that person-centered care in US nursing homes provides the necessary foundation to promote mental and physical wellbeing for persons with complex needs.

An emerging body of literature indicates that resilience, the positive mood response observed in response to stress or adversity, promotes wellbeing in older adults (7). In a world-first study, Angevaare et al. used routine care data collected from older Dutch residents of long-term care facilities to explore the mental health effects of different psychological stressors. The interRAI dataset enabled the authors to compare associations between both observer and self-reported mood outcomes. Remarkably, the study found that in their Dutch sample, major life stressors, particularly conflict with other care recipients and staff, were associated with positive mood symptoms.

Measuring changes in cognition over time is crucial for the early detection and treatment of cognitive impairment in older adults. The InterRAI *Cognitive Performance Scale* (CPS)—ranging from 0 (intact) to 6 (very severe impairment)—and the *Montreal Cognitive Assessment-5 min* protocol (MoCA 5-min)—ranging from 0 to 30—are frequently used for measuring cognition in long-term and clinical care settings. Since older adults frequently move between these settings, Andersson et al. were able to link scores on both instruments to facilitate the tracking of cognition across the continuum of care. The authors found that a CPS score of 0 (intact) and 3 (moderate) corresponds to a MoCA 5-min score of 24 and 0, respectively. This study demonstrates the opportunity of cross-walking scores between the two cognitive measures; however, the authors noted that CPS had higher sensitivity for severe cognitive impairment, whereas the MoCA 5-min was superior for measuring mild impairment.

New additions to the mental health suite

While many articles in this special issue draw on existing data extracted from interRAI assessments, three publications explored the psychometric evaluations of new interRAI mental health instruments. First, Barbaree et al. describe the development of a forensic supplement to the *MH* and *Problem Behaviour Scale*. The instrument underwent rigorous evaluations in three samples of adult forensic inpatients, prison inmates, and youth in custody. The authors state that their innovative tool enables mental health professionals to predict which inpatients are at risk of violence across forensic settings. In practical application, early identification could facilitate appropriate treatments to reduce the need for acute control interventions and to manage behaviors that could hinder the person's progress toward community reintegration.

Stewart, Celebre, Hirdes, et al. designed an algorithm to predict violence specifically in children and youth. The authors deemed the interRAI Risk of Injury to Others (RIO) algorithm a strong predictor of violence that can competently assist decision-making and facilitate early intervention. Lastly, Stewart, Celebre, Iantosca, et al. designed and validated a novel *Autism Spectrum Screening Checklist* (ASSC). The authors report that the ASSC can serve as an initial screen to identify high-risk children and youth assessed as part of routine practice.

Next steps for the interRAI mental health suite

In summary, the articles in this Research Topic provide valuable insights into the richness of interRAI data and recent mental health innovations within the interRAI suite of assessment systems. These data are not exclusive to interRAI fellows, but researchers interested in exploring further the value of the data are encouraged to contact the authors or visit our website. Moreover, these studies and the new innovations support the needs and outcomes of persons with mental illness across different care settings, age groups, and countries.

Author contributions

JF, GC, JH and JPH contributed to the framework of the editorial and draft reviews. TS drafted the editorial. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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REVIEW
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The interRAI Suite of Mental Health Assessment Instruments: An Integrated System for the Continuum of Care

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The lives of persons living with mental illness are affected by psychological, biological, social, economic, and environmental factors over the life course. It is therefore unlikely that simple preventive strategies, clinical treatments, therapeutic interventions, or policy options will succeed as singular solutions for the challenges of mental illness. Persons living with mental illness receive services and supports in multiple settings across the health care continuum that are often fragmented, uncoordinated, and inadequately responsive. Appropriate assessment is an important tool that health systems must deploy to respond to the strengths, preferences, and needs of persons with mental illness. However, standard approaches are often focused on measurement of psychiatric symptoms without taking a broader perspective to address issues like growth, development, and aging; physical health and disability; social relationships; economic resources; housing; substance use; involvement with criminal justice; stigma; and recovery. Using conglomerations of instruments to cover more domains is impractical, inconsistent, and incomplete while posing considerable assessment burden. interRAI mental health instruments were developed by a network of over 100 researchers, clinicians, and policy experts from over 35 nations. This includes assessment systems for adults in inpatient psychiatry, community mental health, emergency departments, mobile crisis teams, and long-term care settings, as well as a screening system for police officers. A similar set of instruments is available for child/youth mental health. The instruments form an integrated mental health information system because they share a common assessment language, conceptual basis, clinical emphasis, data collection

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approach, data elements, and care planning protocols. The key applications of these instruments include care planning, outcome measurement, quality improvement, and resource allocation. The composition of these instruments and psychometric properties are reviewed, and examples related to homeless are used to illustrate the various applications of these assessment systems.

Keywords: care planning, outcomes, quality, case-mix, psychometric properties, homelessness, integration

INTRODUCTION

The lives of persons living with mental illness are affected by the interplay of a broad range intrinsic and extrinsic factors emerging over the life course. From the earliest stages of life to the person's final moments, these factors can influence opportunities for growth and development, access to resources, engagement in interpersonal relationships, participation in community, and achieving an overall sense of well-being.

Mental health concerns are both pervasive and heterogeneous. Mental illness and substance use disorders are the world's leading cause of disability (1) accounting for up to 32% of years lived with disability and 13% of disability-adjusted life years (2). Unipolar depression was the fourth leading cause of total disease burden in 2000, after perinatal conditions, lower respiratory infections, and HIV/AIDS (3). With many underlying psychological, biological, social, economic, and environmental causes, it is unlikely that preventive strategies, clinical treatments, therapeutic interventions, or policy options will succeed as singular solutions for the challenges of mental illness.

Persons living with mental illness tend to receive services and supports in multiple settings across the health care continuum that are often fragmented, uncoordinated, and inadequately responsive. Needs may remain unaddressed (4) as the person navigates a path to many providers that function in narrowly defined siloes. Patient flow through episodic service environments (*e.g.*, hospitals) may be constrained (5) and access to appropriate services may be delayed due to lengthy waiting lists (6).

To be effective, any health system's approach must include strategies for identifying and responding to mental illness and related dimensions of health and well-being throughout the life course and in all parts of the health care continuum. As such, the ability for different providers, organizations and sectors to communicate with one another is crucial.

This paper provides an overview of the interRAI suite of mental health instruments, which is designed to function as an integrated assessment and screening system to provide a holistic view of the person's strengths, preferences, and needs. It begins with an examination of the range of factors that must be considered beyond psychiatric symptoms in order to support a person-centered approach to shared decision-making. Next, it describes the design, psychometric properties, and applications of interRAI mental health assessments using examples related to homelessness and trans-institutionalization.

Assessing the Bigger Picture: The Need to Look Beyond Psychiatric Symptoms

System integration requires the use of a common language for describing needs, monitoring service use, and tracking outcomes over time. Even within a specific care setting, unstructured narrative charts have little value when they are simply "electronic paper records" (7). Medical charts are incomplete, cumbersome, and overly narrow in their focus (8–10). While natural language processing might reduce the burden of reading volumes of narrative notes (11, 12), unstructured charts often have too many information gaps to have value (13). Standardized clinical assessment data can be more useful if they cover the relevant domains, use psychometrically sound data elements, and can be accessed and interpreted for immediate use.

Some clinicians are reluctant to use standardized assessment tools (14) even though their role in evidence-informed practice is recognized (15). Their reasons might include a perceived lack of benefit over clinical judgment, concerns over psychometric properties, and practicality (14). Even if these issues are addressed to one clinician's satisfaction, inconsistency across settings in the choices of measures prevents communication between organizations serving the same individual.

Given the complexity of mental illness over the life course and the likelihood of engaging with diverse service providers, the data requirements for assessment are not rudimentary. Obviously, psychiatric symptoms, cognitive function, diagnosis, and behavioral issues will be highly relevant in most clinical contexts, particularly during acute episodes or mental health crises. However, if the view is widened to the person's broader experience, ability to function, and overall well-being, more domains must be considered as part of a comprehensive assessment of the "whole person".

Life Course Perspective: Growth, Development, and Aging

About 20% of the Canadian population experiences problems with mental health or addictions annually and about half will face mental health problems by age 40 (16). Estimates from New Zealand's Dunedin cohort studies suggest that only 17% of the population will have enduring lifetime freedom from mental illness (17). This is explained, in part, by factors at both ends of life.

About 70% of mental health problems are reported to begin in childhood or adolescence (18), many of which persist over the lifetime (19, 20). Early childhood development sets the stage for social and emotional functioning, academic achievement, and interpersonal relationships (21, 22). As an individual's identity develops in adolescence (23), social networks and peer pressure (24), substance abuse (25), parenting styles (26), and school performance come into play (27). Age-based service restrictions mean the transition from youth to adulthood is often met with fewer mental health resources (28).

Aging is associated with the onset of a number of conditions that can affect mental health, with dementia as the most obvious example (29, 30). Mental illness may accelerate the aging process resulting in shorter life expectancy and greater years of life lost compared with the general population (31–33). Some, but not all, of this is attributable to deaths by suicide (34). Other causes include higher smoking rates leading to increased cancer and cardiovascular disease (35, 36) and higher rates of diabetes arising from poor diet, physical inactivity, and drug related side effects (37). Persons with psychiatric diagnoses who do survive to later life have greater odds of being the most frail (38).

Physical Health and Disability

Physical comorbidities are often neglected needs in persons living with mental illness (39, 40). Health care providers are commonly divided according to whether they provide physical health or mental health services. This bifurcation occurs to the detriment of persons living with mental illness who tend to receive lower quality medical care for physical health problems (33, 41). For example, mental health problems are often overlooked or stigmatized in acute hospital settings (33), cancer screening tends to be inadequate (42), and effective therapeutic regimens are less likely to be received by patients with mental illness who have acute myocardial infarction (43). In mental health settings, treatment of physical health problems is often delayed or inadequate (44, 45), and health promotion may be regarded as a low priority (46).

Mental health issues may be both consequences and causes of physical disability. A four-nation study showed that impaired physical functioning and dual sensory loss were associated with greater odds of depressive symptoms in home care clients (47). Suicide attempts may cause disability among survivors, but also there is increased risk of suicide among persons living with physical disabilities (48–51) for reasons that include pain and a sense of burden to others (52, 53).

Social Relationships

Social isolation and loneliness are increasingly recognized as important risk factors for the physical and mental health of persons of all ages (54–56). For example, social support networks may play an important role in facilitating recovery from mental health problems (57) and they may provide instrumental support with tasks such as child care, transportation, or medical management (58). On the other hand, mental health problems may pose barriers to forming or maintaining close personal relationships over the life course (59, 60). In addition, social relationships may be a source of stress, trauma, or abuse (61–63) that can have immediate and long-term consequences for mental health. Hence, interventions must consider both the social resources that may be beneficial and relationships that may be detrimental to the person's well-being.

Economic Resources

The pathways between poverty, deprivation and mental illness are multifold. Low income households are associated with higher rates of depression and antisocial behavior in children, but the impact may lessen if household resources improve (64). Job loss may pose tremendous stress on individuals and families resulting in worsened physical and mental health (65). However, for persons with pre-existing mental illness, unemployment and poverty are pervasive (66) resulting in reduced access to adequate food, shelter, clothing, and medical treatment. The stigma associated with poverty and mental illness (67, 68) may be further magnified in low resource nations (69).

Homelessness and Housing

Stable housing is an important prerequisite for recovery. Persons who lack stable housing, particularly the homeless, commonly experience higher rates of physical and mental illness, poor quality of life and high mortality (70–74). At the core of homelessness are the processes of marginalization and exclusion, with multiple risk factors driving these experiences (75–78). For instance, persons with childhood trauma, mental illness, and substance use are at greater risk for housing instability and homelessness (79). Homelessness arises from an interplay of individual vulnerabilities, interpersonal, structural, and systemic factors. Individual factors consist of psychosocial vulnerabilities connected to family background, health, and trauma. Interpersonal factors are linked to behaviors like substance use. Poverty, unemployment, and lack of affordable housing are examples of the structural factors; lack of social security of the systemic ones.

Substance Use

The relationship between substance use and mental illness is multifaceted. Based on a recent meta-analysis, more than half of persons with mental illness have a comorbid substance use disorder (80). This comorbidity leads to poorer clinical outcomes, worsened physical and mental health; higher levels of disability; increased risk of suicidal behavior (81), homelessness, and psychiatric readmissions (82); and greater difficulties in interpersonal and family relationships (80). Symptoms of mental illness may interfere with substance use treatment and the reverse may also be true (83).

Proposed mechanisms for this comorbidity include self-medication where people use substances to treat their own mental health symptoms; the reverse-causal pathway where substance use causes or worsens the symptoms of mental illness or side effects of substances produce symptoms similar to mental illness; and a shared environmental or genetic vulnerability where factors like poverty or childhood trauma increase risk for both (84). Considering the complexity of these relationships, comprehensive assessment is needed to understand the context of substance use in relation to symptoms of mental illness.

Trans-Institutionalization and the Criminal Justice System

Deinstitutionalization of mental health services began in Canada and other countries in the 1960s–70s with the rapid closure of psychiatric hospitals followed by further reductions in general hospital admissions for mental health in the 1990s (85). In most countries, the motivations for this change included breakthroughs in pharmaceutical treatments (86) combined with an emphasis on human rights and social inclusion of persons with mental illness (87), and the expectation of better outcomes in the community (88). However, legal concerns and fiscal decisions aimed at reducing health care expenditures (85, 89) were also important drivers. Globally, there is considerable variability in rates of deinstitutionalization (90, 91) despite broad based philosophical support (92, 93).

Deinstitutionalization is associated with improved life expectancy for persons with mental disorders (94), disability reduction (90, 91), better quality of life, and greater autonomy (95). Adverse consequences include a reported rise in trans-institutionalization, homelessness, and criminalization of persons with mental illness (96–99). While there is debate about the extent to which deinstitutionalization has resulted in negative outcomes (100, 101), contact with the criminal justice system is now a common experience for persons with mental illness.

Police have become the first line of contact for many persons living with mental illness (102, 103), with substance use and impulse control issues as common causes (104). In some jurisdictions, the large-scale expansion of inpatient forensic mental health services has been driven by increased admissions of younger individuals from ethno-racial minorities with low levels of violence and substance use offences (105). Specialized mental health courts provide alternative mechanisms for dealing with offenders with mental illness (106), and more advanced analytics of data based on high quality assessments will be essential for the improvement of forensic mental health services (107).

Recovery

The shift to community-based mental health services has been accompanied by a transition from a biomedical care model to one that emphasizes personal recovery (108–110). While there is no common global definition of recovery (111), there are agreed-upon common core principles. For example, that mental health is viewed in terms of a continuum of functioning; recovery may be an iterative or non-linear process; and belonging, community engagement, hope, connectedness, identity, freedom from stigma, meaning in life, and empowerment are key markers to consider (108). Providing a supportive environment that builds on strengths and is calibrated to needs is a priority, rather than stopping services (112). Treatment of symptoms is important, but "clinical recovery" is either not enough or not fully possible in some cases. Therefore, assessment must consider the person in a broader social context to reach beyond symptoms alone.

Stigma

Stigma associated with mental health problems often hinders full citizenship and inclusion in society (113, 114). At the societal level, *public stigma* includes labeling persons with mental illness as dangerous or less competent than the general population. At the individual level, *self-stigma* occurs when persons apply psychiatric labels to their identity, often with negative consequences. Those who experience perceived stigma or discrimination may apply stereotypes to themselves resulting in underestimation of their own potential and a sense of helplessness (115). This may lead to avoidance of necessary care, increasing problems in multiple domains, and worsened prognosis (116, 117).

Conglomeration *Versus* Integration of Assessment

If we accept that standardized assessment has value, we must consider how to define that standard. In many health care settings, usual practice has been to create a conglomerated information system made up of home-grown intake forms combined with a collection of clinical scales used to measure singular issues (*e.g.*, cognition, depression) on an "as-needed" basis.

Data from these conglomerated systems are typically not automated and forms completed separately are not linked. For the service recipient, this can lead to repetitive measurement of the same issues and limited access to clinically relevant information for team members in the circle of care. Longitudinal case histories cannot be constructed easily, linkages between clinical issues tracked on different forms may go unrecognized, and person-level analytics cannot be readily applied to the clinical record. Data compiled this way have little utility for population level analyses because converting them into a complete, electronic database is a daunting task. Handwritten notes on incomplete forms stored in locked filing cabinets serve little purpose beyond single-case after-the-fact chart audits.

Even if data are automated, when the choice of which scale to use for a particular concern is left to individual clinicians, there will almost certainly be no measurement consistency at the organization or system levels. *The Handbook of Psychiatric Measures* (118) contains 26 chapters with over 275 distinct psychiatric measures, and that list was almost surely incomplete at the time of publication. Assuming one could resolve the controversy over whether the Montreal Cognitive Assessment should be used in place of the Mini Mental State Examination (119), what is the likelihood of a consensus on which of the nine depression measures listed in the *Handbook* should be used with all patients, in all settings, during all episodes of care? At the population level, inconsistent data have diminished value. Imagine the response by an organization ranked negatively in an outcome-based quality indicator where different providers use different tools. The fact that an indicator was "not measured the same way" across settings will be the immediate defense used to negate the validity of any differences in performance suggested by the indicator.

Using specific scales on an "as-needed" basis is also a flawed strategy. We do not always know who has a given problem without asking. Indeed, one of the values of comprehensive assessments is that they force the clinicians to ask about underlying issues that go beyond the immediate, presumed problem. Persons with substance use problems are not only found in substance use programs; depression affects people other than those in a mood disorder program; cognitive impairment spans the barriers of a dementia unit. Under-detection of issues like pain, depression and dyspnea is an important problem throughout the health care system (120–122).

If we succeeded in achieving a consensus on a set of tools to measure psychiatric symptoms using a collection of single-focus measures, the data volume and time to complete assessment could still be unwieldy. For example, a set of 15 well-known mental health instruments would measure cognition, (123), delirium (124), depression (125), anxiety (126), psychosis (127), mania (128), trauma (129), pain (130), sleep (131), behavior (132), substance use (133), instrumental activities of daily living (134), functional status (135), suicidality (136), and aggression (137). Despite comprising more than 400 different items, this set does not address many of the key issues highlighted previously.

Further, intellectual property and licensing requirements may be difficult to resolve. Within a single clinical setting the task of securing permissions for 15 or more different instruments would be a challenge, but to do so on a national level is impractical. This would be further complicated by electronic health record vendors licensing requirements, as well as the challenge of training clinical staff on coding conventions that likely differ dramatically among instruments. Finally, though the conglomerated set of assessments may measure the severity of an issue at a given time and can be used on a repeated basis to monitor changes, these measures generally do not invoke a clinical response in reaction to their numeric scores.

The alternative to a conglomeration of stand-alone tools is to use a single, integrated assessment system that can be applied across care settings to persons of any age. The system should serve multiple applications for multiple audiences, including triggering a clinical response leading to shared decision-making in support of key recovery goals.

THE INTERRAI SUITE OF MENTAL HEALTH INSTRUMENTS: AN INTEGRATED ASSESSMENT SYSTEM

interRAI (www.interRAI.org) is a not-for-profit network of over 100 researchers, clinicians and policy experts from over 35 countries in North and South America, Europe, Asia, Africa and Oceania (138–140). It was founded with an initial focus on geriatric research in the early 1990s, but its scope broadened to include vulnerable persons of all ages. interRAI's multinational program of research aims to develop and implement comprehensive assessment and screening systems to support improved quality of care and quality of life among persons of all ages with complex needs across the continuum of health and social service settings. This includes the creation of psychometrically sound measurement systems, the application of data from those assessments to support multiple uses by multiple audiences, and completion of multinational comparative analyses and "natural policy experiments."

The initial innovation behind interRAI assessments is that they were designed not only to describe status or severity at a given time, but also to invoke a clinical response through the use of embedded triggering algorithms and care planning guidelines (141).

The first interRAI instruments were designed to be used in a single sector at a time (142, 143), and the release of interRAI's mental health instrument for in-patient psychiatry (144) represented its first effort to target the general adult population. In 2000, interRAI launched a major effort to redesign all of its assessment instruments to function as a fully integrated suite of measures (145–148). The most recent developments by interRAI include the creation of a parallel suite of instruments for children and youth (149, 150), screening systems for use by non-health professionals (151), and a set of self-report tools to measure patient experience (152–154) and patient reported outcome measures(155, 156).

The interRAI suite of assessment instruments includes over 20 comprehensive assessments, supplementary assessments, and screeners. All of these systems include indicators related to mental health (particularly cognition and depressive symptoms). However, the focus in the following section will be on the adult versions of the mental health instruments using homelessness to illustrate how they can provide insights about strengths, preferences, and needs.

Assessment and Screening Instruments for Adults

Mental Health Settings

Inpatient Psychiatry

The interRAI Mental Health (MH) assessment (157, 158) supports care plan development in 20 domains, and is used in in-patient mental health settings at admission, discharge (if more than 7 days after admission), every 90 days (for long-stay patients), and when there is a clinically significant change in the person's status that is not a self-limiting and could require modifications to the care plan. The instrument is available in English, Canadian and Belgian French, Flemish, Icelandic, and Finnish.

The first version of the instrument was released in 1999, with a major update in 2002. The most recent version 9.1.2 was published in 2012 (157) with revisions designed to make it fully compatible with the interRAI suite (147). The MH was pilot tested in Nordic countries and the US, but the primary implementation has been in two Canadian provinces (Ontario, Newfoundland and Labrador). Local implementations have occurred in two other provinces (Quebec, Manitoba). To date over 1.4 million assessments have been completed on over 320,000 unique individuals in Canada.

The target audience is adults aged 18 years and older, including acute, long-stay, forensic and geriatric patients. Canadian provinces have also implemented the MH in adult-designated beds, even if those are occupied by persons under 18 years of age. This proved to be a helpful source of data for publications that pre-dated the completion of the child-youth suite of mental health instruments (159).

The assessment is comprised of 396 items in several domains (see **Table 1**). It is mainly completed by mental health professionals (typically nurses or social workers), and includes a limited number of self-report items. Most items employ a standard 3-day look-back period, although service use and therapies use a standard 7-day window. Other items use 30-day, 90-day or lifetime estimates depending on the nature of the issue. The average time to complete the assessment is 1 hour, and it can be used as a replacement for a standard nursing intake assessment. The MH instrument deals with items that usually would be addressed in mental health assessments, but also expands the scope to look at broader issues within a time frame for completion that is consistent with conventional practice. It contains about the same number of items as the hypothetical conglomerate of stand-alone tools described earlier, but it substantially increases the scope of issues addressed.

Community Mental Health

The interRAI Community Mental Health (CMH) assessment (160) supports care plan development in 20 domains. It is designed for community agencies employing mental health clinicians, including those with case managed mental health services and assertive community treatment programs. The assessment can be used at intake, discharge, every 6 months depending on length of stay, and after a change in the person's status that requires care plan modification. If the person is admitted to the community agency from an inpatient setting using the MH, the discharge MH assessment is shared to support continuity of care (161) to allow additional time for community staff to establish a clinical relationship with the person. The target audience for the CMH is also adults aged 18 years and older, including a broad range of service recipients. Although community mental health agencies are the typical service provider, it has been used in consultation liaison services for long-term care to deal with psychiatric and behavioral issues outside the usual scope of practice for clinicians in those settings as well as a Dutch study of homeless services recipients (162). The original version of the CMH released in 2007 was pilot tested in Ontario, Canada, New York State, Finland, Belgium, Chile and Hong Kong. The most current version 9.2 published in 2012 is compatible with the interRAI suite. Newfoundland and Labrador have begun provincial implementation of the system, as well as regions in Ontario and Quebec. The Swiss Home Care association has announced plans for national implementation. The instrument is available in English, French (Canadian, Belgian, Swiss), Swiss German, Swiss Italian, Flemish, Finnish, and Chinese. For this paper, 12,862 assessments from pilot

TABLE 1 | Item counts by domain area and interRAI mental health system for adult populations (age 18+ years).

Characteristic	**interRAI Assessment or Screening Instrument**					
	Mental Health (MH)	Community Mental Health (CMH)	Emergency Screener for Psychiatry (ESP)	Brief Mental Health Screener (BMHS)	Forensic Supplement (FS)	Addiction Supplement (AS)
Setting	Inpatient psychiatry	Community (ACT, case management)	Emergency department, mobile crisis	Police, EMS, other settings without MH staff	Forensic services	Addiction programs
Item counts						
Administrative & tracking	43	39	27	22	7	6
Mental status indicators	42	40	33	8	6	0
Substance use/addictions	17	19	10	1	0	17
Harm to self/others	13	17	12	9	11	0
Behavior	9	6	5	2	3	0
Cognition	8	8	5	1	0	0
Functional status	16	23	3	0	0	0
Communication & vision	4	4	1	0	0	0
Physical health conditions	40	41	0	0	0	11
Stress & trauma	19	21	1	0	1	0
Medications	5[1]	4[1]	4	1	0	0
Service use & treatments	36	36	2	0	0	1
Control interventions	13	0	0	0	0	0
Nutritional status	10	10	0	0	0	0
Social relations	12	31	9	0	5	1
Employment, education & finances	9	9	0	0	0	0
Housing, Home environment, Living arrangements	5	10	6[2]	3[2]	0	0
Diagnoses	30	28[3]	16	0	0	0

[1] An additional detailed list of medications used in the last 3 days is optional.
[2] Home environment assessed only if home visited by staff or key informants.
[3] Section allows for entry of additional DSM/ICD diagnoses as needed.

studies are available for analyses. Because of constraints related to European data protection laws, it was not possible to complete pooled analyses with those data (162).

The CMH includes 405 items dealing with comparable domains and look-back periods as used in the MH. The two instruments share 330 common items, but the CMH has 75 items not present in the MH and the MH has 66 items not present in the CMH. The main differences relate to issues that are encountered in one, but not the other, service environment. For example, the CMH includes an expanded range of items on social relationships and supports in the community, and on the home environment. The MH includes items on control interventions (*e.g.*, restraints) not used in community settings.

The average time to complete the CMH is also an hour, but completion time may be affected by the lack of access to another informant for persons who have difficulty responding. This issue poses a greater challenge than noted in the interRAI Home Care assessment (163) where caregivers are routinely available as additional sources of information.

Emergency and Crisis Services

The interRAI Emergency Screener for Psychiatry (ESP) (164) is designed for general emergency departments, psychiatric emergency departments, and mobile crisis teams. Like the MH and CMH, the ESP is typically completed by nurses, social workers, or clinicians other than psychiatrists. It is used at the time of crisis/emergency, with the expectation that a follow-up assessment for persons remaining on service would revert to the MH or CMH once the person is stabilized.

The first version of the ESP was pilot tested in Ontario in 2004, and the interRAI suite version 9.1 was published in 2011. The ESP's 141 items are a subset of those in the MH and CMH. The instrument has been pilot tested in Ontario and Quebec, Canada and Finland. Two regional mental health services in Canada have begun implementation of the ESP and a child-youth variant of the instrument. The current data holdings available at the time of writing comprised 5,249 ESPs completed in Canadian organizations.

The target audience for the ESP is also adults aged 18 years and older; however, the clinical focus of the ESP is narrower. Whereas the MH and CMH focus on care plan development in 20 areas, the emphasis of the ESP is on patient safety issues and acute symptoms. Thus, the ESP has a 24-hour look back period to focus on immediate presenting concerns. It triggers care plans in three areas of safety (harm to self, harm to others, inability to care for self), and in substance related withdrawal symptoms.

The average time to complete the ESP is 30 min; however, the acute nature of illness may pose barriers to continuous completion of the assessment if other informants are not available.

Police, Emergency Medical Services, and Other Non-Mental Health Settings

The interRAI Brief Mental Health Screener (BMHS) is a short screening tool intended to be used by non-mental health professionals who may be the first line of contact for persons with mental health needs (165). The initial target audience for the BMHS is police services (151) with the aim of facilitating improved communications among polices officers, emergency mental health services, and community mental health agencies (166). The BMHS is a 46-item subset of the ESP, but the training manual includes additional materials for training non-mental health staff in the use of appropriate terminology to describe the person's presenting symptoms. It is designed to be used at a single time point, and it employs a 24-hour look back period.

The first draft version of the BMHS was developed using analyses of 41,019 MH admission assessments to determine the minimum subset of items needed to identify persons who would be admitted to inpatient psychiatry due a combination of disordered thought and danger to public safety (167). The draft BMHS was tested with two police services and five hospitals in Ontario in 2011. The finalized version 9.3 of the BMHS was published in English and French in 2015, and the screener is now in extensive use by over 40 police agencies (local, provincial, and federal) in four Canadian provinces. A pilot study of the BMHS in one US region is expected to launch in 2020. For the purposes of the present paper, 70,005 Canadian BMHS assessments were used.

Unlike the previous assessments, the BMHS is not a care planning tool. It is designed to provide a systematic means of summarizing the observations of police officers (and other non-mental health staff) using the same items that are employed in the interRAI mental health suite. It can also be considered a mental health training intervention, because the screener provides guidance to those using the instrument on how to identify and describe mental health symptoms. The BMHS includes three patient safety algorithms related to harm to self, harm to others, and inability to care for self based on machine learning analyses of MH and BMHS data (168). These algorithms help police and others to communicate acuity to hospitals and community mental health agencies in real time. The Ontario Human Services and Justice Coordinating Committee recommended the province-wide use of the BMHS in 2019 in order to facilitate more timely and appropriate transfers of the care of persons with mental illness from police control to mental health agencies (169).

There is considerable potential to employ the BMHS in other settings. Emergency Medical Services are also in frequent contact with persons with mental health crises in the community and face similar decision-making challenges. In addition, a non-police version of the BMHS is available that could be used with peer-led agencies, shelters, food banks, or other settings for persons with mental illness.

Forensic and Addictions Services

The interRAI MH and CMH instruments both address a broad range of adult service recipients, including persons with addictions and those in contact with the criminal justice system (170–172). However, in forensic and addictions programs, there may be value in obtaining additional information about the severity of the problem (*e.g.*, criminal convictions) or items that would not be asked routinely for all service recipients (*e.g.*, readiness for change, health symptoms associated with substance abuse, dynamic and static forensic risk factors).

To that end, interRAI has two new supplements for the MH and CMH to expand depth in criminal justice and addictions with 33- and 35-items, respectively. These items provide additional severity measures, risk algorithms and specialized care planning triggers for these clinical subpopulations only. At the time of writing, both supplements are in beta versions, with expected publication in 2020.

Non-Mental Health Settings for Adults

All interRAI assessment and screening systems, including those for non-mental health settings, have at least a core set of mental health items. A brief description of some of the main adult instruments follows with examples of mental health research done in those settings.

Intellectual Disability

The interRAI Intellectual Disability (ID) assessment (173, 174) is used with adults aged 18 years and older with intellectual and developmental disabilities (*e.g.*, Down syndrome, autism) in community and residential services. It comprises 320 items, including 188 in common with the interRAI MH, and it is usually completed by developmental services workers. The ID includes support planning protocols for abuse by others, communication, continence, injurious behavior, meaningful activities, mental illness, and social relationships (175). The mental health content of the ID includes measures of psychological well-being, stressful life events and trauma, cognition, psychosis, extrapyramidal symptoms, mood, anxiety, negative symptoms, sleep disturbance, behaviors, violence, and previous psychiatric hospitalizations. These indicators have been the focus of a number of studies in ID settings (176–180) as well as cross-national comparison of persons with ID (181).

The interRAI ID has been implemented in the state of New York (USA) and in Prince Edward Island (Canada). It was used in Ontario, Canada to support the closure of the province's last three large institutions for persons with intellectual disabilities (179, 180, 182–184). Several other jurisdictions in the USA and Canada have announced plans to implement the ID. ID supplements to the MH and CMH instruments are currently being pilot tested in Ontario and in Belgium.

All interRAI mental health assessments include items on intellectual disability, since persons with dual psychiatric and ID diagnoses are an important subpopulation in mental health settings. Several interRAI papers have examined persons with intellectual disabilities in trans-institutional settings (179, 185–189).

Home Care and Nursing Homes

interRAI's Long Term Care Facility (LTCF) and Home Care (HC) instruments (142, 143, 163, 190, 191) were first developed more than 25 year ago. By the end of 2018, over 9 million interRAI home care and nursing home assessments had been completed in Canada alone. In the US, since 1990, over 100 million interRAI nursing home assessments have been completed. The use of LTCF and HC is worldwide; other nations with large scale implementations of one or both of these instruments include Iceland, Finland, Belgium, France, Switzerland, Italy, Hong Kong, and New Zealand.

The LTCF and HC contain 322 and 318 items, respectively, and are completed by health professionals (typically nurses or social workers). The mental health items assessed in both instruments include cognition, delirium, mood, behaviors, psychosocial well-being, psychosis, alcohol and psychotropic medications. The 27 care planning protocols triggered by the HC and LTCF include ones dealing with cognitive loss, delirium, mood, behavior, abusive relationships, tobacco and alcohol use, and appropriate medications (192).

The mental health research in long-term care with the LTCF and HC includes depression (193), bipolar disorder (194, 195), suicidal behaviors (196, 197), traumatic brain injury (198–200), delirium(201, 202), aggressive behavior (203–205), and cognitive impairment (206–210).

Two quality of care issues of considerable interest are use of physical restraints (211–218) and potentially inappropriate use of antipsychotics (211–214, 219–225). The Canadian Institute for Health Information (CIHI) now reports interRAI's risk adjusted quality indicators for restraint and antipsychotic use in nursing homes in seven provinces/territories. This will expand to all other jurisdictions except Quebec once current implementations are complete.

Instruments for Children and Youth

The newest instruments in the interRAI mental health suite are those designed for children and youth. Implementation of the interRAI MH in all adult inpatient beds in Ontario was mandated in 2005 in response to recommendations from the province's Joint Policy and Planning Committee (JPPC) of the Ministry of Health and Long Term Care and the Ontario Hospital Association. The JPPC also called for development and implementation of a compatible system for children and youth. In response, interRAI researchers developed the interRAI Child/Youth Mental Health (ChYMH) assessment system for children aged 4–18 in mental health settings (226) as well as a shorter screener (227).

The ChYMH has 382 items and 31 summary scales (*e.g.*, internalizing, externalizing, distractibility and hyperactivity, aggression, anxiety, social disengagement, depression severity index), and risk assessments to inform the intensity and nature of the child or youth's service needs (149, 159, 228–236). Additionally, the ChYMH has 30 care planning protocols and a preliminary system to describe resource intensity (237). An Adolescent Supplement covers items not addressed with younger children (*e.g.*, substance use) and a Youth Justice Supplement is for youth in correctional settings. A variant of the ChYMH is also available for children/youth with intellectual and developmental disabilities (238). Finally, a new instrument for newborns to three-year olds is nearing completion (239).

The interRAI ChYMH has already been adopted by 90 children's agencies in Ontario, and three other provinces have expressed interests in adopting the system. In addition, there were 16,588 MH assessments on children aged 13–17 in adult mental health beds in Ontario by December 2018.

The availability of an integrated suite of mental health assessment systems that span the life course from newborns to centenarians provides enormous potential to improve care with various transitions that occur over the life span. In addition, at the person-level these compatible assessment systems can provide a rich continuous clinical picture of the person's growth, development and aging from a comprehensive perspective. At the population level, the large-scale implementations of these instruments portend the emergence of a new, detailed longitudinal database of large cohorts of individuals living with mental illness in the earliest stages of their lives until the latest stages and end of life.

What Makes interRAI an Integrated Mental Health Information System?

The following factors make interRAI's mental health assessments and screeners an integrated health information system that spans the continuum of care for persons of all ages. In this and subsequent sections, interRAI data holdings are used to illustrate concepts discussed below. **Table 2** provides a summary of the data sources used in these examples.

Common Language

All interRAI instruments use common terminology to define the same items across all settings. Mood, psychosis, cognition, pain, function and physical health systems use the same definitions, inclusion/exclusion criteria, and phrasing wherever they appear irrespective of the type of setting. Items in the child/youth instruments only differ from the adult instruments when a developmental rationale requires the difference (*e.g.*, performance of activities of daily living). Also, most instruments employ a standard 3-day look back period; except the ESP and BMHS use a 24-h look back due to the acute nature of the conditions addressed.

Common Conceptual Basis

All interRAI assessment instruments are designed first and foremost to support care planning, by embedding data elements where algorithms trigger the need for further intervention in a given area. The development process for instruments always begins with identifying the focal domains for care planning and then identifying the minimum item set to trigger the need for additional investigation. Secondary consideration is given to items that are not used for care planning, but could be used for outcome measurement, resource allocation, of quality management. Specific items to only track matters of research interest are not included in these systems.

Common Clinical Emphasis

The primary focus of interRAI assessments is on function and symptoms rather than diagnosis. These instruments track provisional and finalized psychiatric and medical diagnoses and they provide rich clinical information that is relevant to diagnosis, but they are not intended to be diagnostic systems. Rather they focus on what are the person's strengths and needs, how the person relates to others and engages in the community, what the person can do independently, and where support needs are required.

Common Data Collection Methods

All interRAI systems employ a common and consistent assessment methodology. For the clinician-administered instruments, the assessor is provided with specific item definitions, time frames, inclusion/exclusion criteria, lists of examples, coding guidelines, and instructions for the assessment approach. The assessments do not use a fixed narrative set of questions, and the order of completion can be adapted to the natural flow of the assessment process on a case-

TABLE 2 | Data sources used to illustrate concepts in manuscript.

Instrument	Country	Setting	Type of implementation	Base sample N[4]	Population level data?	Notes
Mental Health (MH)	Canada (NL, ON, MB)	Psychiatric Hospitals/units	Mandated use	230,790	Yes	Unique individuals. Most recent episode 2005–17. Excludes stays <3 days.
Community Mental Health (CMH)	Canada (NL, ON), USA, Finland Netherlands	Community mental health Homeless services	Pilot sites & early adopters Research sites	CA-8,627; US-2,689; FI-1,506 436	No No	Unique individuals. First assessments 2007–17.
Emergency Screener for Psychiatry (ESP)	Canada (ON)	Emergency rooms, mobile crisis teams	Pilot sites, early adopters	5,264	No	Assessments between 2007 and 17
Brief Mental Health Screener (BMHS)	Canada (ON, MB, SK)	Police services	Early adopters	70,005	Yes	Screeners between 2014 and 18
Long-term Care Facility (LTCF)	Canada (NL, NS, ON, MB, SK, AB, BC, YT) Canada (ON, MB)	Nursing homes Complex Cont'g Care hospitals	Mandated use Mandated use	470,350 268,685	Yes Yes	Unique individuals. Most recent episode, 2010–18 Unique individuals. Most recent episode, 1996–2018
Home Care (HC)	Canada (NL, NS, ON, MB, SK, AB, BC, YT)	Home care agencies	Mandated use	718,721	Yes	Unique individuals. First episode 2003–18
Community Health (CHA)	Canada (ON)	Community support services	Mandated use	28,965	Partial	Unique individuals. First episode 2012–18
Palliative Care (PC)	Canada (ON)	Community palliative care	Mandated use	40,013	Yes	Unique individuals. Assessments from first episode 2011–18

[4] *N's in some tables vary because they use subsets of the base sample.*

by-case basis. Assessors are aware of the information they need to acquire for a given item, but they are free to adapt approaches to each item to be culturally or gender-appropriate. Assessors use all sources of information available to them, including direct questions posed to the person, observation of the person's behavior and mannerisms, interviews with family or other members of the support network (where appropriate), information exchanges with other members of the circle of care, and medical or other records. When these information sources provide conflicting evidence, clinicians exercise their best judgement to record what response they believe to be the most correct answer for a given item. It is also possible to parcel out portions of the assessment to different staff members. For example, clerical staff could readily complete administrative and tracking elements or data on historical service utilization. Other mental health disciplines may complete some but not all portions of the assessment. For auditing practice, one individual must sign-off that the assessment is complete and as accurate as possible given available information.

This assessment approach is standardized for all interRAI systems and shared items are assessed in the same manner. What differs among instruments is the curated item sets and associated scales and algorithms. Thus, information between sectors can be compared directly, and staff with experience in interRAI systems in one sector can easily learn another interRAI instrument if they move to another sector. While items sets and clinical issues may be new, the approach to completing items remains consistent.

Common Core Elements

Mood, pain, cognition, and functional status are basic human characteristics that are relevant in any setting and any age group. In that light, there is a set of common items that are measured in almost all instruments. The main exceptions are screeners that are intended to use a reduced item set for limited targeting purposes, and the newborn to three year-old instrument that has items dealing with earliest stages of human development.

This consistency of measurement allows for the examination of some clinical issues at the population level. For example, **Figure 1** shows the distribution of interRAI's Cognitive Performance Scale for about 1.7 million individuals across a variety of adult service settings in Canada (see **Table 2** for data sources). Scores range from zero for cognitively intact to six for very severely cognitively impaired. There is a clear transition from less to greater cognitive impairment as one moves from populations whose usual residence is in the community to facility-based settings. The most severely cognitive impaired population is nursing home residents with a previous history of psychiatric hospital admissions. The third most severely impaired population is inpatient psychiatry patients who were admitted from nursing homes. Both of these trans-institutional populations have much more severe levels of cognitive impairment than the general inpatient psychiatry population.

Common Care Planning Protocols

interRAI's clinical assessment protocols are designed to inform the care planning process for issues identified in the assessment. These protocols are grouped according to clusters of care settings serving persons with common clinical issues who may nonetheless be at different points in the treatment trajectory. The MH, CMH, and ESP are adjacent sectors of the mental health system that use the same set of mental health protocols to address the needs of their shared populations. Similarly, the LTCF, HC and interRAI Community Health Assessment share common protocols for a population that is generally affected by geriatric issues or issues related to physical disability paired with medical complexity and/or cognitive impairment. The protocols for supporting adults with ID can be used in residential and community settings, and the ChYMH instruments have shared

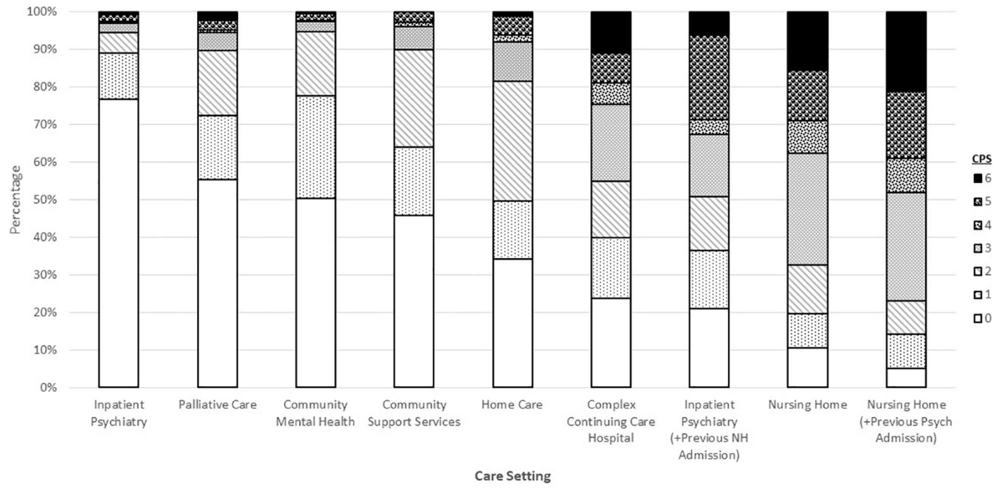

FIGURE 1 | Percentage distribution of cognitive performance scale scores across Canadian care settings.

protocols for community and facility based settings for children/youth.

Psychometric Properties of interRAI Mental Health Instruments

One of the main value propositions for adopting research-based assessment systems over "home grown" bespoke forms is that decision-makers must have confidence in the veracity of the findings generated by the assessment. The data must be meaningful, accurate, and relevant to the issues affecting the person who has been assessed. Reliability and validity are two basic psychometric properties to be considered and the cornerstone for instrument development (240).

Reliability

Inter-Rater Reliability

In any health care system it is essential that independent assessments by different trained clinicians yield consistent answers. To be cost-effective and to minimize assessment burden, it should be feasible to use assessment information completed by another colleague (including from a different care setting) to inform our own clinical decision-making process.

To appraise this, interRAI has a long history of engaging in inter-rater reliability testing of its assessment systems (142, 143, 191, 241–248). The approach used has been to conduct independent assessments of service recipients without contact between the assessors and with a limited time gap between assessments. This conservative, yet pragmatic, approach mimics what may occur in usual practice in health care settings. Although it is convenient to use vignettes in reliability research they are avoided because they do not capture the nuances and complexities of "real life". Similarly, assessors do not work together in pairs because that approach violates assumptions of independence between observers (249), which could inflate reliability estimates and does not reflect usual practice patterns in health care.

Recognizing that interRAI assessments share a common core of data elements that are combined with specialized items unique to a given sector, it is feasible to use inter-rater reliability evidence from multiple sectors to evaluate instrument performance. In a 12-nation study of inter-rater reliability of five different interRAI instruments (MH, LTCF, HC, Palliative Care, and interRAI Post-Acute Care), the mean weighted kappa for the core items common to all instruments was 0.75 and the kappa of the specialized mental health items was 0.64 (145). Both results suggest "substantial" inter-rater reliability (250).

Internal Consistency

Challenges with inter-rater reliability studies are that they are expensive, intrusive to the person being assessed twice, and of no clinical benefit to that person. Therefore, it is useful to employ other statistical approaches to reliability evaluation that can be done continuously without additional assessment. When instruments use parallel form scales to measure underlying domains with multiple items, it is possible to compute measures of internal consistency using Cronbach's alpha (251). This approach is used to evaluate new scales developed for the interRAI suite, but it can also be deployed to monitor data quality continuously with large scale implementations as has been done with other interRAI assessments (252, 253).

Table 3 describes several clinical summary scales that are available in the interRAI mental health suite and **Table 4** shows the internal consistency results for seven parallel form scales from four interRAI mental health instruments in three countries. The scales include symptoms typically of interest in mental health settings; however, the two measures of functional status (activities of daily living (ADL) and instrumental activities of daily living (IADL)) are relevant to understanding disability in the assessed populations. Virtually all scales in all settings examined in **Table 4** meet or exceed the standard alpha value of 0.70 for good internal consistency and, in several instances, exceed 0.80 indicating excellent reliability. Good reliability is evident in both acute and longer-term service settings. In addition, the Positive Symptoms Scale, as assessed by police officers, has comparable reliability to that found when administered by mental health clinicians. The two exceptions in performance are the Aggressive Behavior Scale (ABS) in US community mental health settings and the Mania Scale in Canadian ESP settings. The US findings may be a function of an attenuated distribution of the ABS in the US pilot site (see **Table 5**). Site specific analyses of the Mania scale performance indicate that the problem was with one ESP pilot site, suggesting that training may have been a concern. Put differently, 39 of 41 evaluations of scale reliability in diverse mental health settings met or exceeded standard cut-points for good reliability.

Validity

Validity is a more complex psychometric issue than reliability, requiring evaluation through a number of methods. The key questions of interest include: does this item or scale measure what I think it measures? Does the assessment address the important characteristics affecting the person's well-being? How does the instrument compare with other widely used systems? Do risk indicators actually predict future outcomes of interest?

Face and Content Validity

Face and content validity are necessary, but not sufficient criteria to meet for developing an assessment system. The interRAI development process typically addresses these through extensive involvement of front-line practitioners and researchers combined with reviews of the current literature. For example, as part of the development effort for the care planning protocols, key informants from several nations were asked: a) How consistent is the MH-CAP with the Recovery Model as used by your organization? (83% rated the protocol reviewed to be mostly or completely consistent); b) How consistent is the MH CAP with guidelines/best practices used by your organization? (92% rated them as mostly or completely consistent); and c) How would you rate this CAP in terms of its use as a support for care planning in this area? (90% rated them as good or excellent). In addition, critical feedback from informants was used to inform final revisions to the penultimate versions of these care planning protocols.

TABLE 3 | Summary of scales and algorithms in interRAI mental health instruments.

interRAI scale	Domain	Type of scale	Scale components	Range	Included in
Aggressive Behavior Scale	Aggressive behavior	Parallel form Sum of items	Verbal abuse; Physical abuse; Socially inappropriate/disruptive; Resists care	0–8	MH, CMH, ESP
Activities of Daily Living (ADL) Scale	Basic physical function	Parallel form Sum of items	Personal hygiene; Locomotion; Toilet use; Eating	0 to 16	MH, CMH, ESP
Negative Symptoms Scale	Negative symptoms	Parallel form Sum of items	Anhedonia;Withdrawal from activities of interest; Lack of motivation; Reduced social interactions	0 to 12	MH, CMH, ESP
CAGE-Crosswalk	Behavioral signs of addiction	Parallel form Sum of items	Need to cut down substance use; Angered by criticisms from others; Guilt; Drinking/using in am	0 to 4	MH, CMH
Cognitive Performance Scale	Cognitive function	Decision tree	Daily decision making; Short-term memory; Making self understood; Performance in eating	0 to 6	MH, CMH, ESP
Depressive Severity Index	Depressive symptoms	Parallel form Sum of items	Sad, pained facial expressions; Negative statements; Self-deprecation; Guilt/shame; Hopelessness	0 to 15	MH, CMH, ESP
Instrumental Activities of Daily Living Capacity	Higher level physical functioning	Parallel form Sum of items	Meal preparation; Ordinary housework; Managing finances; Managing medications; Phone use; Shopping; Transportation	0 to 30	MH, CMH, ESP
Mania	Mania symptoms	Parallel form Sum of items	Inflated self-worth; Hyperarousal; Irritability Increased sociability/hypersexuality; Pressured speech; Labile affect; Sleep problems—hypomania	0 to 20	MH, CMH, ESP
PAIN	Frequency and intensity of pain	Parallel form Sum of items	Pain frequency; Pain intensity	0 to 4	MH, CMH
Positive Symptoms Scale	Positive symptoms	Parallel form Sum of items	Hallucinations; Command hallucinations; Delusions; Abnormal thought process	0 to 12	MH, CMH, ESP, BMHS
Risk of Harm to Others	Harm to others	Decision tree	Violence/Extreme Behavior; Violent Ideation; Intimidation/threats; Aggressive Behavior Scale; Positive Symptoms Scale; Insight; Delusions; Sleep	0 to 6	MH, CMH, ESP
Self-Care Index	Self-care	Decision tree	Cognition; Positive Symptoms; Insight; Decreased Energy; Expressive Communication; Hygiene; Mania Scale; Anhedonia	0 to 6	MH, CMH, ESP
Severity of Self-harm Scale	Self-harm	Decision tree	Self-harm ideation; Suicide attempts; Suicide plan; Others concerned; Depressive severity scale; Positive Symptoms Scale; Cognitive Performance Scale	0 to 6	MH, CMH, ESP

TABLE 4 | Internal consistency of clinical scales derived from interRAI Mental Health Instruments, by country.

Parallel Form Scale	Cronbach's Alpha					
	CMH			BMHS Canada (n = 72,734)	ESP Canada (n = 5,249)	MH Canada (n = 230,790)
	Canada (n = 8,667)	Finland (n = 1,506)	New York (n = 2,689)			
Depressive Severity Index (0–15)	0.89	0.84	.84	NA[5]	.71	.75
Positive Symptoms Scale (0–12)	0.72	0.73	.74	.73	.72	.71
Negative Symptoms Scale (0–12)	0.90	0.84	.87	NA	.86	.85
Mania Scale (0–20)	0.70	0.68	.70	NA	.61	.77
Aggressive Behavior Scale (0–12)	0.70	0.71	.60	NA	.70	.77
Activities of Daily Living–Short Form (0–16)	0.81	0.74	.83	NA	NA	.89
Instrumental Activities of Daily Living Summary (0–30)	0.85	0.89	.79	NA	NA	.94

[5] *NA—Scale not used in instrument.*

Convergent Validity

The patterns of associations in a dataset can provide insights about whether the instrument measures what one thinks it measures. The initial version of the MH was successfully evaluated by examining the presence of expected associations with age of cognitive loss and functional decline, the relationship

TABLE 5 | Univariate distributions of selected clinical scales derived from interRAI instruments by country.

Scale	CMH			ESP Canada (n = 5,249)	MH Canada (n = 230,790)
	Canada (n = 8,667)	Finland (n = 1,506)	US (NY state) (n = 2,689)		
	Percentage (n)				
Depressive Severity Index					
0	31.0 (315)	13.6 (205)	47.4 (542)	24.3 (1287)	25.0 (57, 631)
1–3	30.5 (310)	27.3 (411)	26.4 (302)	30.0 (1, 590)	32.0 (73, 767)
4–7	20.8 (211)	27.4 (412)	15.0 (172)	19.5 (1, 032)	25.9 (59.850)
8–15	17.6 (179)	31.7 (478)	11.2 (128)	26.2 (1, 390)	17.1 (39, 542)
Mania Scale					
0	27.4 (278)	13.4 (201)	54.0 (615)	31.8 (1, 638)	47.3 (109, 149)
1–3	41.3 (418)	32.2 (485)	29.0 (331)	32.4 (1, 665)	25.7 (59, 333)
4–8	23.6 (239)	37.6 (566)	13.3 (151)	25.0 (1, 285)	19.1 (43, 983)
9–20	7.7 (78)	16.9 (254)	3.8 (43)	10.8 (558)	7.9 (18, 325)
Aggressive Behavior Scale					
0	65.4 (664)	61.7 (929)	77.8 (882)	81.8 (4, 293)	75.7 (174, 607)
1–3	27.6 (280)	29.3 (441)	18.9 (214)	15.1 (794)	13.4 (31, 014)
4–6	6.0 (61)	7.2 (108)	2.7 (30)	2.8 (145)	7.1 (16, 385)
7–12	1.1 (11)	1.9 (28)	0.7 (8)	0.4 (18)	3.8 (8, 784)
Cognitive Performance Scale					
0	46.7 (474)	33.7 (507)	59.3 (665)	81.2 (4251)	67.1 (154, 827)
1–2	47.2 (480)	54.8 (825)	36.8 (413)	15.9 (834)	24.1 (55, 686)
3–6	6.1 (62)	11.6 (174)	3.9 (44)	2.9 (150)	8.8 (20, 277)
Instrumental Activities of Daily Living Summary Scale					
0	50.1 (495)	39.2 (590)	49.4 (580)	NA[6]	63.4 (146, 298)
1–3	13.3 (131)	10.6 (160)	15.7 (185)		11.4 (26, 276)
4–9	17.0 (168)	14.3 (216))	19.7 (232)		10.0 (23, 099)
10–18	10.9 (108)	19.2 (289)	10.9 (128)		6.8 (15, 629)
19–30	8.8 (87)	16.7 (251)	4.3 (50)		8.4 (19, 488)

[6] *IADL Scale not collected in interRAI ESP.*

between depression measures in suicide related indicators, readmission rates and problems with medication management, and cognitive performance with behavior (248).

As an extension of this approach, one might examine the extent to which hallmark clinical symptoms of various psychiatric diagnoses are associated with the presence of those diagnoses in the assessment data. A clear positive association would provide reassurance that the instrument measures symptoms that have meaning to clinicians. **Table 6** shows the relationship that could be expected between various mental status indicators and provisional diagnoses of neurocognitive disorders; substance related and addictive disorders; schizophrenia spectrum and other psychotic disorders; and depressive disorders. For the first three diagnoses in all three settings, the anticipated relationships with symptoms are strong, in the appropriate directions, and the c-statistics are generally at the 0.80 level or higher. For depression diagnoses, the odds ratios for the depressive severity index and social withdrawal index are in the appropriate directions, but the associations with depressive symptoms are stronger than with social withdrawal (which may relate to other diagnoses). The c-statistics for depression diagnoses are between 0.64 and 0.70.

Criterion Validity

A common approach to validation is to compare a new instrument to another scale that is recognized as a "gold standard" measure. The challenge in mental health is that few measures are universally accepted as a gold standard, and biological markers are not particularly useful as they might be in somatic illness. Previous interRAI research has established the criterion validity of the following scales and items: pain scale *vs* Visual Analogue Scale (254); Cognitive Performance Scale versus Mini Mental State Examination and Montreal Cognitive Assessment (255, 256); Depression Rating Scale versus Hamilton and Cornell Scales and psychiatrists ratings (257); Aggressive Behavior Scale versus Cohen Mansfield Agitation Inventory (203); delirium algorithms versus the Confusion Assessment Method (258); recorded diagnoses versus acute hospital medical records (259); and mental health care planning triggers versus clinician judgement (260). In a developmental project to refine an earlier version of the interRAI MH, criterion validity studies with 876 patients in 11 psychiatric hospitals/units yielded the following correlations: Aggressive Behavior Scale with Neuropsychiatric Inventory Total Score r = 0.50 and with PANSS Aggression Risk Profile r = 0.58; Pain Scale with McGill Pain Questionnaire r = 0.64; Positive Symptoms Scale with PANSS Positive Symptoms r = 0.62; Negative Symptoms Scale with PANSS Negative Symptoms r = 0.49 (261).

Predictive Validity

Arguably the most important (and difficult) form of validity to establish for an assessment system is predictive validity. Presumably, the ultimate purpose of assessment is to guide

TABLE 6 | Odds ratios (95% CL) for provisional psychiatric diagnoses by associated symptoms and setting, Canada.

Provisional diagnosis	Covariate	ESP (n = 5, 235)		CMH (n = 11, 641)		MH (n = 230, 790)	
		Odds Ratio	c	Odds Ratio	c	Odds Ratio	c
Neurocognitive disorders	Cognitive Performance Scale (ref = 0)						
	1–2	12.73 (7.77–20.86)	.82	10.06 (6.73–15.04)	.82	2.90 (2.74–3.08)	.86
	3–6	47.89 (27.10–84.62)		88.93 (55.68–142.05)		8.57 (8.01–9.16)	
Substance related & addictive disorders	Misuse prescription meds (ref = no)	2.07 (1.65–2.61)	.79	(0.86–1.55)	.78	1.24 (1.20–1.28)	.87
	Count of current substances used	2.37 (2.16–2.59)		1.42 (1.12–1.81)		2.28 (2.24–2.32)	
	Days drank to intoxication (ref = 0)						
	1–8	2.49 (2.07–2.99)		NA		NA	
	9-daily	6.77 (5.40–8.49)					
	5+ drinks in single sitting (ref = 0–4)	NA		1.54 (1.34–1.77)		2.65 (2.56–2.73)	
	CAGE crosswalk score (ref = 0)						
	1	NA		5.25 (4.06–6.78)		4.02 (3.86–4.19)	
	2			8.88 (6.62–11.91)		7.14 (6.85–7.45)	
	3			16.78 (12.27–22.94)		14.80 (15.17–15.45)	
	4			19.49 (13.40–28.34)		26.69 (25.36–28.08)	
Schizophrenia spectrum & other psychotic disorders	Positive Symptoms Scale (ref = 0)		.84		.71		.80
	1–2	3.11 (1.87–5.17)		3.42 (2.95–3.97)		4.10 (3.97–4.24)	
	3–5	8.73 (6.68–11.42)		4.20 (3.54–4.98)		6.96 (6.77–7.16)	
	6–12	21.58 (16.97–27.44)		5.64 (4.20–7.57)		14.77 (14.34–15.22)	
	Insight to MH condition (ref = full)						
	Partial	1.72 (1.39–2.14)		2.18 (1.95–2.44)		1.79 (1.74–1.85)	
	None	1.63 (1.21–2.20)		2.81 (2.16–3.64)		2.26 (2.17–2.34)	
Depressive disorders	Depressive Severity Index (ref = 0)		.64		.70		.65
	1–3	1.35 (1.15–1.59)		2.20 (1.86–2.60)		1.49 (1.46–1.53)	
	4–7	1.74 (1.45–2.10)		4.09 (3.25–5.16)		2.34 (2.29–2.40)	
	8–15	2.13 (1.77–2.57)		6.25 (4.55–8.59)		3.78 (3.67–3.90)	
	Social Withdrawal Scale (ref = 0)						
	1–4	1.01 (0.86–1.19)		1.66 (1.40–1.96)		1.14 (1.12–1.17)	
	5–8	1.38 (1.16–1.65)		1.57 (1.24–1.98)		1.41 (1.38–1.45)	
	9–12	2.30 (1.95–2.72)		1.41 (1.05–1.90)		1.60 (1.55–1.64)	

interventions that will have an impact on a future clinical trajectory of change. This approach was used extensively to identify triggering rules for interRAI's mental health care planning protocols (see discussion below). Examples of publications reporting on this type of validity include studies of inpatient violence (262), re-hospitalization (82); and suicide behaviors (196, 197).

Applications of interRAI Instruments

Critically, all interRAI assessment instruments are designed to be used as part of normal clinical practice to serve multiple functions for multiple audiences (263), including: a) care planning; b) outcome measurement; c) resource allocation; and d) quality improvement. In addition, the aggregated data compiled as part of regular use can be employed for policy analysis, evaluation and research. Examples of peer-reviewed health services research based on interRAI MH data include: mental health needs of prisoners (264, 265); mental health service planning (266); access to psychiatrists by linguistic minorities (267) and nursing home residents (268); use of ECT by psychiatric inpatients (269); prolonged stays (270, 271); length of stay (272, 273); and restrictions in movement in forensic patients (172). Examples of clinically oriented research with these data include studies of: sexual dysfunction (274, 275); incontinence (276, 277); discharges against medical advice (229, 278); medication non-adherence and misuse (229, 279, 280); restraint and acute control medication use (281); and pharmacoepidemiological studies (282).

Care Planning

The Clinical Assessment Protocols (CAPs) associated with the suite of interRAI assessments are care planning guidelines designed with a common structure and clinical approach, but they are adapted to the populations and service settings for which they should be used (175, 192, 283–286). Each CAP contains five main components: a) a description of the importance of the clinical issue; b) goals of care underlying CAP design; c) triggering algorithms that use the assessment items to classify persons for different care planning approaches; d) guidelines to consider for both immediate actions to deal with safety concerns and longer-term strategies that may be used; and e) additional reference materials and resources that may be consulted.

The CAP development process involves three main approaches. First, interRAI's large international network is deployed to engage with clinicians, researchers, policy makers, and advocacy groups to discuss priorities and approaches to care recommended in different countries. Second, reviews of literature and best practice guidelines help identify practical, evidence-based interventions for specific clinical concerns. Third, interRAI's large longitudinal data holdings are used to develop and validate the predictive validity of CAP "triggering" algorithms. The results of these analyses are included in the mental health CAP descriptions to identify expected triggering rates and outcomes for inpatient, community and emergency settings. Finally, agreement with clinician ratings was also used to validate and refine the CAP triggering rules (287).

CAPs are designed using several key principles. The intervention guidelines must be rooted in empirical evidence from the peer reviewed literature in multiple continents so as not to reflect only one system of care. In addition, all mental health CAPs are framed on recovery principles (108, 111), including shared decision-making and support of the person's autonomy calibrated to his/her current level of functioning. The approach engages the person and, where appropriate, the informal support network in collaborative discussion to review the assessment findings about the person's strengths and needs and to identify the person's preferences for how CAP issues will be addressed, if at all. CAPs are not intended to be robotic care planning libraries. Rather, they provide qualitative “interview guides” that outline potential responses to the quantitatively defined triggering algorithms derived from the standardized assessment. Similarly, the CAPs are not a diagnostic system; they are designed to focus on intervention strategies at the person, family, and community levels that might enhance the person's quality of life in as many dimensions as possible.

The CAPs triggered by the interRAI mental health suite are listed in **Table 7**. The interRAI MH and CMH trigger all CAPs, but have somewhat different protocols for informal supports. The interRAI ESP triggers mainly the patient safety related CAPs as priority issues for crisis situations. Previous publications have highlighted triggering patterns and outcomes associated with the CAPs for traumatic life events (288), education and employment (289), and harm to others (262). **Figure 2** shows the triggering rates for patient safety CAPs by homelessness in different service settings. The triggering rates for these CAPs in homeless persons in four settings (community dwelling recipients of Dutch homeless services, Canadian community mental health, emergency/mobile crisis, and inpatient settings) are lowest for the purposeful self-harm CAP and highest for the self-care CAP. With the transition from community to acute hospital-based services, the triggering rates for purposeful self-harm and harm to others are higher for all groups. Conversely, self-care triggers at the highest rate for homeless persons in community mental health settings. For non-homeless populations, the triggering rates for patient safety issues are generally lower than with homeless persons, but the rates and severity levels are also higher in emergency and hospital settings than in the community.

The CAPs can be used at the person-level to inform care planning, or aggregated at the organization or population levels to provide estimates for need analyses in various domains. The CAPs focus on current issues that increase the risk of adverse outcomes or those that might be addressed to support recovery. For example, the CAP for traumatic life events (288) targets two sub-groups for intervention: a) persons who face immediate threats to their safety due to assaults, abuse or criminal

TABLE 7 | List of clinical assessment protocols triggered by different interrai mental health instruments.

CAP Name	Trigger Levels (Number and focus)	interRAI Mental Health Assessment		
		Inpatient (MH)	Community (CMH)	Emergency (ESP)
SAFETY				
Harm to Others	2 levels; risk severity	✓	✓	✓
Suicidality and Purposeful Self-Harm	2 levels; risk severity	✓	✓	✓
Self-Care	2 levels; risk severity	✓	✓	✓
SOCIAL LIFE				
Social Relationships	2 levels; degree of isolation, family dysfunction	✓	✓	×
Informal Support	2 levels; type of support needed	×	✓	×
Support Systems for Discharge	1 level; availability of support on discharge	✓	×	×
Interpersonal Conflict	2 levels; extent of conflict	✓	✓	×
Traumatic Life Events	2 levels; immediate safety, ongoing impact	✓	✓	×
Criminal Activity	1 level; violent or non-violent criminal behavior	✓	✓	×
ECONOMIC ISSUES				
Personal Finances	2 levels; economic hardship; IADL capacity	✓	✓	×
Education and Employment	2 levels; reduce risk, support employment/education	✓	✓	×
AUTONOMY				
Control Interventions	2 levels; use in emergency and non-emergency situations	✓	✓	×
Medication Management and Adherence	2 levels; IADL & adherence, stopped meds/side effects	✓	✓	×
Rehospitalization	2 levels; risk severity	✓	✓	×
HEALTH PROMOTION				
Smoking	2 levels; withdrawal symptoms, encourage cessation	✓	✓	✓
Substance Use	2 levels; current problematic use, prior problematic use	✓	✓	×
Weight Management	2 levels; problem BMI; problematic eating behaviors	✓	✓	×
Exercise	2 levels; physical activity & presence of health concerns	✓	✓	×
Sleep Disturbance	2 levels; sleep disturbance & cognitive impairment	✓	✓	×
Pain	2 levels; treatment priority level	✓	✓	×
Falls	2 levels; risk severity	✓	✓	×

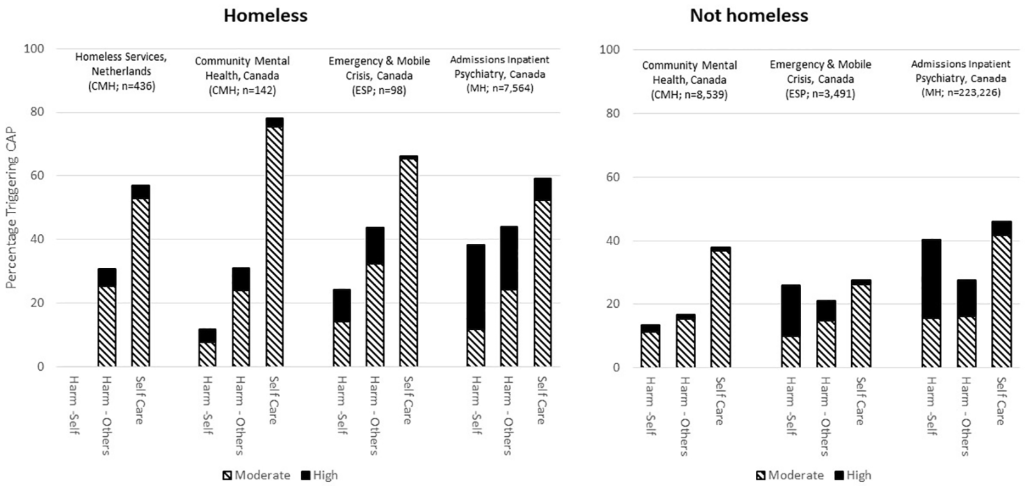

FIGURE 2 | Triggering rates for three patient safety CAPs, by homelessness, setting and country.

victimization that has occurred within the last 7 days; and b) persons who experienced potentially traumatic life events and who described those events as inducing a sense of intense fear or horror. The latter group were found to have elevated rates of PTSD related symptoms (288). However, from a population perspective it is also sometimes useful to examine patterns of lifetime exposure to adverse circumstances to inform policy development. **Figure 3** shows the lifetime rates of criminal victimization (excluding assaults, abuse), and three types of assault or abuse by homelessness and gender. Whether considering the homeless population receiving services in the community or psychiatric inpatients admitted from homeless settings, the lifetime rates of criminal victimization, assault or abuse are higher than in the non-homeless population. Moreover, women (whether homeless or not) are systematically more likely to have experienced the three types of abuse in their lives.

Outcome Measurement

interRAI instruments contain numerous embedded scales (see **Tables 3** and **5**) and individual items that summarize the presence/absence and severity of needs at a given point in time. These may be examined longitudinally with reassessments or when linked to previous interRAI assessments done in other care settings. At the person-level, these longitudinal changes provide insights about the person's changes in strengths and needs, response to treatment, and progression or recovery from illness.

Figure 4 shows the distribution of the Positive Symptoms Scale (see **Table 3** for scale description) for homeless and non-

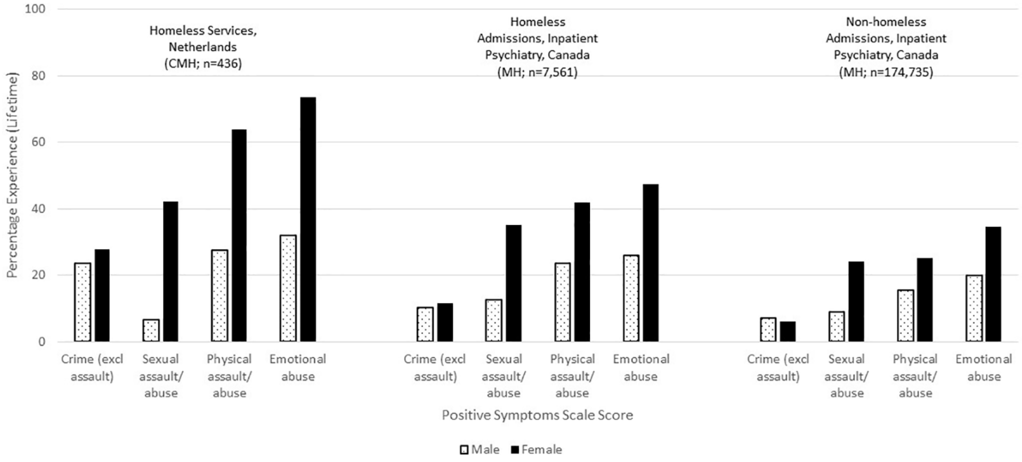

FIGURE 3 | Percentage distributions of lifetime history of victimization by homelessness and service setting, Canada and Netherlands.

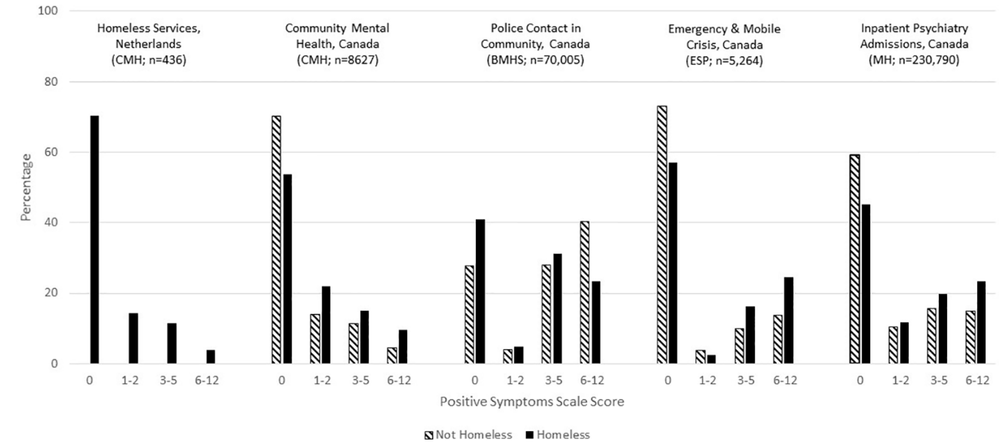

FIGURE 4 | Percentage distributions of positive symptoms scale score by homelessness and service setting, Canada and Netherlands.

homeless persons in five care settings. About 30% of persons in homeless services in the Netherlands, who receive only limited mental health supports, have signs of psychosis compared with almost half of the homeless persons in Canadian community mental health agencies. Severity of positive symptoms increases among those in contact with hospital or emergency mental health services, but it is most pronounced for homeless persons at the time of contact with police. In all settings, except police contacts, the severity of positive symptoms is greater for homeless than non-homeless persons.

Figure 5 shows the transitions in the Positive Symptoms Scores by homelessness from the time of admission to discharge for persons with stays of less than 90 days. Both populations improved substantially in symptom severity, but the scores were worse at admission and discharge for homeless persons.

Quality Indicators

interRAI has an extensive history of developing risk-adjusted outcome-based quality indicators. While scales and items tracked over time for individuals can be useful for person-level care planning, the longitudinal data may be aggregated at the population level to benchmark performance for internal quality improvement, accreditation and public reporting (290–297). Although interRAI's nursing home quality indicators are reported on-line nationally (298, 299), its mental health quality indicators (MHQIs) are currently provided to hospitals for internal use only. A detailed summary of these risk-adjusted quality indicators is provided elsewhere (300). The majority of these indicators are outcome-based, with the exception of a limited number of process indicators dealing with restraint and acute control medication use. There are two main outcomes: a) improvement in symptoms for

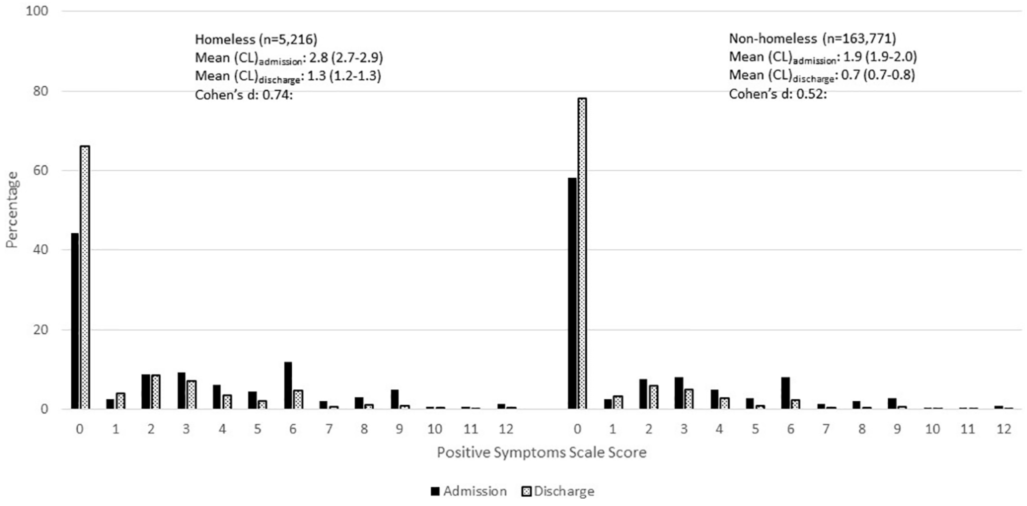

FIGURE 5 | Percentage distribution of positive symptoms scale scores at admission and discharge within 90 days, inpatient psychiatry, Canada.

persons who have non-zero values for the scale of interest at admission; b) failure to improve or worsening for persons who do not have maximum scores at admission. The outcomes include common psychiatric symptoms (*e.g.*, depressive symptoms), functional indicators (*e.g.*, medication management), and others that are less commonly tracked (*e.g.*, pain).

Figure 6A shows the population-based risk-adjusted MHQI rates over time for three improvement indicators stratified by homelessness (homeless *vs* not homeless) in Canadian inpatient psychiatry. The rates are more volatile for the homeless indicators due to smaller sample sizes, but there are only small differences between the two subgroups for improvement in hallucinations and depressive symptoms. Both of these indicators show improvement rates to be above 0.70 as the risk-adjusted proportion improving from baseline to follow-up. On the other hand, for the homeless group, improvement rates are much lower for capacity to manage finances, despite this group having a somewhat better improvement rate than non-homeless persons.

Figure 6B shows three risk-adjusted MHQIs for worsening or failure to improve in the same three domains. Rates of worsening or failure to improve increased (indicating poorer care) over time with notably higher rates for homeless persons. The indicator for depressive symptoms also showed poorer performance over time, but no substantive difference between subpopulations. On the other hand, rates of worsening or failure to improve in managing finances declined over time for both groups.

Resource Allocation

interRAI systems may also be used to inform decisions about the allocation of health care resources at the person and population levels. In non-mental health settings, interRAI systems have been developed to prioritize access to community and institutional services (301) and for eligibility determination in long-term care (302). Mental health counterparts to this work include a level of care framework based on the interRAI MH (303), analyses of service complexity for children with mental health needs and developmental disability based on the ChYMH-DD (304), and a decision-support algorithm describing resource intensity based on the interRAI ChYMH (305).

Case-mix systems have considerable value for informing a variety of health care decisions, including funding methodologies (306). These systems tend to have two main components: a) a classification system, based on clinical characteristics, to group service users into categories with similar levels of resource use; and b) a weighting system (case-mix indexes or CMIs) assigns ratio-level numeric values to these groups that can, among other functions, be applied to funding formulas in payment systems. interRAI-based case-mix systems are available for nursing homes (307–309), home care (310), intellectual disability services (311, 312), and intervener/interpreter services for dual sensory loss (313).

The Diagnosis Related Groups (314) system is widely used in acute general hospitals, but a consensus was reached over three decades ago that the system was inadequate for describing resource use in psychiatry (315). A number of studies pointed to the potential to use per-diem based case-mix systems that estimate costs of care per day of stay, rather than episode-based systems that attempt to predict length of stay (316–318). Most research of this type in mental health has been in hospital settings with only modest progress in community mental health services (319). In addition, although better than episode-based models, the ability to explain variance in resource use in psychiatry is lower than in more homogeneous care settings such as nursing homes (320).

The System for Classification of In-Patient Psychiatry (SCIPP) is a per-diem case-mix system for inpatient mental health services based on an earlier version of the interRAI MH (321–324). SCIPP was developed through a staff time

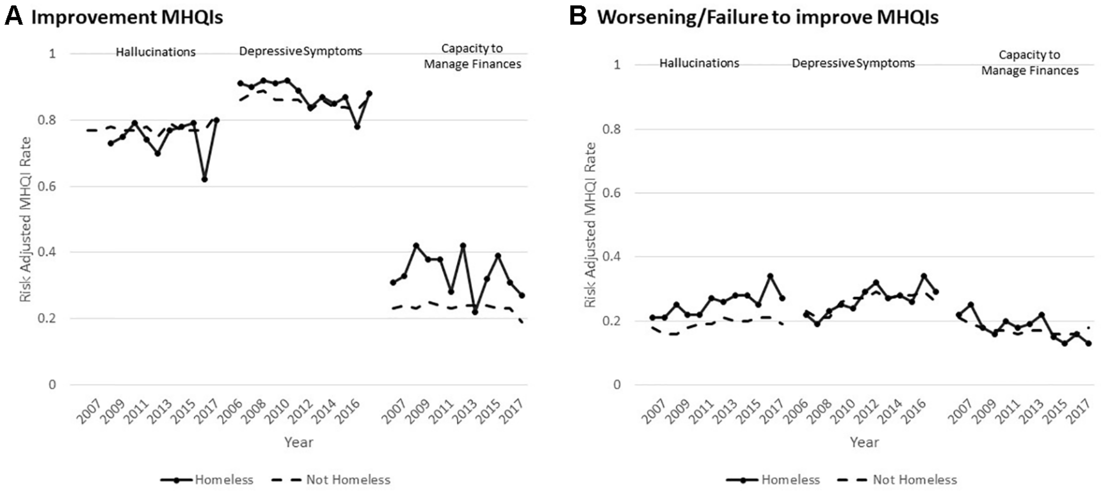

FIGURE 6 | Temporal changes in three risk adjusted mental health quality indicators by year, inpatient psychiatry, Canada. **Figure 6A** shows the risk adjusted rates of improvement in hallucinations, depressive symptoms, and capacity to manage finances in the last 90 days or at discharge (if discharged less than 90 days since baseline assessment). **Figure 6B** shows the risk adjusted rates of worsening of or failure to improve in hallucinations, depressive symptoms, and capacity to manage finances in the last 90 days or at discharge (if discharged less than 90 days since baseline assessment).

measurement study of about 2,000 patients in 34 psychiatric hospitals in three Canadian provinces. The System for Classification of In-Patient Psychiatry (SCIPP) includes about 100 variables for a 47-group algorithm (see **Figure 7**) explaining about 26% of variance in per diem resource use among adult psychiatric patients. There is an 8.4 to 1 range in CMIs across the SCIPP groups. Careful attention was paid to avoiding the use of service variables, facility variables, gameable items and items that had poor psychometric properties. The SCIPP algorithm provides an important step forward in case-mix research for psychiatry. It achieves a higher explained variance than has been possible in episode-based systems, and does so without the use of independent variables that would be problematic to administer as part of a prospective payment system.

Figure 8 shows historical trends in the mean CMI scores in Canadian psychiatric hospitals/units using the MH as part of routine practice. Between 2006 and 2017, the mean admission CMIs rose from 1.567 to 1.657 equating to a 5.7% increase in resource intensity. On the other hand, the discharge CMIs were virtually unchanged over that time period at about 0.940. This indicates two main points: a) there is roughly a 55% drop in resource intensity from admission to discharge associated with the alleviation of symptoms related to mental health and co-morbid conditions; and b) hospitals admitted heavier patients

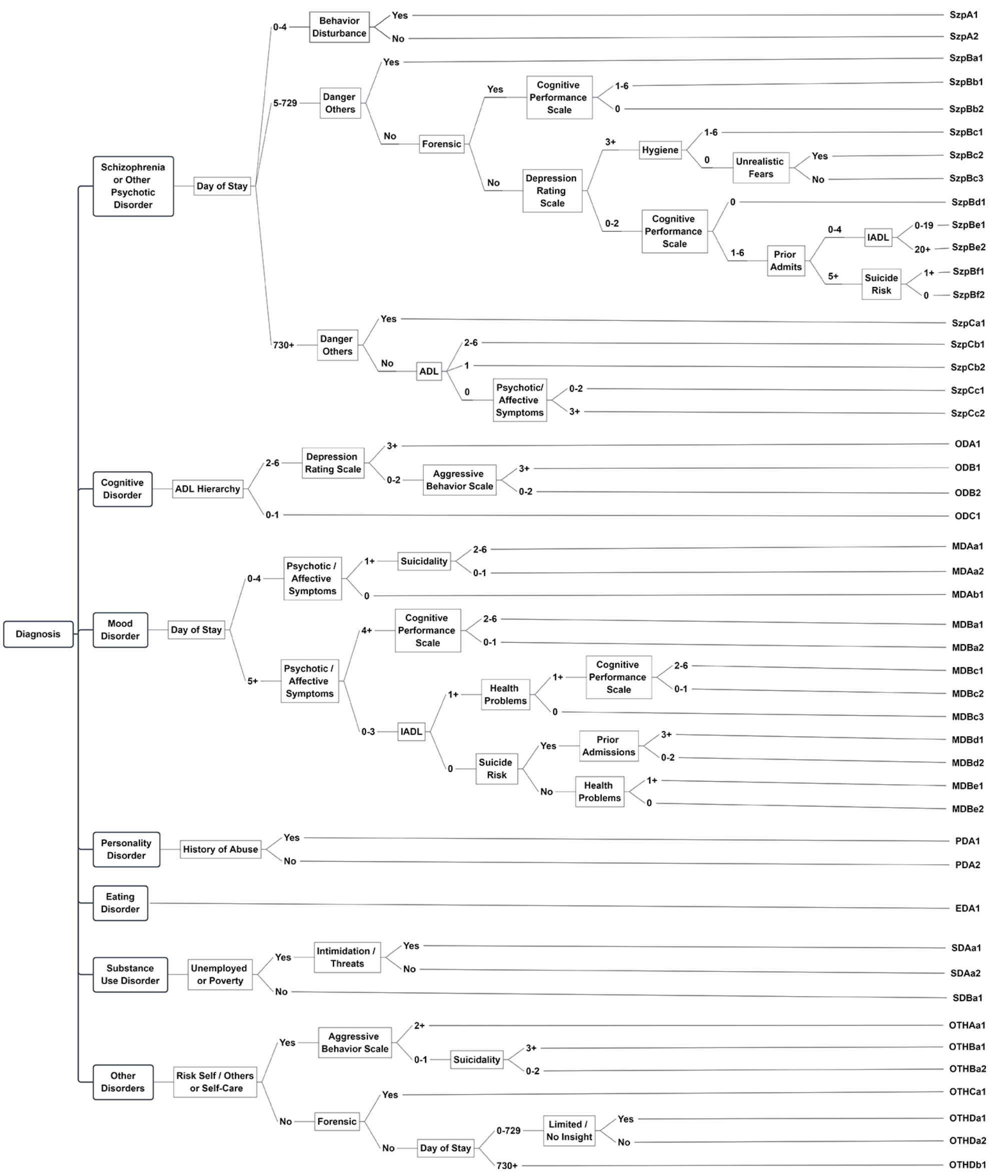

FIGURE 7 | System for classification of inpatient psychiatry (SCIPP) schematic. Blue boxes represent decision points, gold ovals represent terminal SCIPP groups.

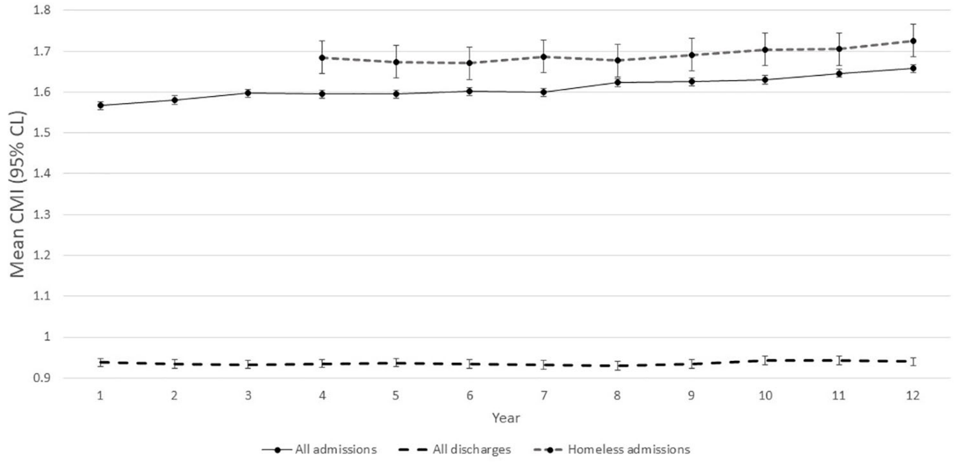

FIGURE 8 | Trends in mean in (95% CL) SCIPP case-mix index values, inpatient psychiatry, Canada.

over time without changes in their resource intensity when discharged. In addition, homeless persons were consistently more resource intensive at admission compared with the general populations with relative differences ranging between 5.6 and 4.2%.

FUTURE DIRECTIONS

Although much has been accomplished through interRAI's two decades of research on its mental health instruments, some limitations of the existing instruments must be addressed in order to continue to improve their utility.

There is a clear need for more cross-national research and implementation of the mental health suite. Low-middle income nations are of particular interest, but adaptations to lower resource environments are likely to be necessary. Many such countries are undertaking dramatic reforms of their mental health systems to place greater emphasis on decentralized networks and primary care (325–328) where interRAI's mental health systems have not yet been used. Another gap is the lack of a triage and screening tool for intake services and public "help" lines. These gaps may be addressed, in part, through the development of companion self-report instruments to reach populations not receiving mental health services. Such instruments might also be useful for settings with few available mental health professionals.

Another limitation is that the translation of interRAI instruments into normal clinical practice is heavily dependent on robust implementation strategies led by highly committed mental health professionals. The ability to realize the full potential of all clinical and management applications can be hindered by implementations that emphasize the data collection aspects of the system rather than its clinical use (329, 330). Moreover, even though interRAI instruments are designed to function as an integrated, cross-sectoral system, the sharing of assessment results between clinicians may not occur for reasons including ineffective communication and collaboration between those sectors (160). Further, relatively little work has been done to date on how best to present interRAI assessment results to patients as part of the shared decision-making process.

Also, while a great deal of validation work has been done, there is need for additional research on criterion validity related to mania, anxiety, and trauma. Predictive validity studies related to suicide and forensic risk are underway. It would be useful to complete inter-rater reliability studies between assessments completed by nurses or social workers and those done by clinical psychologists and psychiatrists. Of particular importance is the need for validation and refinement studies for the SCIPP system, particularly for specialized populations (*e.g.*, forensics). Also, there is no case-mix system available at this stage for the community mental health instrument.

The availability of rich longitudinal datasets with over 1 million observations of over 400 clinical variables creates opportunities for applying new machine learning and artificial intelligence tools. When combined with real-time analytic capabilities in electronic medical records, the potential to create new personalized medicine applications that place the person's data in the context of population level data is considerable. In addition, linkage to other data sources—wearable devices, registry and administrative data, biomarker data (*e.g.*, laboratory values, genetic data)—provides great opportunity for novel insights and innovative improvements to mental health services. Such discoveries have already been made by linking Icelandic genetic data and interRAI nursing home data to examine Alzheimer disease and cognitive decline (331, 332).

Finally, if the next 20 years of use of interRAI mental health systems sees the same degree of growth in its child/youth instruments, the future opportunities for understanding mental health from a life course perspective can be realized. The availability of scientifically sound, standardized, and fully compatible measures that follow persons living with mental illness from the earliest life stages throughout adulthood will be an unprecedented new opportunity to develop solutions to alleviate the impact of mental illness for persons of all ages.

AUTHOR'S NOTE

The authors are all part of the interRAI network.

ETHICS STATEMENT

Ethics clearance for secondary analyses of interRAI data gathered by other organizations was obtained from the University of Waterloo (ORE#30173).

AUTHOR CONTRIBUTIONS

All authors contributed to the formulation of the ideas presented in the study and provided critical feedback to the manuscript. JPH drafted the first version of the manuscript, with major sections contributed by CE, MF, JH, AH, LM, CP, SS and CA. JPH, JF, MJ, BF, and LM made editorial changes to initial drafts and in response to reviewers' comments. JPH, BF, and CE conducted data analyses of Canadian, US and Dutch data, respectively.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2019.00926/full#supplementary-material

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Mood Disturbances Across the Continuum of Care Based on Self-Report and Clinician Rated Measures in the interRAI Suite of Assessment Instruments

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Background: Mood disturbance is a pervasive problem affecting persons of all ages in the general population and the subset of those receiving services from different health care providers. interRAI assessment instruments comprise an integrated health information system providing a common approach to comprehensive assessment of the strengths, preferences and needs of persons with complex needs across the continuum of care.

Objective: Our objective was to create new mood scales for use with the full suite of interRAI assessments including a composite version with both clinician-rated and self-reported items as well as a self-report only version.

Methods: We completed a cross-sectional analysis of 511,641 interRAI assessments of Canadian adults aged 18+ in community mental health, home care, community support services, nursing homes, palliative care, acute hospital, and general population surveys to develop, test, and refine new measures of mood disturbance that combined clinician and self-rated items. We examined validity and internal consistency across diverse care settings and populations.

Results: The composite scale combining both clinician and self-report ratings and the self-report only variant showed different distributions across populations and settings with most severe signs of disturbed mood in community mental health settings and lowest severity in the general population prior to the COVID-19 pandemic. The self-report and composite measures were strongly correlated with each other but differed most in populations with high rates of missing values for self-report due to cognitive impairment (e.g., nursing homes). Evidence of reliability was strong across care settings, as was convergent validity with respect to depression/mood disorder diagnoses, sleep disturbance, and self-harm indicators. In a general population survey, the correlation of the self-reported mood scale with Kessler-10 was 0.73.

Conclusions: The new interRAI mood scales provide reliable and valid mental health measures that can be applied across diverse populations and care settings. Incorporating a person-centered approach to assessment, the composite scale considers the person's perspective and clinician views to provide a sensitive and robust measure that considers mood disturbances related to dysphoria, anxiety, and anhedonia.

Keywords: mood disturbance, validity, scale development, reliability, continuum of care, interRAI

INTRODUCTION

Mood disturbances, including symptoms associated with anxiety and depression, have been increasing in prevalence in the population (1–3), and this has been exacerbated greatly due to lockdowns, social isolation, economic and health-related concerns during the COVID-19 pandemic (4–6). Problems of mood may be transitory, but they affect persons of all ages, gender, social class, and cultures. They are experienced worldwide, can begin in early stages of life (7–14), and can persist throughout the life course (15–18). Although there are important biomedical factors that can affect mood, a broad array of psychosocial and environmental factors can also trigger, worsen, or prolong these symptoms to become more persistent problems related to depression (15, 19).

As a consequence, mood disturbance is a pervasive problem affecting the general population as well as the subset of persons utilizing health care services. Indeed, health service providers in community and facility-based settings encounter persons with mood disturbance that can complicate the provision of health services (16, 20–23). Mood disturbance is a health problem that must be addressed for its own sake; however, it also warrants attention because it can also interfere with adherence to treatment regimens (24–26), recognition and response to symptoms (27, 28), and it increases resource intensity after adjusting for other clinical factors (29–31). Problems with mood may often be transient; however, they should be attended to with early interventions when the risk of transition to a more permanent form of mood disorder is evident.

The relative success of health care organizations in managing and alleviating problems related to mood is considered to be sufficiently important to justify its use as an outcome based indicator of quality of care in mental health (32) and non-mental health settings (33–39). For example, the Canadian Institute for Health Information publicly reports a risk-adjusted quality indicator for worsened depressive mood in long-term care facilities on a national basis (www.yourhealthsystem.cihi.ca).

The interRAI suite of clinical assessment instruments is used internationally as a comprehensive, integrative health information system providing a common clinical language for evaluating the strengths, preferences, and needs of persons of all ages across the continuum of care (40–48). These instruments include a variety of measures of mood that can be used as standalone items or in summary scales. The most widely used mood measure from this suite is the Depression Rating Scale (DRS) (16, 49–53), which is an additive scale based on the frequency of occurrence of seven items (e.g., tearfulness, repetitive anxious complaints) with scores ranging from 0 to 14. Cross-sector studies of the reliability of the DRS have shown it to have acceptable internal consistency based on Cronbach's alpha scores of 0.70 or more (54–56) as well as strong inter-rater reliability based on weighted kappa values in excess of 0.60 (41, 57).

Although the DRS has been in widespread use for over two decades, there are some important limitations that warrant efforts to develop an alternative mood measure that could be employed across health settings over the life course. For example, the tripartite model of depression and anxiety (58, 59) suggests that it is important to consider indicators of dysphoria, anxiety, and anhedonia. However, the DRS includes only indicators of the first two factors, despite the relevance of anhedonia (60), and longitudinal studies have shown that items on social withdrawal provide additional predictive value for future depression diagnoses after adjusting for the DRS (61). A further criticism has been related to the modest correlation between the clinician-rated DRS with self-reported measures like the Geriatric Depression Scale (GDS) (62). Koehler et al. showed that the DRS and GDS were both related to depression diagnoses in long-term care settings (62) yet, they were relatively uncorrelated with each other. This limited correlation suggests that clinician-rated and self-reported measures address important, but different aspects of mood. Clinicians may be insensitive to certain aspects of mood that self-report measures may pick up. In addition, practical and economic considerations may preclude the use of clinician-only rated systems for screening of the general population. For example, some low resource nations do not have sufficient mental health human resources to respond to the clinical needs of all persons with severe mental health issues (63, 64) let alone to have health professionals to do broad-based population screening. There is also growing interest in the use of self-report measures for patient reported outcome measurement (65, 66). On the other hand, self-report measures may also cause under-detection due to cultural biases (67, 68) or non-response due to cognitive impairment or communication difficulties (62). Hence, there could be important advantages to an assessment strategy that combines the use of clinician-rated and self-reported measures of mood that are consistent between populations, health and social service settings, and geographic regions, in a manner that permits longitudinal monitoring of mental health outcomes. Such measures could be used for person-level and organizational-level applications including care planning, need identification, outcome evaluation, measurement-based care, and risk adjustment.

The DRS was first created as a clinician-rated scale with interRAI's original nursing home assessment (50) and then validated for use with assessments for other settings as they became available (51–54). However, with the advent of interRAI's new integrated suite of instruments, a set of three self-reported measures of dysphoria, anxiety, and anhedonia was introduced. Our objective was to create alternative mood scales for use with all interRAI assessments including a composite version with both clinician-rated and self-reported items as well as a self-report only version. Testing was also done to ensure that the clinician-rated items could function as a scale in legacy instruments that predate the new suite (e.g., RAI-MDS 2.0; RAI-MH); however, our focus here is on the newer instruments since they will be the only standard to be adopted internationally in any new implementations of interRAI systems.

METHODS

We completed a cross-sectional analysis of 511,641 interRAI assessments of Canadian adults age 18 years or more in community mental health, home care, community support services, nursing homes, palliative care, acute hospital, and general population surveys to develop, test, and refine new measures of mood that combined clinician and self-rated items. We examined convergent validity, criterion validity, and internal consistency across a continuum of care settings serving diverse populations. Although interRAI data are available for over 30 other countries, we chose to focus on Canadian data only to avoid country level effects and as such we defer analyses of those international data for future testing. Our emphasis here was on multiple care sectors within one nation with awareness that cross-national testing will be an important next step.

Samples

This study includes stratified analyses of large samples of individuals with highly diverse demographic backgrounds and heterogeneity in health status across multiple care settings, age groups and life stages. The data for our study samples came from three types of implementations of interRAI systems First, we sampled from diverse settings where there was mandated routine clinical use in the full population of service recipients: home care[1] (using interRAI Home Care (69), community support services [using interRAI Community Health Assessment (56)], palliative home care [using interRAI Palliative Care (70–72)], and nursing homes [using interRAI Long Term Care Facility (73, 74)]. Most of these data are from the province of Ontario; however, that province still uses an older version of the nursing home instrument[2] (75, 76) that excludes self-report items so data from the province of New Brunswick based on the newer interRAI LTCF assessment were used instead. Second, pilot or regional implementations of interRAI systems were done for community mental health services [using interRAI Community Mental Health (44)], wellness checks in home care [using the interRAI Check-Up Self-report version (77, 78)], and emergency department screening [using the interRAI Emergency Department Contact Assessment (79)] of older adults in acute hospitals. The third type of implementation was research-only use of interRAI self-report items in telephone and on-line surveys of the general population.

Table 1 provides an overview of the seven main study populations used in our analyses. In every setting we used only the most recent observation for each person assessed, so the within-sector samples all represent unique individuals. There is a possibility that some persons were assessed at different times in different settings (e.g., home care and nursing homes), but we did not have identifiers that could be used to link records between sectors. Therefore, although there were up to half a million individuals included in this analysis, the actual number will be somewhat less than that because of some persons receiving care in two or more settings during the study period.

The community mental health sample was of 7,256 adults receiving those services in the Niagara and Chatham Kent regions of Ontario between 2015 and 2019. Most of this sample was comprised of young and middle-aged adults with only 11.0% being aged 65 years or more. About half were male and about one-third were married[3]. As people within this sample were accessing community-based mental health services, it is not surprising that more than half had a mood disorder diagnosis present when assessed. Less than 5 percent had moderate or worse cognitive impairment based on a score of three or more on the Cognitive Performance Scale (80, 81), which is substantially lower than would be evident in care settings for frail older adults (e.g., home care, nursing homes).

Adult home care clients comprised the largest study sub-population with 352,161 unique Ontarians receiving long-stay home care services between 2018 and 2021. These services predominantly target older adults, so most of the sample was over 65 (85.7%), most were female, and one-third were married. About one quarter had an existing depression diagnosis, and about one quarter had moderate or worse cognitive impairment.

The community support service sub-population included 28,302 Ontarians receiving community services, representing a lighter care population than is typically seen in home care. The most recent data available were for the 2016–2017 period. This population has a similar age distribution as seen in the long-stay home care population, but somewhat more females, fewer

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[1] Note: "home care" refers to community based personal support and nursing services provided in the person's home. "Community support service" agencies provide social and support services they tend to target a lower intensity population.

[2] The Resident Assessment Instrument 2.0 (RAI 2.0) is the predecessor to the interRAI LTCF. The RAI 2.0 is comprised only of clinician-rated items, so it cannot be used for the self-reported or composite variants of the mood scale. However, it does include the clinician-rated items that can be used for a clinician-only variant of the scale. Additional information is available on request.

[3] In this manuscript, "married" refers to both formalized legal marriages and common-law partners of either the same or opposite sex.

TABLE 1 | Sample characteristics.

Characteristic	CMH (*n* = 7,256)	HC (*n* = 352,161)	CHA (*n* = 28,302)	CUSR (*n* = 4,930)	LTCF (*n* = 8,237)	PC (*n* = 106,759)	EDCA (*n* = 1,432)	Community surveys	
								Telephone (*n* = 643)	**On-line (*n* = 1,921)**
Region	Ontario	Ontario	Ontario	Ontario	New Brunswick	Ontario	Ontario, Quebec	Waterloo Region	Canada
Setting	Community mental health	Long-stay home care	Community supports	Home care wellness check	Nursing homes	Palliative home care	Emergency departments	General population	General population
Basis for use	Regional implementation	Provincial mandate	Provincial mandate	Regional implementation	Provincial mandate	Provincial mandate	Research pilot	Research	Research
Years	2005–2019	2018–2021	2016–2017	2020–2021	2016–2020	2011–2021	2017–2018	2011	2021
Age									
18–44	55.0	2.8	3.1	3.7	0.5	2.6	0.0	37.2	49.5
45–64	34.0	11.5	10.4	15.0	4.8	24.1	0.0	38.8	34.7
65–74	6.2	16.2	16.6	19.4	12.4	26.3	12.4	|	12.0
75–84	3.3	29.5	31.7	27.8	28.4	27.7	38.6	|24.0	2.4
85+	1.5	40.0	38.1	34.0	54.0	19.2	49.1	|	0.4
Female	52.1	60.5	68.4	59.9	65.4	41.6	58.9	59.6	56.7
Married	29.3	37.7	26.7	37.9	28.8	60.0	NA	NA	57.6
Depression/ mood diagnosis	54.2	24.0	18.6	NA	27.5	NA	NA	NA	34.2
CPS							NA	NA	NA
0	67.5	19.0	44.1	33.7	6.7	53.2			
1–2	28.8	55.1	47.1	50.1	31.4	36.2			
3–6	3.7	25.8	8.7	16.2	61.9	10.7			

The 2011 Waterloo Region general population survey did not have adequate sample size to allow breakdown of older adults into further subgroups. The reported value reflects the percentage aged 65+ years in that survey only.

married individuals, lower rates of depression diagnoses, and notably lower rates of moderate or worse cognitive impairment.

A second long-stay home care population sample was comprised of 4,930 clients captured during 2020–2021. This sample, who normally would have received the interRAI HC assessment as part of routine care, were screened with the interRAI Check Up self-report instrument (and not the interRAI HC instrument) due to practical restrictions that prevented in-person visits during the start of the COVID-19 pandemic. As shown in **Table 1**, this sub-population was comparable to the interRAI HC assessed population in age, marital status, and gender but they had lower rates of cognitive impairment.

The nursing home sample was the only sample to be fully gathered outside of Ontario, since New Brunswick was the only Canadian province to have fully adopted the interRAI LTCF at the start of our study. The sub-population of 8,237 unique individuals were assessed between 2016 and 2020 and they had the highest proportion of persons aged 85 years or more. Two thirds were female and about one quarter were married. Diagnosed depression was evident at a rate comparable to the Ontario home care sample; however, this population also had the highest rates of moderate or worse cognitive impairment.

The palliative care sample was comprised of 106,759 unique Ontarians receiving community based palliative care through the provincial home care program between 2011 and 2021. This sub-population was younger than the home care population; however, about three quarters were aged 65 years or more. Unlike the home care population, the majority were married and only about 40 percent were female. Depression diagnoses were not available, but moderate or worse cognitive impairment affected only about 11 percent of this sub-population.

The emergency department sample of 1,432 individuals was obtained from a pilot implementation of the interRAI ED-CA in a study of screening for potential frailty among older adults in emergency departments in Ontario and Quebec done between 2017 and 2018. The study sample was constrained to older adults with about half being aged 85 years or more. Marital status, depression diagnoses, and CPS scores are not tracked in the ED-CA.

Two community samples of the general population were obtained from research projects done before and during the COVID-19 pandemic. One study included 642 respondents to a telephone survey in the Waterloo Region only that was done in 2011. Participants were selected using random-digit dialing of the general population. A second study done in partnership with Mental Health Research Canada used an on-line survey of a polling company's pre-existing participant pool, and it included 1,921 respondents from across Canada in February 2021, which corresponded to the third wave of COVID-19 in Canada. Both samples are comprised mainly of young and middle-aged adults with comparable percentages who were female. As with the palliative sample, the majority of those in the on-line survey were married (not available for the 2011 survey). Of particular note is the high rate of depression diagnoses reported in the 2021 community survey with rates exceeded only by the community mental health sample (question was not asked in the 2011 survey).

Measures

Five of the interRAI assessments used in this research (CMH, HC, CHA, LTCF, PC) are comprehensive assessments completed by trained health professionals (mainly nurses) at different points during the episode of care (40, 43). Typically, this occurs at admission/intake and then on a structured reassessment cycle that varies by sector (e.g., 3 months in long-term care and 6 months in home care or community mental health). In addition, periodic reassessments may occur on an unscheduled basis if there is a recognized clinically significant change (improvement or worsening) that is persistent and requires a change to the care plan. All of these instruments have multiple applications for diverse audiences including care planning, outcome measurement, quality monitoring, and resource allocation (32, 43, 44, 82).

The interRAI ED-CA is a clinician-led screening-level assessment that is done with older adults in emergency departments. It is not intended to support the full care planning process; however, it includes several measures that can be used to inform clinical management in the emergency department (79, 83, 84).

For the clinician-led assessment and screening instruments, the assessor employs evidence from all sources of information to determine the most appropriate response for a given item based on their best judgement. This includes direct observation of and interviews with the person, discussion with key informants (e.g., family members when appropriate), information provided by staff and professional communications, and review of the chart. Clinicians are provided with standardized item definitions, inclusion/exclusion criteria, illustrative examples, observational timeframes, and coding guidelines as part of the standard training approach for interRAI assessments (85, 86). Most items on the clinician-led assessments are based on clinical judgement; however, there is a subset of items that are self-report only with standardized narrative structures for the items and response sets. The cross-sector reliability and validity of these instruments have been reported elsewhere (41, 54, 57). The composite measure of mood that we developed is based on a combination of clinician-rated and self-reported items included in these assessment systems; however, we also developed a self-report only variant that can be used as a standalone scale. In addition, we created a clinician-only variant that can be used for backward compatibility with legacy instruments (results for clinician-only version not reported here but are available on request).

The Check-Up Self-report version and the survey questions used for the general populations are based on self-report items that have fixed, standardized questions and responses. The CU-SR can be self-administered or be done with a lay survey interviewer, but the interviewer does not require clinical credentials. The responses are strictly based on the person's self-report without clinical judgement being applied by the interviewer. Previous research has reported in the reliability and validity of the CU-SR in community-based research (77, 78).

Analyses

Scale Construction

Figure 1 provides a schematic representation of coding rules for three variants of mood scales that can be derived from the new

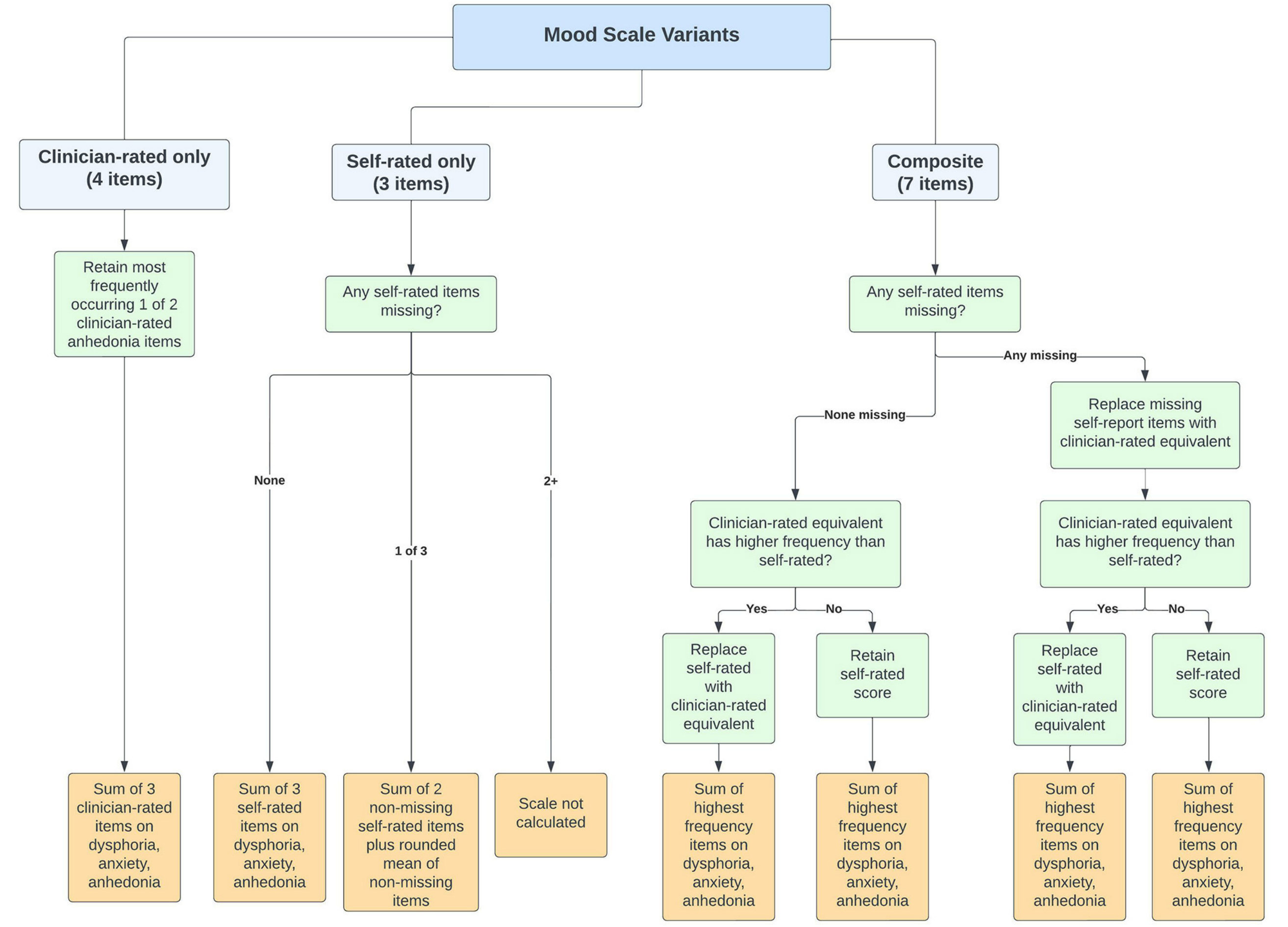

FIGURE 1 | Schematic representation of coding rules for three variants of Mood scale.

interRAI suite of assessments. The Composite Mood Scale (CMS) is based on four clinician-rated and three self-rated items dealing with dysphoria, anxiety, and anhedonia. All indicators use a 3-day lookback period and have the following four level response values: 0-not present; 1-not exhibited, but present recently; 2-exhibited in 1–2 of last 3 days; 3-exhibited daily (wording varies slightly for self-report items). The clinician-rated items include one item for dysphoria (presence of sad, pained, or worried facial expressions), one item for anxiety (repetitive non-health-related anxious complaints), and two items for anhedonia (social withdrawal and loss of interest[4]). The self-report items include one for dysphoria (feeling sad, depressed, or hopeless), one for anxiety (feeling anxious, restless, or uneasy) and one for anhedonia (lost interest in things normally enjoy). The self-rated items allow for a non-response category, but that option is not permitted for the assessor rating. Therefore, missing values should only be an issue with the self-rated items.

We chose to do this to maximize sensitivity of detection of mood disturbance. In creating the composite scale, a variety of coding options were considered to test whether collapsing certain response values (e.g., combining infrequently present and not present values) would improve scale performance and we explored alternative rules for use of self-report vs. clinician ratings. There was no improvement in performance when response value ranges were collapsed. The potential loss of sensitivity was a greater concern, so we left all response values unmodified. For the two clinician rated items on anhedonia, the highest of the two values was used to specify the clinician observation for that indicator. After considering alternative substitution or additive models, we chose to code the composite scale first based on the person's self-report. If the self-report item was missing (e.g., unwilling or unable to respond) it was substituted with the clinician-rated item for the indicator. Next, if the clinician rating indicated greater frequency of a symptom being present, the clinician rating replaced the self-report. Once the value of each composite item was specified for the three indicators, their scores were summed to create a score with values of 0–9. All alternative coding options were examined with respect to their ability to predict outcomes of interest; however, this approach provided the best overall performance (results available on request).

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[4] Two options are used for anhedonia because some instruments use only one of those two items.

The Self-reported Mood Scale (SMS) simply sums the scores for the three self-report items. A missing value was permitted for one of the three values and compensated for by assigning the rounded value of the mean of the other two items to the third missing item. As with the composite scale, the self-reported scale values ranged from 0 to 9 with higher scores indicating greater mood disturbance.

Validity

There were three main approaches used to establish validity of the composite and self-reported mood scales. **First**, we used the CMH data to identify which variant of these scales best predicted presence of two types of indicators of convergent validity: (a) a provisional diagnosis of a mood disorder, indicating clinical designation of the problem meeting diagnostic criteria; (b) self-harm indicators, as non-diagnostic markers of presence of a severe problem. The variant that performed best in those comparisons was examined for its relationship to a depression diagnosis in all other data sets where that diagnosis was available.

Second, we examined evidence of convergent validity by comparing mean scale scores (and 95% confidence limits) against sleep disturbance and depression/mood disorder diagnoses across care settings. The other assessments do not include self-harm indicators; however, a measure of difficulty sleeping is widely available in the interRAI suite and it is known to be associated with mood disturbance (3, 87). The diagnosis items for depression or mood disorder in clinician-rated assessments are based on the clinician's confirmation (using all sources of information available) of the presence of a formal diagnosis made by a physician.

The third approach for the self-reported scale only was to establish convergent validity against the Kessler-10 Psychological Distress Scale (K-10) in the on-line community sample only (K-10 was not available in other data sets). The K-10 measures non-specific psychological stress (rather than a measure of mood disorders) that considers anxiety and depressive symptoms experienced in the last 4 weeks. The K10 is commonly used mental health in population health surveys, including in the World Health Organization World Mental Health Initiative surveys (88), as well as in Australia (89), New Zealand (90), and Canada (91).

Reliability

Inter-rater reliability of the clinician-rated items has been reported for the interRAI suite of assessments elsewhere [2, 17] and is not relevant to self-reported items. We did not examine test-retest reliability, but previous multinational work with the interRAI LTCF reported average test-retest reliability of all items with weighted kappas between 0.75 and 0.92 (74). Therefore, our focus was on testing internal consistency based on Cronbach's alpha values for the composite and self-report versions of the scales in all settings.

RESULTS

Table 2 provides the distributional characteristics, scale reliabilities, correlations between scales, and rates of missing

TABLE 2 | Mood scale variant means (SD), medians (Q1–Q3), internal consistency, scale correlations, and missing rates by setting.

Mood scale	CMH (*n* = 7,256)	HC (*n* = 352,161)	CHA (*n* = 28,302)	CUSR (*n* = 4,930)	LTCF (*n* = 8,237)	PC (*n* = 106,759)	EDCA (*n* = 1,432)	Community surveys	
								Telephone (*n* = 643)	On-LINE (*n* = 1,921)
Mean (95% CL)									
Self-Report	3.9 (3.8–3.9)	1.6 (1.6–1.6)	1.3 (1.3–1.3)	2.4 (2.3–2.4)	1.3 (1.3–1.4)	2.1 (2.0–2.1)	2.8 (2.6–3.0)	1.1 (1.0–1.3)	3.5 (3.6–3.4)
Composite	4.8 (4.7–4.9)	2.1 (2.1–2.2)	1.8 (1.8–1.8)	NA	2.5 (2.4–2.6)	2.4 (2.4–2.4)	NA	NA	NA
Cronbach's alpha									
Self-Report	0.87	0.64	0.72	0.70	0.75	0.78	0.79	0.65	0.82
Composite	0.90	0.75	0.79	NA	0.78	0.70	NA		NA
Correlation between scale variants	0.92	0.89	0.90	NA	0.77	0.93	NA	NA	NA
Percentage missing									
Self-report	3.5%	11.0%	3.6%	0.0%	43.8%	13.5%	25.4%	2.2%	1.2%
Composite	0.6%	0.03%	1.2%	NA	0.6%	0.02%	NA	NA	NA

values for the composite and self-report versions of the mood scale across care settings. For both versions of the scale, the highest severity ratings were evident in the community mental health sample. Among the clinical settings, the least severe ratings for both scales were evident in the community support service sample assessed with the interRAI CHA. The only setting where the self-report and composite scales resulted in different rank orders of severity for the sector was in the interRAI LTCF sample. Those able to self-report had scores comparable to the CHA sample; however, when the composite version was used to include ratings for persons with missing data on the self-report items, the mean severity score was second highest after community mental health.

For the settings where only self-report measures were available (i.e., interRAI Check-Up, telephone and on-line surveys), the severity of mood disturbance was second highest among clinical settings in the emergency department. However, a more striking finding is the substantial difference across the estimates for the general population at two points in time. Mean survey ratings in 2011 compared with during the third wave of the COVID-19 pandemic were very different (1.1 vs. 3.5, respectively).

The Cronbach's alpha values for 12 of the 14 possible scores were above 0.70 with seven instances of scores of 0.78 or more. The only instances where values fell below 0.70 were with self-report in home care (0.64) and the 2011 telephone survey (0.65).

The two variants of the scale are highly correlated with each other where both variants were available. That is to be expected given that self-report items are common to both variants. The main uses of the composite scale are to compensate for missing self-report data and to increase sensitivity by using higher scores from clinicians in cases of disagreement. Therefore, it is not surprisingly, that they are less correlated ($r = 0.77$) in the interRAI LTCF where missing values for the self-report items are most prevalent (about 44% of residents compared with 25% of emergency department patients and 4% of community support clients).

Table 3 shows the unadjusted odds ratios (and 95% CL) for the relationship between scores on the composite and self-reported mood scales against the presence of a physician's diagnosis of mood disorder or depression. For most settings, the odds ratio of such a diagnosis being present increased by about 1.3 for each 1-point increment on the scale. For context, persons with a maximum score of 9 on the scale would have a 12-times greater odds of a physician's mood disorder/depression diagnosis than those in the reference group with a score of 0. The c statistic values ranged between 0.67 and 0.75 with strongest values in the community mental health sample, which is in the range of the conventional 0.7 threshold for a good model (92). The exception was in the interRAI LTCF sample where both scales had weaker performance.

Table 4 provides evidence of convergent validity of the two mood scales against mood disorder diagnosis and indicators of self-harm in the community mental health sample. This context is informative because there is greater mental health expertise available and there is greater variance in mental health indicators including higher rates of severe symptoms. We also used these analyses to specify appropriate cut-points for the scales should

TABLE 3 | Unadjusted odd ratios (95% CL) for depression or mood disorder diagnosis present, by mood scale variant and setting.

	CMH (*n* = 7,256)	HC (*n* = 352,161)	CHA (*n* = 28,302)	CUSR (*n* = 4,930)	LTCF (*n* = 8,237)	PC (*n* = 106,759)	EDCA (*n* = 1,432)	Community survey on-line (*n* = 1,921)
Composite scale (1 pt increments)								
Odds ratio (95% CL)	1.32 (1.30–1.35)	1.26 (1.25–1.26)	1.30 (1.29–1.32)	NA	1.09 (1.07–1.10)	NA	NA	NA
c statistic	0.754	0.671	0.702		0.565			NA
Self-Report (1 pt increments)								
Odds ratio	1.33 (1.31–1.36)	1.30 (1.29–1.30)	1.34 (1.33–1.36)	NA	1.12 (1.09–1.15)	NA	NA	1.33 (1.27–1.38)
c statistic	0.744	0.674	0.692		0.57			0.72

TABLE 4 | Unadjusted odds ratios (95% CL) and optimal scale cut-points based on various mental health markers by mood scale variant in community mental health sample only (*n* = 7,256).

	Mood disorder	**Recent self-harm ideation**	**Recent self-harm attempts**	**Others concerned about self-harm**	**Suicide plan present**
Composite scale (1 pt increments) 0–9 scale					
Odds ratio (95% CL)	1.32 (1.30–1.35)	1.35 (1.31–1.39)	1.25 (1.20–1.31)	1.27 (1.24–1.31)	1.35 (1.29–1.41)
c statistic	0.754	0.733	0.682	0.707	0.734
Optmal cut-points					
Dist to 0,1	4	7	7	7	7
Sens-Spec	4	7	7	7	8
Youden	4	6	4	8	7
Self-report (1 pt increments) 0–9 scale					
Odds ratio (95% CL)	1.33 (1.31–1.36)	1.32 (1.29–1.35)	1.23 (1.18–1.28)	1.24 (1.21–1.27)	1.31 (1.26–1.36)
c statistic	0.744	0.739	0.689	0.696	0.734
Optimal cut-points					
Dist to 0,1	3	5	5	6	6
Sens-Spec	3	6	6	6	6
Youden	2	5	5	6	6

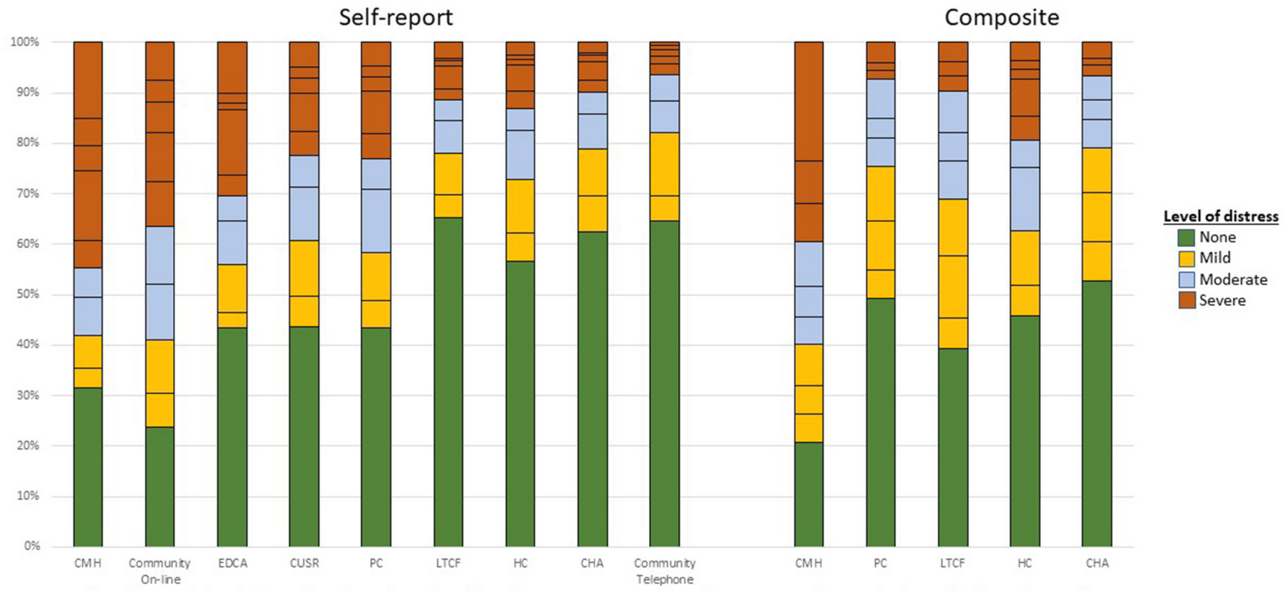

FIGURE 2 | Distribution of mood scale variants by care setting and scale variant. Colors reflects similar levels of mood disturbance for each scale based on cut-points reported in **Table 4**. Horizontal lines within the stacked bars reflects single point increments in the scale value within each settings. The specific scale values (and text labels) in the stacked bars are: green (none)—0 for both self-report and composite version; orange (mild)—1–2 for self-report and 1–3 for composite; gray (moderate)—3–4 for self-report and 4–6 for composite; and red (severe)—5+ for self-report and 6+ for composite version.

clinicians wish to use threshold values to inform decision-making. For all four indicators of self-harm and for the mood disorder diagnosis, each increment in the scale had comparable odds ratios (values ranged between 1.23 and 1.35) and c statistics (values ranged between 0.68 and 0.75). Using mood disorder as a marker for an initial cut-point after the baseline 0 value, suggests that appropriate scores would be 4 or more for the composite scale and 3 or more for the self-reported scale. The more severe threshold based on self-harm indicators would be values of 7 for the composite scale and 6 for the self-report version. For example, persons with a score of 7 on the CMS have over 8-times greater odds of having a suicide plan present compared with those with scores of 0.

Figure 2 shows the mood scale distributions across settings using the abovementioned cut-off values. There was within-group heterogeneity in these scale scores, but the most severe ratings were found in the community mental health sample. One exception was the on-line general population survey during

TABLE 5 | Evidence of convergent validity of mood scale variants with depression or mood disorder diagnosis present.

	CMH (*n* = 7,256)	HC (*n* = 352,161)	CHA (*n* = 28,302)	CUSR (*n* = 4,930)	LTCF (*n* = 8,237)	PC (*n* = 106,759)	Community surveys	
							Telephone (*n* = 643)	Telephone (*n* = 643)
Self-Report								
Difficulty sleeping								
Not present	2.0 (1.9–2.1)	1.2 (1.2–1.2)	0.9 (0.9–0.9)	1.9 (1.8–2.0)	1.2 (1.1–1.2)	1.7 (1.7–1.7)	0.7 (0.5–0.9)	NA
Present, not last 3 days	3.5 (3.3–3.8)	1.8 (1.7–1.8)	1.5 (1.4–1.6)	2.4 (2.0–2.7)	1.4 (1.2–1.6)	2.3 (2.2–2.4)	1.3 (0.8–1.8)	
1–2 of last 3 days	4.9 (4.7–5.1)	2.0 (2.0–2.0)	1.8 (1.8–1.9)	2.8 (2.6–3.0)	2.0 (1.8–2.3)	2.6 (2.5–2.6)	1.2 (0.9–1.6)	
Daily last 3 days	6.4 (6.3–6.5)	2.5 (2.5–2.5)	2.1 (2.1–2.2)	3.7 (3.5–3.8)	2.6 (2.2–3.0)	2.9 (2.9–2.9)	1.9 (1.4–2.3)	
Depression/Mood disorder diagnosis								
Not present	1.9 (1.8–2.0)	1.2 (1.2–1.2)	1.0 (1.0–1.0)	NA	1.2 (1.1–1.2)	NA	NA	2.8 (2.6–2.9)
Present	4.8 (4.7–4.9)	2.8 (2.8–2.8)	2.6 (2.6–2.7)		1.8 (1.7–2.0)			5.0 (4.7–5.2)
Composite								
Difficulty sleeping								
Not present	2.7 (2.6–2.8)	1.7 (1.7–1.7)	1.3 (1.3–1.4)	NA	2.2 (2.1–2.3)	2.0 (2.0–2.0)	NA	NA
Present, not last 3 days	4.7 (4.5–4.9)	2.4 (2.3–2.4)	2.0 (1.9–2.1)		2.8 (2.6–2.9)	2.7 (2.6–2.8)		
1–2 of last 3 days	5.9 (5.7–6.1)	2.7 (2.6–2.7)	2.4 (2.3–2.5)		3.6 (3.4–3.8)	3.0 (3.0–3.1)		
Daily last 3 days	7.5 (7.4–7.6)	3.2 (3.2–3.2)	2.8 (2.7–2.9)		4.2 (3.9–4.4)	3.3 (3.2–3.3)		
Depression/Mood disorder diagnosis								
Not present	2.6 (2.5–2.8)	1.7 (1.7–1.8)	1.4 (1.4–1.5)		2.3 (2.3–2.4)	NA	NA	NA
Present	5.8 (5.7–5.9)	3.4 (3.4–3.4)	3.3 (3.2–3.4)		3.0 (2.8–3.1)			

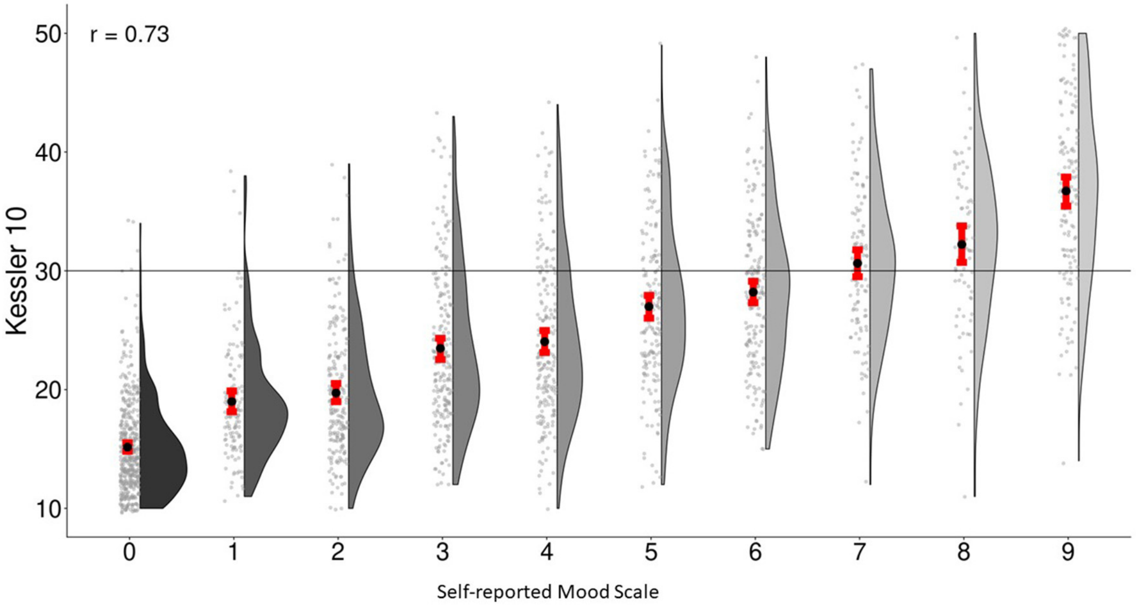

FIGURE 3 | Association between self-reported mood-scale-self-report and Kessler-10 in general-population survey.

COVID-19 where the severity scores for the self-report scale were the highest for all settings. Also, as noted earlier, the prevalence of signs of mood disturbance of differing severity varies most greatly in LTCF where those in the self-report and composite scale subsamples differ most substantially. In that setting, the composite mood scale demonstrates substantially higher rates of mood disturbance than does the self-reported variant.

Table 5 shows the relationships of the two scale variants with difficulty sleeping and depression/mood disorder diagnoses across settings based on mean scale scores and 95% CL. For both scales and in all settings, higher frequency of sleep difficulties was associated with significantly higher mean scores in the mood scales. The same was also true for the presence of depression/mood disorder diagnoses. Again, the COVID-19 community sample demonstrated highest scores on these scales for both those with and without depression diagnoses present.

Finally, **Figure 3** shows the relationship between the K-10 and the SMS. Increments in the SMS are significantly associated with higher K-10 scores and the correlation between the two scales is 0.73. This value is comparable to the value of 0.70 reported elsewhere for brief measures like the PHQ-2 and K-6 (93). Butterworth and colleagues suggest that a K-10 score of 30 or more indicates "very high risk of psychological distress" (1). Persons with the suggested SMS with values of 6 (the cut-off suggest by self-harm indicators in the community mental health sample) and 7 have mean (95% CL) K-10 scores of 28.2 (27.3–29.3) and 30.6 (29.4–31.8), respectively. Put differently, the percentage of persons with K-10 scores increased consistently with each increment of the SMS ranging from 1% of those with a score of 0–85% of those with a score of 9 on the SMS (see **Figure 2**).

DISCUSSION

With the transition to the new suite of interRAI assessment instruments (40) the composite and self-reported mood scales can be adopted as an alternative to the previous standard of the Depression Rating Scale (DRS). While the DRS will remain useful for historical trend analyses, these mood scales have several advantages over the DRS. First, with the inclusion of self-report measures they more directly includes the person's perspective than measures that rely on clinician-only assessments. Second, it is designed to be more sensitive than the DRS by using two types different of measures (clinician-rating and self-report) to better capture indications of mood disturbance. This should help in reducing the rate of under-detection of problems with mood. Third, the addition of anhedonia measures fills an important gap in the content validity of the DRS. Although the mood scale deals with a possibly transitory state in mood, having indicators related to anhedonia provides additional evidence relevant to broader aspects of depression if the indicators of mood disturbance persist over time. Fourth, our analyses provide more robust evidence for clinical cut-points in the mood scales than has been available for the DRS. Fifth, the availability of alternative forms of the scale allows for comparability of measures across diverse clinical settings where self-report or clinician-rated only measures may not be possible or desirable. This also gives the opportunity to compare results from the two perspectives separately when the clinician or self-report scales are considered on their own.

Our analyses provide clear evidence of reliability and validity for these scales to be used as a common standard with various adult age groups across settings in the continuum of care. The scales can effectively employ both the person's perspective and clinician ratings in a manner that allow it to be used for comparisons in settings where factors like cognitive impairment may be important barriers to those that rely on self-report alone. The results shown in **Table 2** illustrated why having the option of clinician ratings available is essential for settings like home care, nursing homes, and palliative care where item non-response for self-ratings can be substantial. On the other hand, the 3-item self-report scale poses minimal burden while demonstrating solid measurement properties across settings and populations.

The results variations in indicators of mood disturbance across care settings were consistent with what one would expect based on the populations served in those settings. However, it was also interesting to note the stark differences in scale scores in the general population samples prior to and during the COVID-19 pandemic. This shows that the mood scale variants are sensitive to contextual variables and major external events.

One observation of concern was the low c statistics and odds for prediction of depression diagnosis in nursing home settings. This might simply be a function of error variance when computing nine different comparisons; however, it is worth noting that depression is often under-detected in that setting (16, 94). The robust c statistic value in community mental health settings suggest that the problem may be with inadequate recognition in nursing homes rather than with the performance of the scale itself. In addition, lack of access to psychiatrists, facility level characteristics or clinical practices may affect the recognition of symptoms of depression (95).

An important benefit of the mood scale variants is that they can be scaled up for use on a national basis with relative ease where there are existing implementations of interRAI systems. In many countries, large scale adoption of new interRAI assessments is complete or underway. For example, over 20 million interRAI assessments have been completed on over 5 million unique Canadians and there is an existing e-heatlh infrastructure to support front-line clinical use, management, governance, and national policy applications of these systems. Several provinces have already begun transition to the new suite of instruments from older versions, so the inclusion of coding standards for these scales in clinical software will allow for rapid, large-scale deployment. In other countries, like the US, New Zealand, Finland, Belgium, Netherlands, Switzerland, Italy, Hong Kong the adoption of one or more of these newer instruments is complete so conversion to use of this scale becomes a relatively modest undertaking related to information technology and training.

It should be emphasized that the mood scale variants are intended to be a decision support tools that could improve access to necessary mental health services. While they are clearly associated with diagnoses of mood disorders or depression, they are not intended to be a substitute for judgement by mental health professionals. They may be used for screening to flag possible mood disorders for referral purposes, and are likely to be an effective for targeting populations in need of mental health services that are in scarce supply in many countries (96) or specific health sectors (95). The inclusion of both psychiatric and somatic measures in interRAI assessments also allows clinicians to take into account the potential link between emotional problems and potential adverse physical health outcomes (97). By identifying clinically meaningful cut-points we can also flag opportunities for improving the quality of life and health with stepped approaches to management of depression (98).

A key opportunity with these mood scales is the value of having a common measure of mood disturbance that can serve to better integrate the identification and response to needs by different partner agencies and professionals in the continuum of care. These measures can be employed in multiple sectors and can follow them for longitudinal patient reported or clinician rated outcome monitoring as patients access different parts of the health system (40, 41). As has been the case with interRAI's existing care planning protocols, the threshold values identified for these scales can be used to trigger differential responses to indications of varying levels of severity or to change in the person over time (70, 82, 99–102). Hence, these scales lend themselves well to use in a measurement-based care (103) strategy whether using the self-report or composite version of the scale.

Several interRAI systems use the DRS or combinations of clinician rated mood items for risk-adjusted outcome-based quality indicators (32–34, 37–39, 73, 104). Although the present results are promising, additional research is needed to examine the responsiveness of the mood scale variants for use in performance measurement. From a face validity perspective, the ability to use the composite version of the scale should be appealing because it circumvents some of the limitations of clinician only ratings. Similarly, the use of the self-report scale for patient reported outcome measurement should be feasible in a very large range of settings where cognitive impairment is not severe. That raises the possibility of multi-sector outcome evaluations of the relative effectiveness of alternative approaches to the management of psychological wellbeing in at risk populations and in the general population.

There are several next steps that would be helpful in future research. Most obvious is the use of non-Canadian data to validate the psychometric properties of the scale variants in other countries, health systems, and populations. In addition, we did not have data for several newer interRAI instruments that have not yet been widely adopted in Canada, including the interRAI Intellectual Disability (105), interRAI Acute Care (106), interRAI Post-Acute Care (107). Moreover, we only examined adults aged 18+ in our study samples, so we are unable to comment on the performance of these scales in children and youth. interRAI has an extensive new suite of instruments for children and adolescents (5, 13, 14, 48, 108–110) so it will be important to establish the boundaries of where these scales do or do not function effectively.

Our present study has numerous strengths including large sample sizes (allowing for rich variation) in multiple sectors of the health system, population-level data for some settings, diversity of persons assessed in terms of clinical needs and demographic characteristics, and the use of trained health professionals to ensure good quality data. However, there are some important limitations to note as well. First, we have not yet examined the longitudinal, within-person trajectories of change in these scales to determine whether they are sensitive to both improvements and worsening of mood disturbance. Second, we need to consider their responsiveness to change when interventions are applied or their predictive validity for future events (e.g., new diagnosis, self-harm attempts, hospitalization). Third, it will be important to replicate these analyses with data from other countries and across cultural settings. Finally, for some settings we did not have access to validity indicators that were available elsewhere. These limitations can and should be readily addressed in future research. At this point we suggest that the level of evidence already available from this work supports adoption of these mood scale variants in jurisdictions that have already adopted interRAI systems.

DATA AVAILABILITY STATEMENT

The data from mandated use of interRAI systems may be obtained through a request of the Canadian Institute for Health Information. Access to data from the community surveys can be obtained on request from the lead author. Requests to access these datasets should be directed to hirdes@uwaterloo.ca.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Waterloo Office of Research Ethics. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

JH drafted the first version of the manuscript and completed most analyses of data. JM and GB contributed to data analyses. JM, CP, JF, MS, GB, MF-M, HH, and SS made editorial changes to initial drafts. All authors contributed to the formulation of the ideas presented in the study and provided critical feedback to the manuscript. All authors contributed to the article and approved the submitted version.

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interRAI Subjective Quality of Life Scale for Mental Health and Addiction Settings: A Self-Reported Measure Developed From a Multi-National Study

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Background: Measuring Quality of Life (QoL) in mental health using self-reported items is important for evaluating the quality of service and understanding the person's experience of the care received.

Objective: The aim of this research was to develop and validate a self-reported QoL instrument for inpatient and community mental health settings.

Methods: Data were collected from diverse research sites in Canada, Belgium, Russia, Finland, Brazil, and Hong Kong, using the 37-item interRAI Quality of Life Survey for Mental Health and Addictions. The survey was administrated to 2,218 participants from inpatient and community mental health settings, assisted living, and the general community. We randomly divided the sample into a training and a test sample (70 and 30%, respectively). We conducted principal component analysis (PCA) and exploratory factor analysis (EFA) using the training sample to identify potential factor structure. Confirmatory factor analysis (CFA) models were then fitted to finalize and externally validate the measurement model using training and test data, respectively.

Results: PCA, EFA, and CFA of the training sample collectively suggested a 23-item scale measuring four latent constructs: well-being and hope (8 items), relationship (7 items), support (5 items), and activity (3 items). This model was supported by the CFA of the test sample. The goodness-of-fit statistics root mean square error, comparative fit index and Tucker-Lewis index were 0.03, 1.00, and 0.99, respectively. Estimated Cronbach's alpha based on the test data was 0.92. Raw Cronbach's alpha values for the subscales were 0.86 for well-being and hope, 0.86 for relationship, 0.69 for support, and 0.72 for activity.

Conclusions: The interRAI SQoL-MHA scale is a valid instrument to measure QoL in mental health settings. The instrument will support the evaluation of the quality of care and can also be used for future research to produce SQoL-MHA values on a quality adjusted-life-year scale, facilitating the evaluation of various mental health interventions.

Keywords: interRAI, quality of life, mental health, staff relationship, psychometric properties, addictions

INTRODUCTION

The past two decades have witnessed a major shift in mental health service policy from an emphasis on symptom reduction to a holistic consideration of recovery, social functioning, and quality of life (QoL) (1). In its Mental Health Action Plan 2013–2020, the World Health Organization has listed QoL as one of the crucial information indicators for the mental health system. The need to disaggregate mental health outcomes by subpopulations to reflect the diverse needs of individuals with different socio-economic and clinical characteristics has been highlighted (2). Another growing consensus is the importance of incorporating perspectives of mental health service users in evaluating clinical trials, services, and policies. Consequently, the interest in patient-reported measures of QoL has gained prominence in mental health practice (3–5).

Several approaches exist for measuring QoL, including objective approaches, subjective approaches, and health-related QoL (HRQoL) (6). One of the earliest approaches, the objective approach, focuses on life circumstances such as employment, income, and housing status (7). Objective measures of health and functioning status are also included (8). However, the objective approach can be limited since patients with similar clinical characteristics and life circumstances can exhibit dramatically different behavioral and emotional responses (6). Subjective quality of life focuses more on people's satisfaction and happiness (9). Early studies of people with mental health difficulties identified a common range of domains, including subjective appraisals of work, leisure, social relationships, finances, health, environment, and opportunities for self-fulfillment (10). Although the objective and subjective perspectives do not always coincide, they both represent important aspects of quality of life that cannot be ignored. HRQoL in essence refers to an individual's perceived physical and mental health over time. Numerous generic, i.e., applicable to the whole population, or disease-specific HRQoLs have been developed. Owing to the wide adoption of cost-effective analysis to inform resource allocation in health care, generic preference-based measures represented by EuroQoL-5D (EQ-5D) and SF-6D have become the most commonly used instruments worldwide (11). Both EQ-5D and SF-6D include a health state descriptive system and a utility scale used to calculate quality-adjusted life years (QALYs). In particular, EQ-5D has been endorsed by the National Institute for Health and Care Excellence (NICE) in England (12).

The question of whether generic measures EQ-5D and SF-6D are "fit for purpose in mental health" was raised more than a decade ago (13). Due to the substantial increase in the use of cost utility analysis, various studies have examined the psychometric validity of EQ-5D and SF-6D in respect to different mental health conditions. Although both measures have demonstrated acceptable levels of construct validity and responsiveness in common mental health problems (such as depression), mixed diagnoses, and personality disorder, a low level of construct validity and responsiveness is evident in anxiety disorders, schizophrenia, and psychosis (14–18). A large-scale study which examined the psychometric validity of EQ-5D and SF-6D displayed a low level of sensitivity and relationship with a wide range of condition-specific indicators (11). This evidence collectively highlights the need to develop QoL measures that are specific to mental health settings, especially for the purpose of making clinical decisions, assess health changes over time, or evaluate the quality of mental health services.

QoL is affected by the complex interactions of factors across the life course. Although QoL is not a characteristic of interventions, treatment, or services a person receives, previous studies have shown a significant relationship between changes in QoL and the quality of care (19). Relationships with mental health professionals are not simply based on technical or procedural transactions, so it is reasonable to expect that those relationships are a meaningful dimension of the person's subjective experience of daily life. We hence hypothesize that relationships with staff and access to service are important correlates of mental health service users' quality of life.

The interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions was developed by interRAI, an international non-profit network of more than 100 clinicians and researchers from over 35 countries (20). The network has developed standardized assessment tools for use in various areas of heath, including mental health (20). These tools can help to provide population-based data as an input to policy decision-making, as well as provide better care plans for individuals and to make best use of available funding. The interRAI Mental Health (MH) and Community Mental Health (CMH) assessment systems were developed to provide a comprehensive assessment of the strengths, preferences, and needs of all adults in inpatient and community mental health settings (20). In addition to large-scale implementation of interRAI mental health instruments in Canada, Belgium, and Switzerland, pilot studies are being undertaken in Finland, Russia, Brazil, and Hong Kong. These assessor-rated instruments allow a service provider to assess key domains of functioning, mental and physical health, social support, and service use. The objective dimension of QoL is also included (21, 22). To supplement existing instruments that are designed for use by mental health professionals such as nurses, social workers, case managers, psychiatrists, and psychologists, the interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions was developed to incorporate the individual's perspective to reflect changes experienced by mental health service users.

The development of the interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions was guided by the literature on recovery from mental illness, where recovery can be defined as "the establishment of a fulfilling, meaning life and a positive sense of identity founded on hopefulness and self-determination" (23, 24). Key processes of recovery include: (1) finding and maintaining hope, (2) re-establishing a positive identity, (3) finding meaningful in life, (4) taking responsibility for one's life, and (5) connectedness (25). As far as we are aware, the development of only one scale, the Recovering Quality of Life scale (ReQoL), was guided by the recovery theme (12). Both REQoL-10 and ReQoL-20 have been shown to be appropriate for measuring service-user recovery-focused QoL outcomes based on the data from the United Kingdom. However, these scales do not consider the psychosocial dimension (e.g., relationship with friends and families).

The interRAI family of assessment instruments considers QoL as a multidimensional concept that includes both the objective and subjective domains and addresses a much broader range of a person's experience than HRQoL. Specifically, the self-reported QoL survey focuses on the subjective domain and aims to allow mental health service users to express their own views about their lives. In developing the survey, feedback from clinical staff and mental health service stakeholders in several countries, as well as inputs from the interRAI Network of Mental Health, which comprises an international and multidisciplinary team of academics, clinicians, and psychometricians, were also sought. The final set of items covers 10 domains: (1) personal outlook, (2) autonomy and self-determination, (3) meaningful activities, (4) friends and family, (5) community, (6) staff relationship, (7) privacy, (8) empowerment and support, (9) discrimination and life circumstances, and (10) access to service. The full list of items under each domain is provided with an accompanying training manual (26). A pilot study of 83 inpatients from a mental health center in Ontario, Canada provided a preliminary examination of the reliability of the interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions. The resulting Cronbach's alpha values for the 10 domains were moderate to high (27). The pilot study concluded that the analyses were only provisional and called for further research including more respondents, in more diverse settings, and in different countries to further test the reliability and validity of the instrument.

To help staff in mental health settings create care plans that are meaningful to the individual, the primary objective of this study was to develop a self-reported QoL for mental health and addictions (SQoL-MHA) scale, using pooled data collected from a multi-regional study conducted in six countries or territories. In addition, a Staff Relationship Scale was created to help service providers identify areas for improvement. The construction of both scales was based on items from the interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions (27), a complementary tool to the assessor-rated assessment instruments developed by the interRAI research group (20).

TABLE 1 | Relative frequency table of data sources by setting ($N = 2{,}218$).

	Community mental health	Inpatient	General community	Transitional care
Canada – community			644	
Canada – inpatient 1		87		
Canada – inpatient 2		83		
Canada - transitional care				148
Belgium	234	181		
Russia		200		
Finland		174		
Brazil	412			
Hong Kong	55			
Total	701	725	644	148

MATERIALS AND METHODS

Data Source

In this multi-regional study, surveys were administrated by trained interviewers from Canada, Belgium, Finland, Russia, Brazil, and Hong Kong over different periods between 2010 and 2020 (see **Supplementary Material** for details). The initial sample comprised 2,218 respondents, 701 (31.61%) from community mental health settings, 725 (32.69%) from inpatient settings, 148 (6.67%) from transitional care, and 644 (29.94%) recruited from the general community. The sample sizes from each study site by setting are shown in **Table 1**. Staff measures were administrated to persons who were using mental health services. Data from this subsample of 1,574 were used to develop the Staff Relationship Scale.

Ethical approval was obtained from the Office of Research Ethics (ORE) at the University of Waterloo (ORE#13848, ORE#20863) for the Canadian, Finnish, Russian, and Hong Kong samples; Southlake Regional Health Centre Ethics Board (SRHC REB) (#0006-1819) for the Canadian transitional care sample; Ethical Committee Research from Centro Universitário São Lucas Ji-Paraná (CAAE 29517319.9.0000.5297) and Ethical Committee Research from Universidade Luterana do Brasil (CAAE 60213316.9.0000.5349) for the Brazilian sample; and Ethical Committee Research of KU Leuven – University of Leuven (Belgium) (S61488) for the Belgian sample.

Measures

The interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions comprises 37 items measuring the person's quality of life and experience with mental health services. The survey has two overarching aims to: (1) learn what life is like for the person; and (2) examine how well a program is providing services to the person. For each item, the respondent is asked to answer on a five-point Likert scale: 0 (Never), 1 (Rarely), 2 (Sometimes), 3 (Most of the time), and 4 (Always). This scale was then collapsed into a three-point scale of 0–1 (Never or rarely), 2 (sometimes), and 3–4 (most of time or always) due to

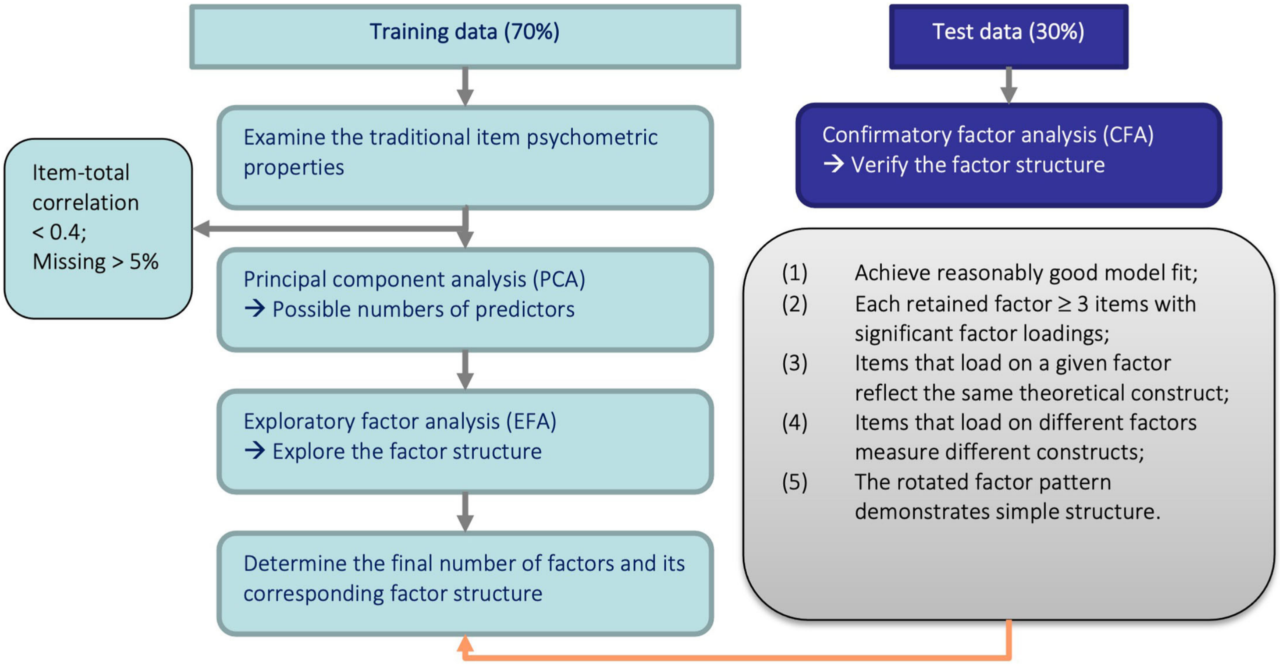

FIGURE 1 | Illustration of the analytical procedure.

low responses in the "Never" and "Rarely" categories. Twenty-seven items were administrated to all participants and were used as candidate items for developing the SQoL-MHA scale. The remaining 10 items were administrated to mental health services users and used as candidate items for developing the Staff Relationship Scale.

Analytical Procedure

We adopted the validation set approach for developing the SQoL-MHA scale. The total sample was randomly divided into a training sample consisting of 70% of the total observations and a test sample of 30%. Our preliminary analysis showed that percentages of missing values ranged from 2 to 8% in the training sample. Using the training data, we first examined the traditional item psychometric properties, represented by item-total correlations and the non-missing response frequency for each item. Items with item-total correlations <0.4 or missing values more than 5% were removed from the subsequent analyses. Our preliminary analysis showed that most items had item-total correlations >0.5. We then chose a more stringent value of 0.4 (slightly higher than the commonly adopted value of 0.3) as the cut-off value to ensure the final scale measuring a general construct QoL (28). A high missing rate in an item may indicate problems such as the items were being poorly worded, exceeding the reading skills of the respondents, or being too specific to a living situation or a diagnosis. In practice, a missing value rate of 5% or above, as a rule of thumb, often requires imputation (29). At the scale development stage, we again chose a strict cut-off value of 5% to rule out potentially problematic items. For the remaining items, the listwise deletion technique was used for handling missing values.

We performed principal component analysis (PCA) to identify the possible number of factors indicated by the number of components with eigenvalues greater than one. We then fitted several exploratory factor analysis (EFA) models to investigate the potential factor structures. The number of components identified in PCA was compared to the number of factors indicated by the best model in EFA for consistency check. Note that although PCA is a descriptive model of data that attempts to account for the entire variance of the correlation matrix rather than just the common variance as in EFA, the number of principle components with eigenvalues greater than one should not deviate substantially from the number of factors indicated by the best fitting EFA model (30). For the EFA, a standard deviation of the residuals (RMSR) <0.05 and a goodness-of-fit measure equal or higher than 0.9 were considered a good fit (31). Determination of the final number of factors and their corresponding factor structure was based on five criteria: (1) EFA model achieves reasonably good model fit; (2) each retained factor is measured by at least three items; (3) items that load on a given factor reflect the same theoretical construct; (4) items that load on different factors measure different constructs; and (5) the rotated factor pattern demonstrates simple structure, i.e., each item should measure a unique domain. Items that did not have sufficiently large loadings on any factors were removed. The resultant factor structure was evaluated in both the training and test samples using confirmatory factor analysis (CFA). This analytical procedure for developing the SQoL-MHA scale is illustrated in **Figure 1**.

The same steps were applied to the development of the Staff Relationship Scale except that we did not use the validation set approach, as the sample size of the service user population was smaller than the general population, and splitting the sample may have comprised the power of the subsequent analysis. The scale was developed and validated using the same sample with complete cases.

Estimation Methods and Fit Statistics

Since responses for all items are ordinal variables, polychoric correlation (instead of Pearson's correlation) coefficients were computed for all data points for latent variable model fittings. For EFA, the principal axis factoring with oblique oblimin rotation was used together with polychoric correlation (32). For CFA, polychoric correlation was used in combination with the diagonally weighted least squares (DWLS) estimator. Previous simulation studies have demonstrated the superior performance of this approach (33). Root mean square error (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI) were used to evaluate the model goodness-of-fit. The cut-off criteria of these goodness-of-fit statistics are heavily contingent. In this study, RMSEA < 0.08, CFI > 0.95, and TLI > 0.95 were considered as a reasonable model-data fit (34–36). However, it is important to note that these cut-off values were concluded based on continuous data that were analyzed using normal-theory maximum likelihood (ML) and should be applied with caution when being generalized to ordinal data that were analyzed using polylchoric correlation and estimators other than ML (37). All data analysis was conducted using the statistical software R (38). Specifically, the *psych* package was used for PCA and EFA and the *lavvan* package was used for CFA (30, 39).

RESULTS

Of the 1,937 respondents with a valid record of gender, 1,041 (53.74%) were female and 896 (46.26%) were male. The majority were in the under 45 and 45–64 years age groups, accounting for 46.49 and 33.02%, respectively, of the 1,781 respondents with a valid record of age. The percentages of respondents aged 65–74 and 75 years or older were 13.81 and 6.79%, respectively.

Development of the interRAI SQoL-MHA Scale

Traditional item psychometric properties for the training sample, including the response proportions and item-total correlation, are summarized in **Table 2**. Raw and standardized Cronbach's alphas generated from the training sample were both 0.90. Item-total correlations ranged from 0.15 ("satisfied with services") to 0.68 ("on the whole, life is good"). One item (opportunities for work or school) was removed due to excess missing values (>5%) and three were removed due to low item-total correlation (<0.4).

We then performed PCA on the remaining 23 items. A total of 1,289 participants in the training sample that did not have missing values in any of the 23 items were included in the subsequent analysis. The first five eigenvalues from PCA ranged from 10.67 to 1.03, suggesting that four to five factors were likely to be sufficient. The eigenvalue ratio of the first (10.67) to second (1.87) eigenvalues was 5.71 (>3), suggesting that a unidimensional interpretation of the scale, in this case meaning that the scale measures a dominant latent construct of quality of life, is appropriate.

TABLE 2 | Abbreviated item content and traditional item psychometric properties: training sample ($N = 1{,}552$).

Item	Missing%	Response proportion%			Item-total correlation
		0	1	2	
Safe w/family and friends	3	9	14	78	0.61
Safe and comfortable in home	3	9	11	80	0.53
If I need help right away, I can get it	2	8	17	75	0.48
In a crisis, know where to get help	3	9	15	77	0.51
Hopeful about future	3	9	24	67	0.62
Life getting better	4	11	30	59	0.63
Feel good about myself	2	12	25	63	0.65
On the whole, life is good	3	12	21	67	0.68
Have good place to live	3	10	10	80	0.53
Manage stresses in life	3	15	29	56	0.58
Know how to make life better	4	12	26	63	0.60
Make choices about things that matter	4	9	19	72	0.57
Concerned about how others treat me	4	32	31	38	0.36
Worried about making ends meet[a,b]	4	40	25	35	0.38
Can get health services[a,b]	2	5	14	81	0.44
Satisfied with services[b]	5	4	14	81	0.15
Participated in meaningful activities	3	15	26	59	0.51
Opportunities for work or school[c]	8	31	14	54	0.45
Motivated in day to day activities	3	12	24	63	0.61
Participate in community activities	2	39	31	30	0.46
Important role in people's lives	4	11	21	68	0.61
Friends and family believe in me	3	9	17	74	0.61
Relationships are good	2	9	15	77	0.58
Help family and friends	3	7	14	79	0.49
Feel part of neighborhood	3	19	24	57	0.52
Get support for decisions	3	8	17	75	0.55
Have people I can count on	2	6	13	81	0.59

[a]Reversed item; [b]Removed due to low item-total correlation; [c]Removed due to excess missing values.

EFA models of up to five factors were fitted to investigate the potential factor structure. The four- and five-factor models provided the best fit with the data, with RMSRs of 0.04 and 0.03, and goodness of fit of off diagonal values of 0.99 and

TABLE 3 | Estimation results of the four-factor exploratory factor analysis model: training sample ($N = 1,289$).

	PA1	PA2	PA3	PA4	$h2^1$
Safe w/family and friends		0.89			0.81
Safe and comfortable in home		0.63			0.51
If I need help right away, I can get it			0.86		0.70
In a crisis, know where to get help			0.71		0.57
Hopeful about future	0.82				0.68
Life getting better	0.75				0.62
Feel good about myself	0.82				0.69
On the whole, life is good	0.59	0.38			0.70
Have good place to live		0.63			0.52
Manage stresses in life	0.61				0.48
Know how to make life better	0.78				0.60
Make choices about things that matter	0.55	0.25			0.48
Can get health services			0.79		0.58
Participated in meaningful activities	0.37			0.42	0.45
Motivated in day to day activities	0.63			0.27	0.60
Participate in community activities				0.74	0.63
Important role in people's lives		0.64			0.61
Friends and family believe in me		0.78			0.72
Relationships are good		0.89			0.79
Help family and friends		0.37			0.41
Feel part of a neighborhood				0.50	0.47
Get support for decisions	0.24		0.48		0.53
Have people that I can count on		0.37	0.43		0.64

[1] *Communalities.*
Factors loadings <0.2 were are not shown here.

1.00, respectively. However, only two items loaded to the fifth factor in the five-factor model. The four-factor EFA model was then chosen as being superior overall based on our analytical protocol (**Figure 1**). Standardized loadings (pattern matrix) of the model based on 23 items are shown in **Table 3**. Factor 1 was predominantly measured by eight items: (1) hopeful about future, (2) life getting better, (3) feel good about myself, (4) on the whole, life is good, (5) manage stresses in life, (6) know how to make life better, (7) make choices about things that matter, and (8) motivated in day-to-day activities, which correspond to a more general construct of well-being and hope. Factor 2 was measured by seven items, including (1) safe with family and friends, (2) safe and comfortable in home, (3) have good place to live, (4) important role in people's lives, (5) friends and family believe in me, (6) relationships are good, and (7) help family and friends, which concurred with the theoretical construct relationship. Factor 3 was measured by five items: (1) if I need help, I can get it, (2) in a crisis, know where to get help, (3) can get health services, (4) get support for decisions, and (5) have people that I can count on, that are in line with the construct support. Factor 4 was measured by 3 items: (1) participated in meaning activities, (2) participate in community activities, and (3) feel part of a neighborhood, which correspond to the activity domain. The factor with the higher loading was kept for the subsequent CFA.

Using the same training sample, we investigated the factor model by conducting a separate CFA, allowing each item to load on only one factor to ensure a simple structure. The Chi-square test statistic was 1049.47 with degrees of freedom of 224. The RMSEA was 0.05 (90% CI: 0.05–0.06) and the SRMR was 0.07. CFI and TLI were 0.99 and 0.98, respectively. This set of goodness-of-fit statistics collectively suggested that the model fit the data well. The factor loadings are summarized in **Table 4**. Factor loadings are all fairly large, suggesting that they are all sufficiently good measures of the respective latent variables. Correlations among the four factors ranged from 0.29 to 0.50 (**Table 5**), which suggests that the four factors measured correlated, yet distinct constructs.

To examine external validity of the factor structure of the QoL scale, the model was fit to a test sample of 550 respondents (see also **Table 4** for the estimation results). The Chi-square statistic was 366.93 (df = 224). The RMSEA and SRMR were 0.03 (90% CI: 0.03–0.04) and 0.06, respectively. CFI was 1.00 and TFI were 0.99. Raw and standardized Cronbach's alphas generated from the test sample were both 0.92. Raw Cronbach's alpha values for the subscales were 0.86 for well-being and hope, 0.86 for relationship, 0.69 for support, and 0.72 for activity. We also conducted a sensitivity analysis to examine the impact of removing items with potential cross loading problem on the CFA model fit and sub-domain reliabilities. Only one item, "have people that I can count on," had relatively high loadings of 0.37 and 0.43 on two factors based on the EFA. Removing this item had no effect on all goodness of fit statistics of interest except that SRMR decreased by 0.001 in the training sample. However, the reliability of the support sub-domain decreased from 0.75 to 0.71 in the training sample, and from 0.69 to 0.62 in the testing sample. This item was therefore kept in the final SQoL-MHA scale.

We further examined the reliabilities by sub-domains for the total sample (combining training and testing data). Raw and standardized Cronbach alphas generated from the total sample were both 0.91. Sub-scale Cronbach alpha values ranged from 0.64 for the activity domain to 0.86 for the well-being and hope domain.

Development of the Staff Relationship Scale

Table 6 shows the response patterns and item-total correlations of the 10 staff items. Raw and standardized Cronbach's alpha

TABLE 4 | Estimation results from Confirmatory Factor Analysis.

Domain		Training sample			Testing sample		
		(*N* = 1,289)			(*N* = 550)		
	Item	Est.	SE	α	Est.	SE	α
Well-being & Hope	Hopeful about future	1		0.86	1		0.86
	Life getting better	0.96	0.02		0.98	0.03	
	Feel good about myself	1.01	0.02		1.06	0.03	
	On whole, life is good	1.05	0.02		1.09	0.03	
	Manage stresses in life	0.86	0.02		0.90	0.03	
	Know how to make life better	0.91	0.02		0.93	0.03	
	Make choices about things that matter	0.87	0.02		0.92	0.03	
	Motivated in day-to-day activities	0.90	0.02		0.99	0.03	
Relationship	Safe w/family and friends	1		0.84	1		0.86
	Safe and comfortable in home	0.87	0.02		0.95	0.03	
	Have good place to live	0.87	0.02		0.90	0.03	
	Important role in people's lives	0.91	0.02		0.96	0.03	
	Friends and family believe in me	1.00	0.02		1.05	0.03	
	Relationships are good	1.00	0.02		1.08	0.03	
	Help family and friends	0.78	0.02		0.86	0.03	
Support	If I need help right away, I can get it	1		0.75	1		0.69
	In a crisis, know where to get help	1.02	0.03		0.99	0.06	
	Can get health services	0.91	0.03		0.92	0.05	
	Get support for decisions	1.15	0.03		1.38	0.06	
	Have people that I can count on	1.33	0.03		1.51	0.07	
Activities	Participated in meaningful activities	1		0.61	1		0.72
	Participate in community activities	0.89	0.03		0.854	0.03	
	Feel part of a neighborhood	1.02	0.03		0.979	0.03	

All factor loadings have P-values <0.001.

TABLE 5 | Correlation matrix of latent variables.

	Training sample (*N* = 1,289)			Testing sample (*N* = 550)		
	Hope	Relationship	Support	Hope	Relationship	Support
Relationship	0.50 (0.01)			0.52 (0.02)		
Support	0.39 (0.01)	0.40 (0.01)		0.30 (0.01)	0.38 (0.02)	
Activities	0.41 (0.01)	0.39 (0.01)	0.29 (0.01)	0.47 (0.02)	0.46 (0.02)	0.30 (0.02)

All factor loadings have P-values <0.001.

values were 0.78 and 0.81, respectively. The percentage of missing values ranged from 4 to 10%. The "feel valued and respected" item was removed due to its lower item-total correlation and the "personal information kept private" item was removed due to excessive missing values (10%). Raw and standardized Cronbach's alpha values increased to 0.81 and 0.82, respectively. We did not strictly follow the missing value <5% and item-total correlation >0.4 rule here since only two items had missing values <5%.

The PCA showed that only the first eigenvalue of 5.05 was greater than one, suggesting that one factor might be sufficient. The two-factor EFA model failed to converge, which also pointed to a single factor model. We then constructed an 8-item single factor CFA model using data from 1,341 complete cases. The model had a Chi-square statistic of 165.04 (df = 20), RMSEA of 0.07, CFI of 0.97, and TLI of 0.95. The factor loadings for the CFA are shown in **Table 7**.

DISCUSSION

In this study, we report the process of developing and validating the SQoL-MHA scale, a new measure for assessing the subjective QoL for mental health service users. The SQoL-MHA is a concise 23-item scale measuring four domains of QoL: well-being and hope, relationship, support, and activity, that are measured by eight, seven, five, and three items, respectively. The CFA yielded a good fit of the test data and confirmed the

TABLE 6 | Abbreviated item content and traditional item psychometric properties for subsample of service users.

Item	Missing%	Response proportion%			Item-total correlation
		0	1	2	
Private conversation	7	7	12	81	0.67
Personal information kept private	10	6	6	89	0.59
Safe around those who provide care	4	3	11	86	0.58
Treated with respect	4	3	8	89	0.59
Feel valued and respected	5	21	28	51	0.48
Privacy respected by staff	7	3	7	89	0.59
Staff help me take responsibility	6	5	16	78	0.63
Can speak my mind around staff	5	7	15	78	0.70
Staff listen to what I say	5	4	15	82	0.67
Staff support my recovery	6	2	10	88	0.65

TABLE 7 | Confirmatory Factor Analysis estimation results for the Staff measure ($N = 1,341$).

	Estimate	Standard errors
Private conversation	1	
Safe around those who provide care	1.05	0.05
Treated with respect	1.02	0.06
Privacy respected by staff	1.07	0.06
Staff help me take responsibility	1.09	0.06
Can speak my mind around staff	1.15	0.06
Staff listen to what I say	1.22	0.05
Staff support my recovery	1.24	0.05

All factor loadings have P-values <0.001.

four-factor model suggested by the EFA. The reliabilities of the sub-scales were moderate to high. The total score of the SQoL-MHA scale ranges between 0 and 46. Sub-scale score ranges were 0–16 for well-being and hope, 0–14 for relationship, 0–10 for support, and 0–6 for activity. The four domains included in the SQoL-MHA scale share similar aspects in key processes of recovery such as hope, self-determination, connectedness, and meaningful activities. The sub-scales can be used to assess specific domains of QoL of interest and to identify areas of improvement that should be targeted on. To allow mental health service providers identify specific areas for improvement and adapt their care environments to enhance users' QoL, an eight item Staff Relationships Scale was developed.

In contrast to scales that have been developed from a single country or region with a relatively homogeneous cultural background, the SQoL-MHA scale was developed through a collective effort of partners in the interRAI family from six countries across four continents. The study involved diverse service environments including inpatient psychiatry, community mental health, and general community settings. To more effectively identify and respond to mental illness and related dimensions of health and well-being throughout the life course, the interRAI suite of mental health instruments has been designed as an integrated assessment and screening system providing a holistic view of an individual's strengths, preferences, and needs. A specific goal is to develop a common language for describing needs, monitoring service use, and tracking outcomes over time, across the health care continuum. It also advocates considering more than psychiatric symptoms alone by taking a broader perspective to address issues like growth, development, and aging; social relationships; economic resources; housing; stigma; and recovery. In the assessor-rated interRAI instruments (e.g., interRAI-MH and interRAI-CMH), objective dimensions of QoL can be measured by items from several relevant domains, including functional status, physical health conditions, social relations, employment, education, finance, and housing. Alongside the increasing implementation of interRAI mental health instruments across the world, the new SQoL-MHA and Staff Relationship Scale can be readily implemented in places where standard assessments have been routinely performed. These patient-reported measures of outcomes and experience of care provide an important subjective complement to existing assessor-rated instruments.

Compared with generic health-related quality of life measures like EQ-5D and SF-6D, the SQoL-MHA scale offers significant advantages as a measure developed specifically for mental health service users. It should also function better than condition-specific measures such as the Hospital Anxiety and Depression Scale (HADS) and the Patient Health Questionnaire-9 (PHQ-9) since it considers a broader range of users with mental health conditions beyond those with depression and anxiety.

This study has some several limitations. First, our respondents were not randomly selected and were unevenly distributed across regions and settings. Any generalization of the findings needs to be made cautiously. Limited by relatively small sample sizes in Finland, Russia, and Hong Kong, measurement invariance analysis was not conducted. It is not clear whether certain items would function differently by culture or characteristics other than the latent construct of interest. Future work should investigate group-wise measurement invariance by subpopulations and longitudinal measurement invariance. The interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions was administrated without additional data on other scales. Therefore, we did not examine the known-group validity due to the lack of diagnostic information in the pilot sites. Neither did we compare QoL across regions as the sample sizes varied significantly between different sites. Only reliability, face-validity, and construct-validity can be established based on the current data. However, a gold standard does not exist for measuring QoL in mental health and addictions. Although adding other scales in the future can help to better understand the difference between generic measures and SQoL-MHA, the absence of a gold standard measure makes it difficult to establish criterion validity. We focused only on examining the psychometric properties of the new measures. Future research is needed to administer generic and condition-specific measures in addition to the interRAI SQoL-MHA scale to better understand their performance with different mental health populations.

CONCLUSION

The 23-item interRAI SQoL-MHA scale is a valid instrument to measure QoL in mental health settings. When used with the Staff Relationship Scale, it will support the evaluation of care quality. Combined with existing information collected through interRAI MH and interRAI CMH, a holistic view (including both the objective and subjective perspectives) of a person's QoL can be assessed. In addition, the tool can be used to calculate quality-adjusted-life years, which will facilitate the evaluation of various health intervention, treatments, and policies in mental health settings. Future research is planned to establish the weights metric needed for calculating QALYs.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the ethical approvals do not allow sharing of raw data of this project. Requests to access the datasets should be directed to John P. Hirdes, hirdes@uwaterloo.ca.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Office of Research Ethics (ORE) at the University of Waterloo. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

HL formulated the research questions, analyzed the data, and took the lead in writing the article. AH, JH, KD, CV, and MS collectively designed the study, lead the data collection in each study site, critically reviewed the analysis, and contributed to the writing of the article. JPH formulated the research questions, designed the study, coordinated the data collection, reviewed the analysis, and wrote the article. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.705415/full#supplementary-material

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An International Pilot Study of Self-Reported Quality of Life in Outpatient and Inpatient Mental Health Settings

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Introduction: Measuring quality of life (QoL) is essential to understand how clients perceive their care. In practice, many instruments are in place to identify mental health diagnoses and measure treatment outcomes, but there are fewer standardized instruments to routinely collect information about self-reported QoL, especially across different mental health settings. Moreover, existing tools have been criticized for being built from the perspective of care professionals rather than the users' perspective. The 23-item Self-Reported interRAI-QoL Survey for Mental Health and Addictions (interRAI SQoL-MHA) tackles these issues, as it is based on self-reported measures and has proven validity across settings and countries.

Objective: The aim of this study is to assess and compare QoL across settings and explore associations between dimensions of self-reported QoL and some items from the interRAI SQoL-MHA in a multinational sample.

Settings: Inpatient and community mental health services.

Methods: Data were collected from organizations in Belgium, Finland, Russia, Brazil, Rwanda, Canada and Hong Kong. Logistic regression models were constructed using each domain scale of the interRAI SQoL-MHA (relationship, support, hope, activities and relationship with staff) as dependent variables.

Results: A total of 2,474 people (51.2% female, 56.7% of age 45 or older) were included in the study. A benchmark analysis showed the samples that performed above the benchmark line or below. The models yielded significant odds ratios among the domain scales, as well as for the items of the interRAI SQoL-MHA, with positive associations for the items "work and education opportunities" and "satisfied with services", and inverse associations for the items "financial difficulties" and for the inpatient setting.

Conclusion: The analysis of associations between the determinants offers relevant information to improve mental health care and clients' perceived quality of life. Information about the determinants can help policymakers to design interventions to improve care outcomes, as well as provide more possibilities for integration into the community. The interRAI SQoL-MHA is innovative, as it can be linked to the third generation interRAI MH and Community MH-instruments, to be used in different mental health care settings, combining the objective and subjective QoL domains.

Keywords: quality of life, benchmarking, mental health services, patient reported experience measures, international comparisons

INTRODUCTION

Over the past two decades, a shift has taken place in the approach to mental health care, moving from an emphasis on the reduction of symptoms, based on pathology and illness, to a more comprehensive and holistic approach (1, 2). The definition put forward by Anthony (1993) was a key milestone for this shift, where recovery was described as *"a deeply personal, unique process of changing one's attitudes, values, feelings, goals, skills, and/or roles. It is a way of living a satisfying, hopeful, and contributing life even with limitations caused by illness. Recovery involves the development of new meaning and purpose in one's life as one grows beyond the catastrophic effects of mental illness* (3)." This new vision brought the client's perspective into the foreground and was a reaction against the singular clinical vision of care professionals, where patients and former patients felt that important aspects were missing in the delivered care (4, 5). Since then, personal well-being, recovery, social functioning and quality of life (QoL) have become essential elements in mental health rehabilitation (6–11). In scientific literature, studies state that evaluating mental health rehabilitative interventions means primarily to determine whether these interventions have the potential to increase users' quality of life (12). In a broader vision, interventions should improve users' sense of well-being, health status as well as satisfaction with life circumstances, including access to resources and opportunities (13, 14). According to Thornicroft and Slade (15), it is the point of view of the service users that counts most in deciding which outcomes should be assessed when evaluating mental health interventions. They agree that quality of life is not closely related to users' needs as rated by the staff, but is closely associated with unmet needs as rated by service users (16, 17). This highlights the importance of users' self-rated measures of QoL.

This expansion of focus is reflected in the Institute for Healthcare Improvements Triple Aim initiative that emphasizes the need for approaches to health service delivery that improve the patient experience of care, improve health of populations, and reduce costs of health care simultaneously (18). The opportunity to engage in international benchmarking on the quality of life of service recipients depends on the availability of standardized measures that are cross-nationally applicable. International comparisons can provide evidence of what is possible in settings with differing resources, and they can provide natural policy experiments to evaluate alternative approaches to service provision (19).

In practice, many instruments are in place to identify mental health diagnoses and measure treatment outcomes, but there fewer standardized instruments routinely collect information about self-reported QoL, especially across different types of mental health settings (20). Existing tools to measure QoL have also been criticized for taking the perspective of care professionals rather than the users' perspective (21, 22). The 46-item interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions (interRAI SQoL-MHA) (23) tackles these aspects, as it is a self-report instrument that can be applied to different types of organizations delivering inpatient care or care in the community. This instrument has a psychosocial perspective of QoL based on the individual's sense of well-being, containing a total of four domain scales: "relationship", "hope", "support", and "activities", with an additional 8-item "relationship with staff" scale. The tool can be best applied in conjunction with the interRAI Mental Health and Community Mental Health care instruments to include both the subjective and objective perspectives of a person's QoL (24).

While several factors have been associated with subjective QoL, lower capacity for everyday functioning and having a greater severity of depressive and anxiety symptoms have been associated with poor subjective QoL (25, 26). However, literature shows that symptom reductions alone usually do not result in significant improvements in QoL, especially when other problems remain (e.g., lack of social contacts, unemployment, stigmatization) (27). Improvements in global life aspects, leisure activities, living situation and social relations are often associated with better QoL outcomes (28–30). At the level of the services, patient involvement is associated with more feelings of empowerment and satisfaction (31). The interRAI SQoL-MHA instrument includes all these important aspects and the aim of our study is to explore these associations further, using the items of the SQoL–MHA tool in relation to its four domains: relationship, hope, support and activities, as well as the domain relationship with staff. By identifying the significant determinants for each of the SQoL-MHA domains, professional caregivers, together with users can build a better care plan. In addition, this information can help organizations and policy makers design interventions for mental health rehabilitation, considering each domain and its significant factors, to improve perceived QoL. Another aim of our study is to compare these results across settings within the countries involved, showing its potential for benchmarking, as the interRAI SQoL-MHA is an innovative tool which is standardized across settings and was validated for worldwide use in research and practice.

MATERIALS AND METHODS

Data Source

Data for this study were collected in seven countries: Belgium, Finland, Russia, Brazil, Rwanda, Canada, and Hong Kong (China). Trained interviewers assessed participants with the 46-item interRAI Self-Reported Quality of Life Survey for Mental Health and Addictions (interRAI SQoL-MHA) (32). Respondents were at least 18 years old at the time of participation and were receiving mental health services in the community or inpatient mental health care. An additional sample of people from the general population in the community was also assessed in Canada through telephone-based interviews.

Ethical Approval

Ethical approval was obtained from the Office of Research Ethics (ORE) at the University of Waterloo (ORE#13848, ORE#20863) for the Canadian, Finnish, Russian, and Hong Kong samples; Southlake Regional Health Center Ethics Board (SRHC REB) (#0006-1819) for the Canadian transitional care sample; Ethical Committee Research from Centro Universitário São Lucas Ji-Paraná (CAAE 29517319.9.0000.5297) and Ethical Committee Research from Universidade Luterana do Brasil (CAAE 60213316.9.0000.5349) for the Brazilian sample; Ethical Committee Research of KU Leuven–University of Leuven (Belgium) (S61488) for the Belgian sample and University of Rwanda (No 071/CMHS IRB/2020) for the sample from Rwanda.

Measures

The interRAI SQoL-MHA consists of 46 items measuring service users' subjective quality of life. The survey was constructed with the purpose of learning what life is like for the user of mental health services and examining how well a program is providing services to this person. Each item is constructed as a 5-point Likert scale based on frequency of the item being true in the person's experience: 0 (never), 1 (rarely), 2 (sometimes), 3 (most of time), and 4 (always). The survey is multi-dimensional and was validated with a Canadian dataset and was later further fine-tuned and validated with an international dataset of 6 countries. The SQoL-MHA instrument was found to have a high reliability, face-validity, and construct-validity across settings and countries (32).

Three additional items to the interRAI SQoL-MHA were used in the analysis: "Work and education opportunities", "Satisfied with services" and "Worried about making ends meet" ("financial difficulties"). These items are not used in the calculation of the domain scales, but they are assessed as stand-alone items together with the items of the scales. The sample of the Canadian general population was not assessed with items relating to relationship with staff, as they were not receiving mental health care.

Analysis

The items of the scale were recoded from a 5-point into a 3-point response: 0–1 (never or rarely), 2 (sometimes), and 3–4 (most of time or always), in order to calculate the scores of the interRAI SQoL-MHA domain scales. This method is consistent with Luo et al. (2021), as the scores "never" and "rarely" had a very low frequency. The approach has also been in used in other interRAI QoL surveys for other care settings (33–36). Each domain scale is calculated as a sum of the recoded items: relationship domain (seven items), hope (eight items), support (five items), and activities (three items) and an additional eight-item staff relationship scale. To assess the statistical significance of the difference in the mean scores of the SQoL-MHA domain scales among countries, we performed ANOVA and GLM adjusted Tukey-Kramer correction for unbalanced samples. To explore the associations between the domain scales of the interRAI SQoL-MHA instrument with each other, as well as the associations with the items from the instrument not belonging to the domain scales, logistic models were built. Using the whole pooled sample, all four domain scales of the SQoL-MHA and the scale of relationship with staff were dichotomized for the logistic models, using the scales as dependent variables. Scores below or equal to the 20th percentile (p20) value were recoded as 0. Scores above the p20 value were recoded as 1. This cut-off value was also applied as the benchmark line in the graphs of the comparisons of settings (34). The models for each of the scales controlled for the setting where the services were delivered (community/inpatient), using the general community population as reference, as well as for the country effect. Dummies for each country were created and Finland was chosen as the reference country, as its model of mental health care has more similarities with most countries involved in the study. Multicollinearity tests were performed for all variables in the models, as high correlations among predictor variables may lead to unreliable and unstable estimates of the regression coefficients. All statistical analysis was performed with software SAS version 9.4.

RESULTS

The sample consisted of a total of 2,474 people from seven countries: 623 (25.2%) users received inpatient care, 1,207 (48.8%) received community mental health services and a Canadian sample from the general population with a total of 644 people (26.0%) living in the community. The samples from Belgium and Canada were both from inpatient and outpatient services. The samples from Brazil, China and Russia came from outpatient care and those from Finland and Rwanda from inpatient facilities. **Table 1** shows the distribution of the samples according to gender and age, as well as the percentage of people who had a partner. There was no data from Russia available for these characteristics. The sample from China (outpatient) showed the highest percentage of women (72.7%) and Rwanda inpatient care the lowest (8.2%). The gender distribution of the total sample was of 51% female. The outpatient sample from Canada consisted of people of age 45 or older, contrasting with all other samples, especially with Finland and Rwanda which had the youngest distribution of the population. The outpatient samples from Brazil and China showed the highest percentages of people reporting to have a partner, both about 44%, while the percentage of the total study population was 32.7%.

Figures 1–5 shows the boxplots for the scores of each of the interRAI SQoL-MHA domain scales. Same colors indicate that the samples have means which are not significantly different from each other. Higher scores in the scales mean better scores for each domain scale. As the samples are not representative for each country, the results should be seen as a comparison between samples, and not as comparison between countries. For the relationship scale (**Figure 1**) we can differentiate four samples with means that are not significantly different from each other (Belgium inpatient and outpatient, Brazil outpatient and Canada inpatient). Another group, with means not significantly differing, consisted of Russia inpatient and China outpatient (respectively 1.35 and 1.34). The sample from the general community population in Canada had the best scores for the relationship scale (mean = 1.91) and the sample from Rwanda the lowest (mean = 0.98), also being the only one with the means below the benchmark of the 20th percentile (p20 = 1.29). **Figure 2** shows that only the sample from China outpatient had the mean below the benchmark of 1.4 for the support scale. **Figures 3**, **4** shows that for the domains hope and activities, none of the samples had means below the p20 line, respectively at the benchmark values of 1.0 and 0.67, although the samples for Rwanda and China had many people with scores below the benchmark lines. In regards to the domain relationship with staff (**Figure 5**), the samples from Russia inpatient and China outpatient scored lower than the benchmark of 1.75. This is the domain with the highest scores when compared to all other domains and the sample from Rwanda scored high (mean = 1.90), as well as the outpatient samples from Belgium (mean = 1.93) and Brazil (mean = 1.89) and the sample from inpatient care in Canada (mean = 1.85).

Table 2 shows the multivariate logistic models for each of the domains of the interRAI SQoL-MHA instrument. There was no collinearity in the models, as all measures fell within acceptable limits for tolerance and variance inflation factors (limit: VIF <

TABLE 1 | Characteristics of the samples of the participating countries and settings.

Country and setting	Female (%)	Age (% 45 and older)	Client has a partner (%)	*N*
Belgium inpatient	39.0	60.8	21.2	181
Belgium outpatient	36.4	54.5	24.7	234
Brazil outpatient	58.3	55.3	44.2	570
Canada general community	59.6	63.1	–	644
Canada inpatient	53.9	51.8	–	170
Canada outpatient	51.4	100.0	21.6	148
China outpatient	72.7	61.8	43.6	55
Finland inpatient	44.3	24.1	–	174
Russia outpatient	–	–	–	200
Rwanda inpatient	8.2	18.4	16.3	98
Total population in the study	51.2	56.7	32.7	2474

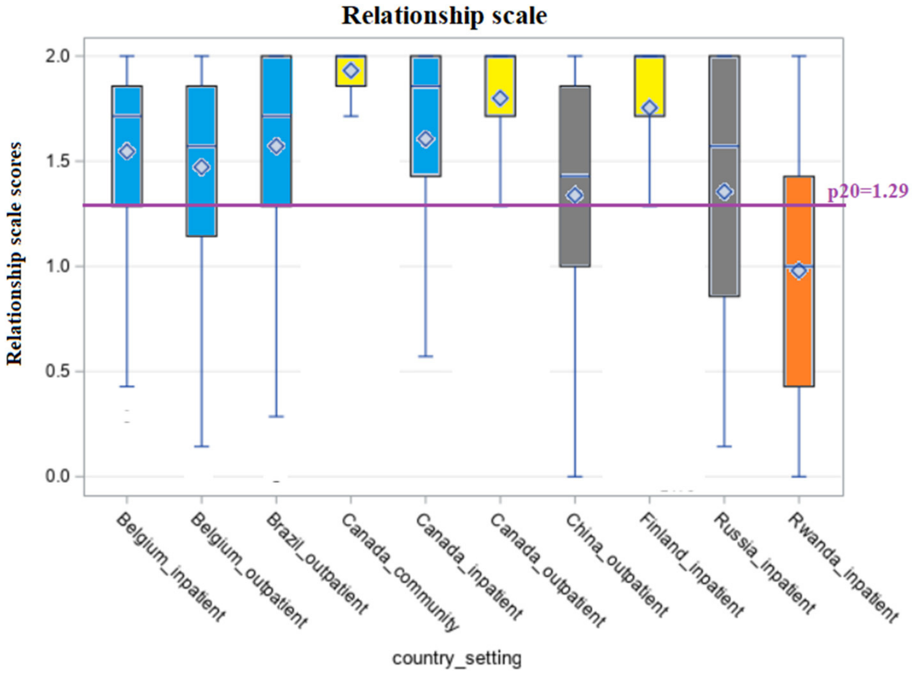

FIGURE 1 | Distribution of scores of the scale "Relationship" across countries and settings.

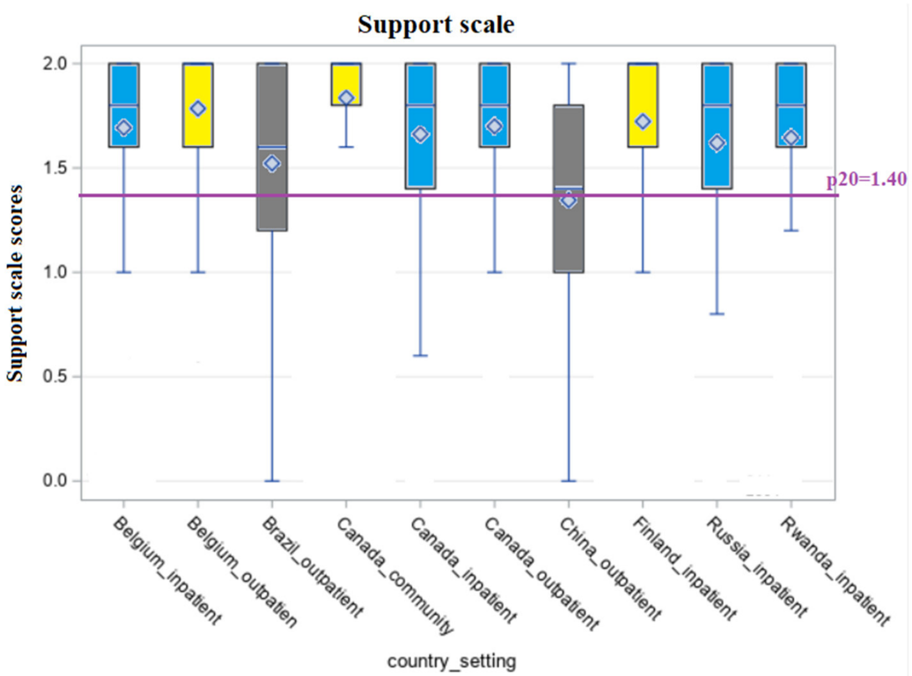

FIGURE 2 | Distribution of scores of the scale "Support" across countries and settings.

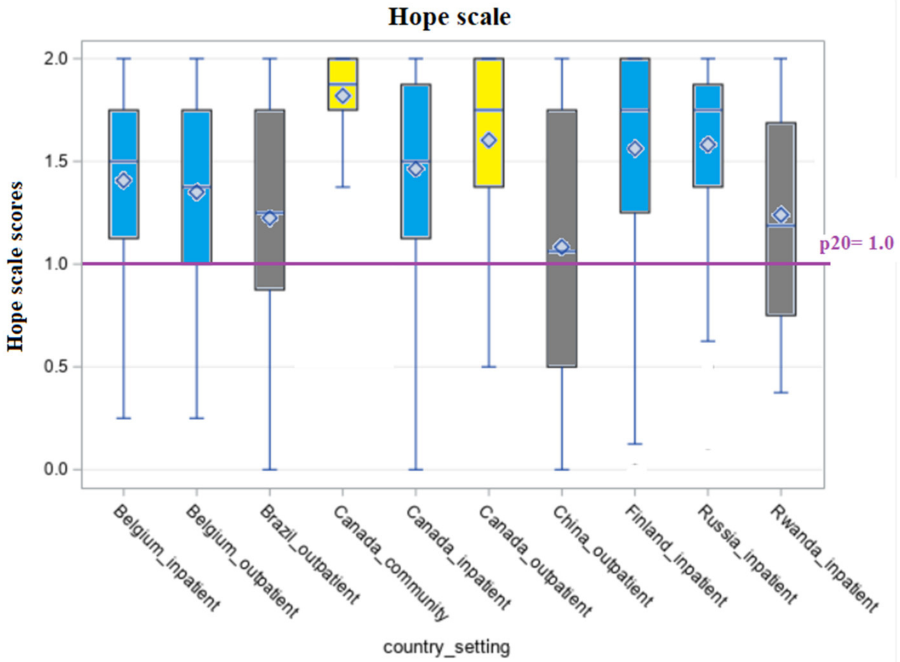

FIGURE 3 | Distribution of scores of the scale "Hope" across countries and settings.

5, most measures were under 2). The analysis of the logistic models did not include missing data. Missing responses on the items of the scales were very limited, mostly between 3 and 5%. The item about work and education opportunities was the only one with more missing values, with a total of 8.5% missing. The domain scales of the SQoL-MHA were in all cases

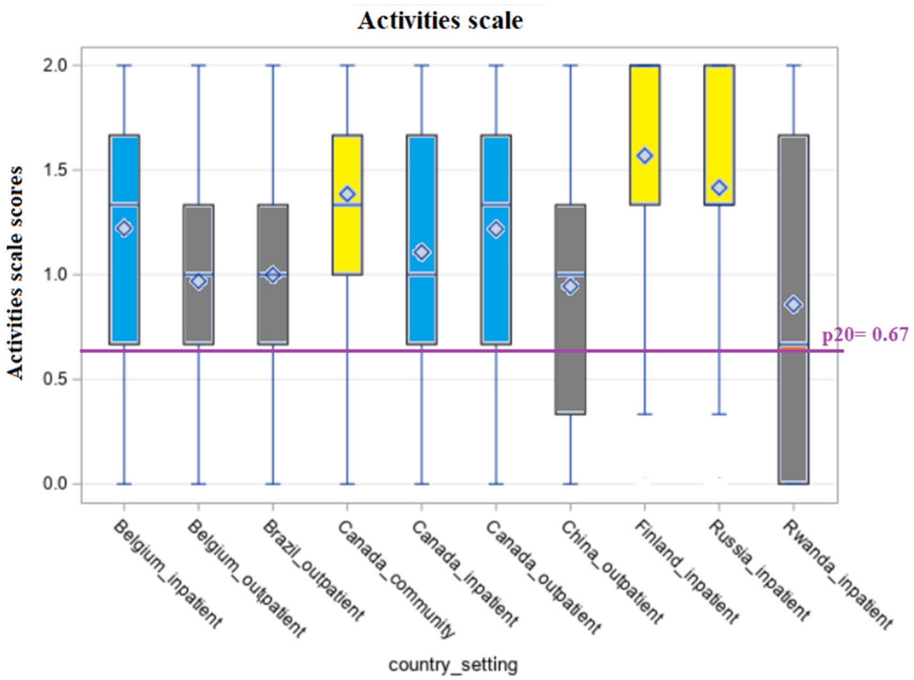

FIGURE 4 | Distribution of scores of the scale "Activities" across countries and settings.

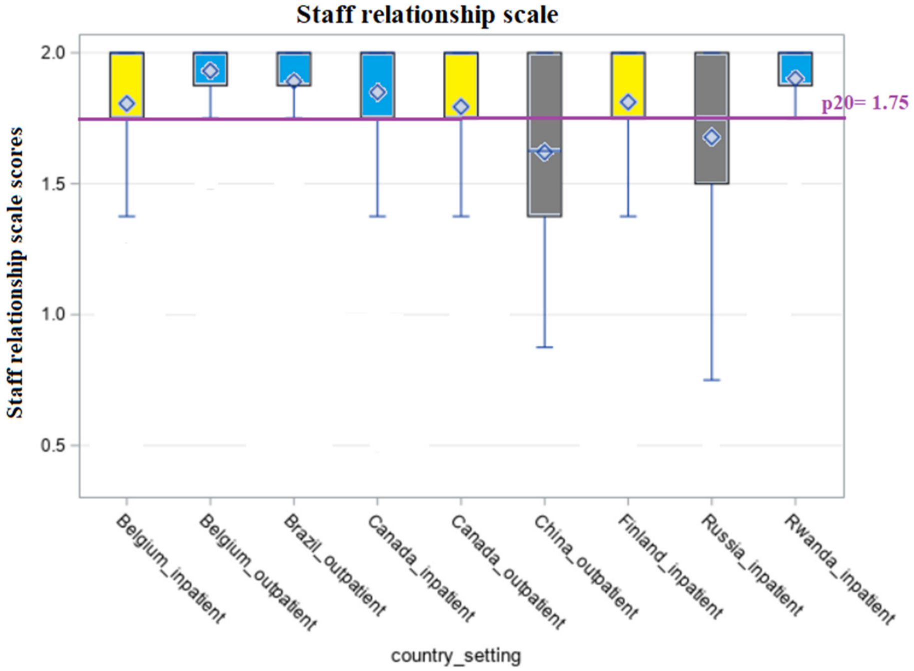

FIGURE 5 | Distribution of scores of the scale "Relationship with staff" across countries and settings.

significantly associated with each other in bivariate analysis (see **Supplementary Material – Table 1**) and in the adjusted logistic models, except for relationship with staff; meaning that each domain scale yielded significant odds ratios for the scores of the other scale. Higher scores in the scale of "support" for example, were associated with higher scores in the domain scale "relationships", "hope" and "activities". For the scale of relationship with staff, only the support and relationship domain scales showed a significant association.

The first model was constructed with the relationship domain scale as the dependent variable. The three other domain scales "support", "hope" and "activities" were significantly associated with this scale and especially the support scale showed a high odds ratio (OR = 4.50 CI = 3.32–6.12). The item "financial difficulties" had a significant and inverse association with relationship scores (OR = 0.53 CI = 0.38–0.73). The same significant and inverse association was found for the inpatient (OR = 0.11 CI = 0.04–0.26) and outpatient (OR = 0.11 CI = 0.05–0.24) settings when compared with the general community population. Both settings yielded similar odds ratios. Controlling for the countries, Belgium, Russia and Rwanda showed a significant inverse association with the relationship scale, showing more likely to have poorer scores in the relationship scale when compared with Finland.

The second logistic model had the support domain scale as dependent variable. The other domain scales "relationship", "hope" and "activities" were significantly associated with support. The item "work and education opportunities" showed a positive relationship with the support scale, as well as the item "satisfied with services", which had a high odds ratio (OR = 9.95 CI = 5.74–17.25). The inpatient setting showed an inverse and significant relationship with the score of the support scale, meaning that the inpatient setting was associated with lower scores for perceived support (OR = 0.52 CI = 0.31–0.85). Controlling for the countries, Brazil and China had a significant association with lower scores on the support scale, when compared with Finland, while Rwanda showed a positive significant association.

The logistic model for the hope domain scale yielded a positive and significant association for all other domain scales "relationship", "hope" and "activities" and for the item "work and education opportunities" (OR = 2.70 CI = 2.04–3.57). The item "financial difficulties" had a low odds ratio in the model (OR = 0.37 CI = 0.26–0.53), showing that financial problems were associated with lower scores in the hope scale. Controlling for the setting, inpatient and outpatient settings were both associated with lower scores for hope, when compared to the general community population. The countries Belgium, Canada and Russia were significantly associated with higher scores in the hope scale.

The fourth logistic model had the activities domain scale as dependent variable. Positive and significant associations were found for the domain scales "relationship", "hope" and "activities", as well as for the item "work and education opportunities" (OR = 1.34 CI = 1.05–1.72). Belgium, Canada and Rwanda were inversely associated with the scores of the activities scale, in comparison with Finland.

The fifth logistic regression model showed the associations for the domain scale "relationship with staff". Only the domain scales "support and "relationship" were significantly associated with the dependent variable. Controlling for the setting, inpatient care yielded an odds ratio of 0.43 (CI = 0.26–0.72) in comparison with the outpatient setting, representing an inverse association with the score of relationship with staff. China and Russia had low odds ratios, but Rwanda yielded a high odds ratio for the scale of relationship with staff (OR = 7.05 CI = 2.81–17.66).

DISCUSSION

This cross-country study showed benchmarking comparisons across settings and countries and pointed out some significant associations between items and the domain scales of the self-report interRAI SQoL-MHA tool. The results showed that positive QoL outcomes are achievable in all nations, including low resource nations like Rwanda.

The results from the logistic models showed significant associations between the scales of the SQoL-MHA instrument, as well as significant associations between some items of the instrument and these scales. The item "work and education opportunities" was significantly associated with the domain scales "support", "hope" and "activities". This is consistent with scientific literature, as mental health clients who are offered more opportunities to work or to receive an education, feel more empowered and have more feelings of hope and support (37, 38). According to Shepherd, *"employment provides not only an income, but improves social contacts and social support, status and identity, a means of structuring and occupying time and a sense of personal achievement"* (39). In addition, work makes daily life more fulfilling and leisure time more meaningful (40). Among several types of profiles of inpatient and outpatient mental health service users, competitive employment is often viewed by users as an important goal in their rehabilitation path (41–44).

Research from the OECD shows that unemployment rates are generally two times higher for people with a mental disorder compared to individuals without such a disorder (45). Moreover, the presence of a mental illness is associated with higher food insecurity and problems to afford adequate housing, as well as homelessness (46, 47). Our results showed that the perception of financial difficulties (item of the SQoL-MHA "financial trade-offs") was significantly and inversely associated with the domain scales "relationship" and "hope". This is consistent with literature as evidence shows that subjective feelings of financial hardship are associated with shame, self-stigma and hopelessness (48–50). In addition, subjective financial hardship tends to be more associated with mental health problems than objective financial hardship, emphasizing the importance of the assessment of subjective financial difficulties (48).

The item "satisfied with services" was significantly associated with the "support" scale. Literature shows associations between frustration with psychiatric services and an inadequate relationship with one's contact person (51). In addition, studies suggest the value of encouraging treatment relationships to develop into positive bonding, so that care users feel supported (52). Research also shows that satisfaction and positive feelings of wellbeing are associated with hope and optimism, as well as greater involvement in society and better relationships. According to Gallagher et al., hope and optimism also contribute positively to the components of social well-being (53). In addition, a high level of self-esteem combined with strong social support, has proven to make individuals less vulnerable to

TABLE 2 | Adjusted logistic models for the interRAI SQoL-MHA domain scales.

	Relationship			Support			Hope			Activities			Relationship with staff		
Determinants	**OR**	**CI−**	**CI+**	**OR**	**CI−**	**CI+**	**OR**	**CI−**	**CI+**	**OR**	**CI−**	**CI+**	**OR**	**CI−**	**CI+**
Support	4.50***	3.32	6.12	–	–	–	2.01***	1.48	2.73	1.88***	1.43	2.48	3.15***	2.25	4.41
Hope	3.16***	2.3	4.30	1.96***	1.45	2.65	–	–	–	3.94***	2.98	5.22	1.36	0.96	1.93
Activities	2.55***	1.91	3.41	1.93***	1.47	2.54	4.17***	3.14	5.54	–	–	–	0.98	0.70	1.37
Relationship	–	–	–	4.39***	3.22	5.96	3.17***	2.32	4.32	2.49***	1.87	3.31	2.53***	1.81	3.54
Financial difficulties	0.53**	0.38	0.73	0.99	0.75	1.34	0.37***	0.26	0.53	1.29	0.99	1.67	0.82	0.58	1.15
Work and education	1.17	0.87	1.57	1.32*	1.01	1.72	2.70***	2.04	3.57	1.34*	1.05	1.72	1.20	0.89	1.63
Satisfied with services	1.48	0.69	3.20	9.95***	5.74	17.25	1.33	0.62	2.87	1.11	0.62	2.00			
Settings (ref = general community)															
Outpatient	0.11**	0.04	0.26	0.86	0.44	1.68	0.21*	0.09	0.48	0.29***	0.17	0.52	(Ref = outpatient.)		
Inpatient	0.11***	0.05	0.24	0.52**	0.31	0.85	0.19**	0.09	0.39	0.59	0.39	1.00	0.43**	0.26	0.72
Countries (ref = Finland)															
Belgium	0.19**	0.08	0.50	1.79	0.84	3.82	2.17*	1.02	4.61	0.36*	0.16	0.81	1.72	0.88	3.37
Brazil	0.67	0.25	1.82	0.38*	0.16	0.87	1.52	0.66	3.53	0.56	0.23	1.35	1.85	0.83	4.13
Canada	0.45	0.18	1.16	1.07	0.51	2.26	2.61*	1.21	5.65	0.31**	0.13	0.69	1.23	0.63	2.41
China	0.38	0.12	1.23	0.34*	0.12	0.97	1.08	0.37	3.14	0.68	0.23	1.98	0.21**	0.08	0.57
Russia	0.05***	0.02	0.13	2.36	0.97	5.73	4.87**	1.85	12.84	0.81	0.31	2.12	0.33**	0.15	0.71
Rwanda	0.07***	0.03	0.18	4.42**	1.83	10.67	1.69	0.74	3.90	0.16***	0.07	0.39	7.05***	2.81	17.66
		$c = 0.88$			$c = 0.82$			$c = 0.88$			$c = 0.79$			$c = 0.77$	

$^{***}p < 0.0001$; $^{**}p < 0.01$; $^{*}p < 0.05$.

OR, Odds ratios; CI-,Lower confidence interval (95%); CI+, Upper confidence interval (95%); c, c-index for goodness of fit.

stressors, being associated with mental well-being, happiness, adjustment, success, academic achievements and satisfaction. It is also associated with better recovery after severe diseases (54).

In our study, the inpatient setting showed a significant inverse association for the domain scales "relationship", "hope", "support" and the scale "relationship with staff", when compared to the general community. For the domains "support", "hope" and "relationship with staff", the inpatient setting yielded lower scores than the outpatient setting. This means that the inpatient setting is associated with relatively lower (poorer) scores in these quality of life domains. To our knowledge, there is no scientific paper showing comparisons/benchmarking of inpatient and outpatient mental health using self-reported QoL measures. Numerous publications compare the user's characteristics or effectiveness of treatment in both settings (55–59), but they do not focus on self-reported QoL measures. An explanation for a poorer perception of "relationship with staff" in the inpatient setting may lie in the concept of expressed emotion. This means that in the inpatient setting, where users are in contact with staff often on a daily basis, professional caregivers may express more criticism and or hostility, or may express over involvement toward the client. In addition, in institutional settings, negative staff reactions may occur more often, as clients tend to have more difficult behaviors than those in outpatient settings (60). Without adequate training, this can lead to negative symptoms, worse functioning or clients' relapse, as well as professional caregivers' feelings of low personal accomplishment and frustration (61, 62). The scale of "support" showed an inverse association for the samples from Brazil and China and the scale of "relationship with staff" for the samples of Russia and China. The sample of Rwanda, however, showed high odds ratios for both these scales, meaning very high positive association with better scores in support and relationship with staff, when compared to Finland. In addition, the sample from Rwanda scored lower than Finland for the domain scales "relationship", as well as Belgium and Russia; and for the scale "activities," and so did Belgium and Canada. These results were also illustrated in the benchmarking graphs. This means that benchmarking of QoL measures is multifaceted, and samples can perform well in some indicators and poorer in others. To our knowledge, this is the first paper to compare inpatient and outpatient care in a cross-country sample. Although the samples are not representative for the countries, they give an indication of the possibilities for benchmarking using the interRAI SQoL-MHA instrument.

The study has some implications worth mentioning. In literature, the lack of studies comparing the QoL of users receiving services in different settings is striking. This can be due to low coordination between settings and the use of many different instruments to assess QoL. The interRAI SQoL-MHA instrument was developed to be used in different settings and, as it has been validated in several countries, can be applied to be used for benchmarking across settings and countries. Moreover, the associations between the scales and items from the SQoL-MHA tool point out the importance of psychosocial rehabilitation in order to reintegrate people with mental health illnesses into the work environment and the community. The item "financial difficulties" and "work and education opportunities" showed significant associations in several QoL domains. In practice, programs like Individual Placement and Support (IPS) proved to be an effective intervention across different settings and economic conditions, leading to competitive employment for people with mental health problems, when compared to traditional vocal rehabilitation. Since it first started in the U.S., it was later also implemented in Europe, Canada, and Australia (63–65).

Our study showed the opportunities offered by the interRAI self-reported Quality of Life instrument (interRAI SQoL-MHA) regarding research and practice, as a validated evidence-based instrument. This tool can be applied in different mental health care settings, in a standardized way, showing possibilities for comparison across countries and settings (benchmarking). Policy makers can view these results as a precedent for coordination across settings, and even countries, within the mental health care framework. Through the use of the same instrument for self-reported QoL, the study showed the possibilities for comparisons and benchmarking. Future research with larger and country representative datasets can provide relevant information to drive policy toward better quality of care and integration across settings. As care users often have a complex care pathway, it is essential to have an effective transfer of information, with the utilization of standard measures. The interRAI instruments offer this standardization, as well as enable evidence-based decision making. By combining the interRAI SQoL-MHA tool with the interRAI-MH or interRAI-CMH instruments, a comprehensive view of subjective quality of care and the objective aspects of care and care needs can be assessed.

STRENGTHS AND LIMITATIONS

The main limitation of the study is that the samples are not balanced and cannot be considered representative of the population of the countries involved, so results should not be generalized. However, as noted by Thompson and Forbes (66) estimates of association remain relatively robust even in highly biased samples. A major strength of the study is the application of the interRAI SQoL-MHA in different settings and countries, as the tool is standardized and has been validated to be used in different mental health care settings worldwide.

DATA AVAILABILITY STATEMENT

The dataset presented in this article are not readily available because the dataset is stored in the secured interRAI server. The dataset can only be available with permission from interRAI. Requests to access the dataset should be directed to prof. John Hirdes, hirdes@uwaterloo.ca.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Office of Research Ethics (ORE) at the University of Waterloo (ORE#13848, ORE#20863) for the Canadian, Finnish, Russian, and Hong Kong samples; Southlake

Regional Health Center Ethics Board (SRHC REB) (#0006-1819) for the Canadian transitional care sample; Ethical Committee Research from Centro Universitário São Lucas Ji-Paraná (CAAE 29517319.9.0000.5297) and Ethical Committee Research from Universidade Luterana do Brasil (CAAE 60213316.9.0000.5349) for the Brazilian sample; Ethical Committee Research of KU Leuven–University of Leuven (Belgium) (S61488) for the Belgian sample and University of Rwanda (No 071/CMHS IRB/2020) for the sample from Rwanda. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JdA, CV, JHe, HL, JPH, AH, BU, and MS prepared the concept and design of the study. JdA performed the statistical analysis, made the presentation of the results and wrote the manuscript. JdA, CV, JHe, HL, JPH, AH, BU, DG, and MS, discussed the results and made critical revisions to the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.719994/full#supplementary-material

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Costs and Savings Associated With the Police Use of the interRAI Brief Mental Health Screener

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Background: The police response to calls for service identified as being related to mental health continues to be highly controversial. Strategies to improve the police response include Crisis Intervention Team (CIT) training and various forms of co-response models neither of which have been subjected to comprehensive evaluations, particularly as to cost-efficiency. A new approach is the use of the interRAI Brief Mental Health Screener to enhance police officer ability to identify persons with serious mental disorders. The purpose of the current study is to evaluate the costs and cost efficiency of the police response to mental health calls using the interRAI Brief Mental Health Screener.

Method: Secondary data was analyzed from the use of the screener from 2018 to 2020 by police officers in a mid-sized Canadian city. Changes were measured in the overall number of interactions police officers had with persons with mental health disorders, the number of incidents where police officers referred the person to hospital, and the time officers remained in the emergency department.

Results: A total of 6,727 assessments were completed with involuntary referrals decreasing by 30%, and voluntary referrals by 34%. The overall time police officers were involved in involuntary referrals decreased from 123 min in 2018 to 113 min in 2020. The average emergency department wait time for voluntary referrals dropped from 41 min in 2018 to 27 min in 2020, while involuntary referrals decreased from 61 min in 2018 to 42 min in 2020. Each averted involuntary referral to the emergency department resulted in a savings of $81, on average during the study period.

Conclusion: An analysis of the costs and costs savings associated with the use of the screener demonstrate that it is a worthwhile investment for police services. An additional benefit is its ability to collect mental health statistics that may be useful to police leaders to justify budgets. Future studies should attempt to devise some method of collecting pre-implementation data that would reveal the true costs and cost-efficiency of using the BMHS, which have been shown to be significant in the current study however, undoubtedly are under-estimated.

Keywords: costs, resources, policing, mental, disorder

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INTRODUCTION

During the course of their duties, police officers interact with persons exhibiting a broad range of behaviors related to mental disorder from indicators of disordered thought alone to behaviors that may pose a risk of harm to themselves or to others. Public attention is often drawn to negative incidents such as those involving excessive use of force, and on the question of whether police officers receive sufficient training on mental health issues (1–8). Police officers themselves often feel ill-prepared for calls for service identified as being related to mental health (6, 7). Additionally, police leaders have voiced concern over how such calls are particularly resource-intensive and costly due to the number of officers involved, the overall length of the calls and the time and resources involved in transporting the person to hospital (9–14). Although considerable time, effort and public funds have been directed toward implementing new approaches to improve the overall police response to persons with serious mental disorders (PSMD), evaluating their overall effectiveness and cost-effectiveness has been problematic (15, 16).

Two major new approaches designed to help police better respond to PSMD involve providing additional training for frontline police officers and implementing co-responder models comprised of police officers and mental health professionals (15). One of the most popular models to enhance police training is the Crisis Intervention Team (CIT), where police officers volunteer to receive additional training on mental health issues (17, 18). The Co-Response Team (CRT) model, referred to as the Mobile Crisis Intervention Team (MCIT) in United States, Canada and Australia and "street triage" in the United Kingdom consists of a police officer paired with a mental health professional to respond to calls for service identified as being related to mental health (19–23). While the CIT model continues to be popular in the United States, Canada and Australia (17, 19), CRTs are currently the most prevalent model in the United Kingdom (22).

A third approach to improving the police response to PSMD is the Hub/Situation Table model based on the work of Scotland's Violence Reduction Unit and the Hub model introduced in Saskatchewan, Canada (15). Known as the Community Safety and Well-being movement, proponents of the model believe that calls for service such as those involving mental health, homelessness and substance abuse are largely social issues as opposed to criminal matters and therefore should not be the sole responsibility of police organizations. Instead, the responsibility should be shared with other community organizations that are better equipped to respond. The "Situation Tables" is where representatives of various community agencies meet to discuss the most appropriate intervention for person(s) identified as being at elevated risk (24). This sharing of responsibility would should therefore lead to better outcomes for those experiencing the problems while at the same time easing the demand on police and police resources (24–27). The Hub/Situation Table model continues to expand across Canada where over 100 communities have adopted it (15).

Although these models represent innovative attempts to improve the police response to PSMD, few formal studies exist that have evaluated either their effectiveness or cost effectiveness (15, 22). For example, the goals of CIT are to divert PSMDs away from the criminal justice system, enhance collaboration between police and community organizations, provide accessible mental health services and improve officer and client safety (15). Although the model has had some positive results such as improved officer attitudes and confidence in de-escalating encounters, there is controversy over whether the initial goal of enhancing officer and client safety has been achieved (17, 18, 28). The few studies examining the cost effectiveness of the CIT model suggest modest savings primarily through the reduction in the use of police custody and the number of persons taken to hospital (or place of safety) by police officers (28–30). Similarly, the few studies examining the cost effectiveness of CRT models suggest that police organizations have realized some savings primarily through the reduced time spent on calls and time spent waiting in hospitals (31–35). A meta-analytic study suggests that the CRT model produces a stronger overall impact than crisis intervention training alone however the authors of the study recommend more research is required (36, 37). As to the Hub/Situation Table model, although it continues to expand and mental health cases represent a large proportion of the cases, there are currently no independent, peer-reviewed studies to support its effectiveness or whether its use has resulted in lower costs to police agencies (15).

A more recent attempt at improving the response to PSMD is the interRAI Brief Mental Health Screener (BMHS), an evidence-based instrument used to help police officers identify serious mental health issues according to behaviors indicative of disordered thought and risk of harm to self or others as opposed to symptoms or diagnoses (38–40). Software built around the BMHS enables officers to complete the assessment on their cell phones and to measure, with a series of algorithms, the capacity of the person to care for themselves, and the level of risk of harm they pose to themselves or others (41) which is consistent with police apprehension authorities. For example, in Canada mental health legislation authorizes police officers to take apparently mentally disordered individuals into custody without prior judicial authorization where there is a fear for the life or safety of the person, or a fear they are a risk to cause harm to others (42).

Though no evaluative studies exist, the BMHS has a distinct advantage over other models in that in addition to its potential to improve officers' ability to recognize indicators of serious mental disorder, it can track calls for service identified as being related to mental health. A major impediment to evaluating the effectiveness and cost-effectiveness of the various models designed to improve the police response is the fact that police services typically do not collect data related to non-crime related calls for service such as those involving mental health, homelessness and substance abuse. From a police organization perspective, the ability to monitor police responses to PSMD in real time, and to track the number of officers and time involved in the call supports deployment and efficient use of resources and helps to estimate costs. Thus, the BMHS has the additional capability of providing a financial basis upon which to evaluate the police vs. alternative, diversionary responses, and the most efficient use of resources.

The growing budgetary constraints on police services, the mounting resource costs related to police responses to PSMD is a serious concern, and the cost-effectiveness of CRT, CIT, and Hub/Situation Table models of police response suggest little or no improvement or reduction in use of police resources. The current study represents one of the few research-based efforts to describe and evaluate the police response and use of resources related to calls for service that involve PSMD, making use of data collected with the BMHS in one mid-size police service in Canada.

MATERIALS AND METHODS

Setting

The setting for the study was Guelph, a mid-sized city in southwestern Ontario, Canada located 40 miles (65 kms) southwest of Toronto, Canada's most populous city. With a population of roughly 160,000, the city is served by one acute care hospital, one resident long term care hospital for complex medical, and rehabilitation services and one center for specialized psychiatric and addiction services. The study used data collected through the use of the BMHS by police officers of the Guelph Police Service, the 14th largest municipal police service in Ontario with 323 members. The site of the study was specifically chosen because, as one of the original pilot sites for the BMHS, its officers have had extensive experience using the instrument and there were several years of data that could be analyzed.

Data Collection Instrument

The BMHS is a short, 23-item, evidence-informed mental health screening assessment instrument currently used by over 40 police services in Canada and the USA (29). Developed through an international effort, the BMHS is used to help police officers identify persons with the greatest probability of falling into a high risk category based on indicators of risk of harm and disordered thought. A primary source of items on the BMHS is the RAI-MH, the mental health assessment system currently used across the province of Ontario whenever a patient is admitted into psychiatric care. The BMHS standardizes observations made by police officers and acts as a framework to enable officers to better articulate the grounds to believe a person has a serious mental disorder. Given the terminology used on the form is consistent with the RAI-MH, the language itself acts as common currency between the systems promoting better integration of systems and services.

Guelph city police officers received initial training on how to complete the BMHS, followed by additional training on how to use the accompanying software. They were instructed to complete the assessment on any member of the public who in the course of their duties, they had reason to believe had a mental health disorder. A software system (29) was built around the BMHS enabling police officers to digitally complete the BMHS assessment on a terminal located in their patrol cars at the scene of the incident. The software also calculates three clinically validated algorithms embedded in the BMHS for risk of harm to others, harm to self, and self-care (the criteria for police apprehension). Risk scores are tracked over subsequent interactions with police officers providing objective clinical feedback to help police officers decide on the most appropriate course of action. The risk scores do not dictate action but rather support a police officer's decision and can be used to justify a police apprehension when communicating with hospital staff. After completing the assessment, the police officer wirelessly transmits a summary of observations made at the scene of the incident to predetermined destinations which could include a hospital and any designated community mental health agencies. In this way, if the decision is made to transport the person to the ED, the hospital receives an early notification of incoming patients. If the assessment is sent to community agencies, it provides the information and consent (captured by the officer on scene) to initiate a follow up and provide counseling or support services if deemed appropriate.

Data

The software allows for digitized records of assessments to be securely stored in a databased at the Guelph police station and according to a research agreement with interRAI, all users of the BMHS must agree to forward de-identified data to the interRAI Canada data repository at the University of Waterloo where the investigators had access.

Analysis

The purpose of this analysis was to calculate cost savings over time that result from reductions in ED visits after implementation of the BMHS. To do this, using data collected through the BMHS, the total time of calls in minutes is compared between calls that resulted in an involuntary transport to the ED and the total time of calls that did not result in a transport to the ED. Next, the cost of the additional time associated with involuntary transports to the ED is calculated by using the hourly cost of police time (based on wages and benefits = \$54/h) and multiplying that cost by the additional number of minutes and the number of police officers that were involved with the call. For example, if there were two officers involved with the call and the involuntary trip to the ED added an extra hour to the call, the additional cost would be \$108 (1 h × 2 officers × \$54). This calculation is done for all 3 years combined (2018-2020). The total wait time in the ED is also calculated for each individual year to assess whether implementation of the BMHS reduces ED wait times from year to year.

Next, the proportion of all mental health related calls that resulted in (1) an involuntary transport to the ED; (2) a voluntary transport to the ED; and (3) no transport to the ED is calculated. As with the cost analysis, this calculation is done for all 3 years combined as well as for each of the 3 years after implementation of the BMHS. Additionally, the percent change in the proportion of mental health calls with each of these three outcomes from 2018 to 2020 is calculated.

RESULTS

Typical of the majority of police services, data collected by the service is almost exclusively crime-related which is used as a basis for estimating police budgets. Police services therefore, generally do not collect data specific to non-crime related incidents and

TABLE 1 | ED referrals compared to no ED referrals by year.

Action	2018 *N*(%)	2019 *N*(%)	2020 *N*(%)	Total 2018-2020 *N*(%)	% Change 2018-2020
ED referrals	481 (25.4)	468 (19.4)	331 (13.6)	1,280 (19.0)	−31.2%
No ED referrals	1,412 (74.6)	1,941 (80.6)	2,094 (86.4)	5,447 (81.0)	48.3%
Total calls	1,893 (100)	2,409 (100)	2,425 (100)	6,727 (100)	28.1%

TABLE 2 | Involuntary ED referrals compared to Voluntary referrals by year.

ED referrals	2018 *N* (%)	2019 *N* (%)	2020 *N* (%)	% Change over time 2018-2020
Involuntary	326	314	228	−30.1%
	67.8	67.1	68.9	
Voluntary	155	154	103	−33.5%
	32.2	32.9	31.1	
Total	481	468	331	−31.2%
	100	100	100	

in particular, calls for service identified as being related to mental health. References to mental health calls will appear in a police database but will be vastly under-estimated because most references to mental health issues are subsumed under the crime-related activity that is being reported. Thus, there was no existing pre-BMHS implementation data meaning that the analysis for the current study focused on changes in successive years the BMHS was used.

During the study period extending from January 18, 2018 to December 31, 2020, there were a total of 6,727 BMHS assessments (calls for service) completed by Guelph police officers (see **Table 1**). The total number of calls for service identified as being related to mental health increased by 28.1% over the study period from 1,898 in 2018 to 2,425 in 2020. A total of 1,280 (19.0%) involved a trip to the ED while 5,447 (81%) did not result in an ED referral. Referrals to the ED decreased 31.2% from 481 (25.4%) in 2018 to 331 (13.6%) in 2020 while the number of incidents where there were no ED referrals increased by 48.3% from 1,412 (74.6%) in 2018 to 2,094 (76.4%) in 2020.

Police officer referrals to the ED were further subdivided into voluntary and involuntary. Voluntary referrals to the ED involved situations where the PSMD voluntarily agreed to accompany the police officer to the ED whereas involuntary referrals were those where a police officers used their legislative authority to apprehend and transport a PSMD to the ED for the purposes of a psychiatric examination. For the 3-year period of the study, of those persons taken to the ED, 868 (67.8%) were involuntary referrals or apprehensions and 412 (32.2%) voluntarily agreed to accompany police officers to the ED (see **Table 2**). Involuntary referrals decreased by 30.1% from 326 in 2018, to 228 in 2020, and voluntary referrals decreased by 33.5% from 155 in 2018 to 103 in 2020.

TABLE 3 | Average call times (minutes): Involuntary referrals vs. No referral.

Action	2018 (SD)	2019 (SD)	2020 (SD)
Involuntary ED referral	123 (72.1)	110 (55.9)	113 (51.9)
No ED referral	80 (81.4)	79 (72.6)	82 (70.5)

TABLE 4 | Average time (minutes) and cost per call: Involuntary referral vs. No ED referral.

Action	Average time/call (minutes) (SD)	Average cost/call (SD)
Involuntary ED referral $N = 868$	116 (61.4)	$215 ($165)
No ED referral $N = 5,447$	81 (74.1)	$134 ($155)
Difference	35 (96)	$81 ($226)

TABLE 5 | Average hospital ED Wait Times (minutes): Voluntary vs. involuntary referrals.

Action	2018	2019	2020
Involuntary ED referral	61 (52.0)	50 (48.7)	42 (24.4)
Voluntary ED referral	41 (40.7)	33 (24.8)	27 (22.5)
Total ED referrals	54 (49.5)	45 (43.2)	37 (24.8)

When comparing the average time police officers devoted to involuntary referrals to the ED compared to no referrals to the ED, the time spent on involuntary referrals decreased from 123 min in 2018 to 113 min in 2020 (see **Table 3**). There was a very slight increase in time devoted to calls where there was no trip to the ED from 80 min in 2018 to 82 min in 2020. As to the time police officers were required to remain in the ED, the average wait time for voluntary referrals dropped from 41 min in 2018 to 27 min in 2020, while involuntary referrals also saw a drop from 61 min in 2018 to 42 min in 2020.

To calculate the cost of calls for service identified as being related to mental health, service calls were broken down into minutes and multiplied by the number of attending police officers and then multiplied by the salary of a first class constable which was $54.24/h or $0.90/min. Thus, the average time per call for an involuntary referral was 116 min factoring in the number of police officers at 2.6 involved which cost on average $215 per call compared to an average of 81 min where no hospital referral was involved which cost an average of $134 per call. Thus, the difference between involuntary referrals to the ED and No ED referrals was an average of 35 min at an average of $81 per call (see **Table 4**). In regard to the time police officers had to remain in the hospital, there was a decrease in time (minutes) over the study period for both involuntary and voluntary referrals. For involuntary referrals, police officers waited 42 min in the ED in 2020 down from 61 min in 2018 and for voluntary referrals 27 min in 2020 from 41 min in 2018 (see **Table 5**).

DISCUSSION

The purpose of the current study was to evaluate the costs and cost efficiency of the police response to calls for service identified as being related to mental health using the BMHS. The number of such calls for service increased by almost 30% over the study period which could be explained by the fact that police officers were increasingly more aware of indicators of mental health problems and in completing the BMHS. As to ED referrals, fewer persons were taken to the ED over the study period with an overall decrease of just over 30% and a decrease of 30% for involuntary referrals which may be due to officers having a more informed understanding of when to apprehend PSMDs. In other words, with the use of the BMHS, the police are now better able to determine when an ED visit is needed and when it is not needed. Also, further analysis would be needed to determine is the lower number of referrals to the ED is related to increased activity of the CRT which commenced activity in 2015.

An unfortunate limitation of the current study is the lack of baseline pre-implementation data that results from the fact that police services generally do not collect non-crime related data. Therefore, only decreases in ED referrals over time after implementation of the BMHS could be assessed. Because the largest decreases in ED referrals are likely to take place immediately after implementation of the BMHS, this study likely greatly understates the actual cost savings achieved by implementing the BMHS. Even so, this study still demonstrated significant reductions in ED referrals. The lower number of ED referrals may be related to the fact that identification practices may have changed over the period of observation that in turn led to fewer ED referrals and lowered costs. That is, with the implementation of the BMHS, police officers were required to complete the BMHS on all persons exhibiting indicators of mental health issues, some serious and some not as serious. The increase mental health calls could be the result of an increase in the number of BMHS assessments completed on persons exhibiting less serious indicators who in the past would have been ignored by police officers. With an increase in cases (or BMHS assessments being completed), the percentage of persons taken to the ED would naturally decrease with a corresponding decrease in associated costs. However, this assumes that increases in identification occurred from the first year of implementation of the BMHS onward, as increased identification from pre-BMHS to the first year of implementation cannot be assessed because pre-BMHS data on MH visits is not available.

Another limitation was the inability to determine from the data the proportion of persons taken to the ED who were subsequently admitted into psychiatric care. A higher proportion of admissions could support the argument that the BMHS enables police officers to identify the most appropriate persons to be taken to the ED which should result in a decrease in overall time officers are involved in ED referrals and less time spent in the ED, both of which should lead to cost-savings. Finally, a more general limitation of the study is the lack of a control group which would may have identified other factors influencing the results such as changes within the police service, community, or world (e.g., COVID-19) could have impacted or caused the findings.

An additional benefit of using the BMHS, is its ability to collect such statistics that police leaders can use to justify their budgets. This is the first study that examined specific costs associated with the use of a novel strategy to improve the police response to calls for service identified as being related to mental health. This analysis of the costs savings associated with the use of the BMHS helps to demonstrate that implementing the BMHS is a worthwhile investment for police services As was noted in a recent study involving the BMHS, the successful implementation of any form of new technology is problematic, and requires training and familiarity with the instrument (43). However, the BMHS shows great promise in predicting which calls evidence potentially serious mental health issues, and may require admission at the ED. As more and more police services in Canada and now the US implement the BMHS, and as the instrument continues to be developed and refined, it is anticipated that police officers, hospitals and community agencies will become increasingly familiar and comfortable in using the BMHS to support decision making, with the goal of improving outcomes. Although this analysis demonstrates that cost savings are achieved with continued use of the BMHS, the actual cost savings accrued from implementation of the BMHS are undoubtedly larger. Future studies should attempt to devise some method of collecting pre-implementation data so that the true cost savings of using the BMHS can be calculated. Police services could also consider the use of the BMHS in conjunction with the other models discussed in this paper as it may be possible to more accurately evaluate their effectiveness and cost-effectiveness with more accurate data pertaining to the number of calls for service related to mental health.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the dataset analyzed for this study can be found in the Canadian repository for interRAI Canada at the University of Waterloo, Waterloo, Ontario, Canada. Only interRAI Fellows have access to the data. Requests to access the datasets should be directed to https://uwaterloo.ca/interrai-canada/.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Nipissing University Research Ethics Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

RH coordinated the project and wrote the draft of the manuscript and along with GB formulated the research questions. JH and HK were responsible for the data analysis, creating the charts and tables, and assisting in framing the research questions. All authors approved the submitted version of the work.

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The Forensic Supplement to the interRAI Mental Health Assessment Instrument: Evaluation and Validation of the Problem Behavior Scale

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Background: Numerous validation studies support the use of the interRAI Mental Health (MH) assessment system for inpatient mental health assessment, triage, treatment planning, and outcome measurement. However, there have been suggestions that the interRAI MH does not include sufficient content relevant to forensic mental health. We address this potential deficiency through the development of a Forensic Supplement (FS) to the interRAI MH system. Using three forensic risk assessment instruments (PCL-R; HCR-20; VRAG) that had a record of independent cross validation in the forensic literature, we identified forensic content domains that were missing in the interRAI MH. We then independently developed items to provide forensic coverage. The resulting FS is a single-page, 19-item supplementary document that can be scored along with the interRAI MH, adding approximately 10–15 min to administration time.

We constructed the Problem Behavior Scale (PBS) using 11 items from the interRAI MH and FS. The Developmental Sample, 168 forensic mental health inpatients from two large mental health specialty hospitals, was assessed with both an earlier version of the interRAI MH and FS. This sample also provided us access to scores on the PCL-R, the HCR-20 and the VRAG. To validate our initial findings, we sought additional samples where scoring of the interRAI MH and the FS had been done. The first, the Forensic Sample ($N = 587$), consisted of forensic inpatients in other mental health units/hospitals. The second, the Correctional Sample ($N = 618$) was a random, representative sample of inmates in prisons, and the third, the Youth Sample ($N = 90$) comprised a group of youth in police custody.

Results: The PBS ranged from 0 to 11, was positively skewed with most scores below 3, and had good internal consistency (Cronbach's Alpha = 0.80). In a test of concurrent validity, correlations between PBS scores and forensic risk scores were moderate to high (i.e., r with PCL-R Factor two of 0.317; with HCR-20 Clinical of 0.46; and with HCR-20 Risk of 0.39). In a test of convergent validity, we used Binary Logistic Regression to demonstrate that the PBS was related to three negative patient experiences (recent verbal abuse, use of a seclusion room, and failure to attain an unaccompanied leave). For each of these three samples, we conducted the same convergent validity statistical analyses as we had for the Developmental Sample and the earlier findings were replicated. Finally, we examined the relationship between PBS scores and care planning triggers, part of the interRAI systems Clinical Assessment Protocols (CAPs). In all three validity samples, the PBS was significantly related to the following CAPs being triggered: Harm to Others, Interpersonal Conflict, Traumatic Life Events, and Control Interventions. These additional validations generalize our findings across age groups (adult, youth) and across health care and correctional settings.

Conclusions: The FS improves the interRAI MH's ability to identify risk for negative patient experiences and assess clinical needs in hospitalized/incarcerated forensic patients. These results generalize across age groups and across health care and correctional settings.

Keywords: risk assessment, forensic mental health, restraints, seclusion, coercive interventions, control procedures, patient safety

BACKGROUND

The most important problem faced by mental health professionals in a forensic inpatient environment is the ever-present threat to personal safety. Interpersonal violence by psychotic or personality-disordered patients necessitates staff use of coercive interventions to prevent serious injuries for both staff and patients. Therefore, comprehensive assessments of forensic patients must include an appraisal of their risk for violence while in hospital and their likely need for coercive intervention. The interRAI MH purports to be a comprehensive assessment for inpatient psychiatry. Nevertheless, there have been concerns raised in forensic mental health settings that, while the interRAI MH provides good coverage of content domains pertinent to general mental health issues, there are content domains relevant to forensic mental health that are not sufficiently covered. interRAI convened a task group to examine this issue and concluded that additional item content was needed to address forensic risk. Accordingly, as described in this article, we set out to devise a set of relevant items to be contained in a Forensic Supplement (FS) to the interRAI MH.

In addition, the present article describes our development of a scale, the Problem Behavior Scale (PBS), designed to predict negative outcomes experienced by forensic mental health patients in hospital. Specifically, the negative outcomes include interpersonal violence (perpetrated by the forensic inpatient) and the coercive interventions engaged in by staff to control the violent or potentially violent patient. Coercive interventions include: (1) environmental restraint, more commonly referred to as seclusion, (2) physical/mechanical restraint, and (3) chemical restraint (1). The issue of coercive interventions in mental health is fraught, with many perceiving these as an infringement of basic human rights and a threat to the therapeutic relationship, and others arguing that these interventions are necessary to ensure safety for staff and other patients. Our article does not directly address the appropriateness of coercive interventions. Rather, we attempt to develop an instrument to be incorporated into the interRAI MH system, to assess patients at admission to hospital to predict their need for coercive interventions. With a risk framework in place, it may be feasible to employ appropriate early interventions and de-escalation strategies to prevent the use of coercive interventions in some instances.

The article describes our study with two parts. In the first, we use a sample of forensic mental health patients to develop the PBS, including a preliminary evaluation of its reliability and validity. In the second, we sought to cross-validate this instrument with a second larger sample of forensic mental health patients and, using additional samples, to generalize the findings to other forensic settings, specifically adult prisons, and youth custody settings. For the prison sample, we analyzed data originally collected in a large study of prison inmates in Michigan (2). For the youth sample, we used data originally collected in a study of youth detained in Ontario, Canada (3).

Patient and Staff Safety in Inpatient Mental Health

A systematic review of literature (4) on patient safety in mental health inpatient settings found 364 high-quality articles, including publications from over 31 countries, and involving over 150,000 inpatients. These studies focused on ten aspects of patient safety, and the top two concerns were interpersonal violence (116 articles) and coercive interventions (98 articles). When patients engage in violent behavior on a psychiatric ward, staff are required to control that behavior, and to reduce risk to other patients and staff. Coercive control techniques involve the use of physical restraints or seclusion and are used to prevent the individual from further violence. Coercive control techniques can be used effectively to control violence, but they have negative side effects for patients and staff. Patients in long-term restraints can suffer serious health effects including embolism leading to death. According to the Substance Abuse and Mental Health Services

Administration (5), between 50 and 150 patients die each year in the US. Patients in seclusion can suffer long term, serious, and permanent psychological effects. Staff restraining or secluding a violent patient are also at risk of serious physical harm.

A meta-analysis of the world's literature (6) estimated the prevalence of violence among psychiatric inpatients. Their study included 122 surveys of psychiatric units around the world, including 12 countries and a total of 69,249 patients. The hospital units included acute care, forensic, and mixed units in mental health specialty hospitals. They estimated that 32.4% of psychiatric inpatients had been violent at least once while in hospital. They report that prevalence is much higher among forensic inpatients (47.7%) than acute care patients (26.2%) or general psychiatric patients (22.1%). These differences were even more significant when they compared incidence rates. Forensic units had an incident rate per 100 admissions of 406, while rates on acute care units (49) and general psychiatric units (39) were much lower.

A systematic review and meta-analysis (7) examined the use of risk assessment instruments used to predict violence while detained in forensic psychiatric hospitals. It identified the nine instruments most frequently used to assess violence risk, then conducted a systematic search of five international databases to identify studies examining the predictive accuracy of those tools in forensic inpatient settings. The authors identified risk assessment instruments designed for the prediction of short-term (within 24 h) risk for violence, and those designed for a longer-term prediction (i.e., weeks, months). This meta-analysis included data on 78 individual samples involving a total of 6,840 patients. The median AUC value was higher for short-term tools (AUC of 0.83) compared with longer-term tools (AUC of 0.68). The short-term tools were the *Broset Violence Checklist* (BVC) (8) and the *Dynamic Appraisal of Situational Aggression* (DASA) (9). Most samples assessed the performance of the *HCR-20* (10) (27 studies) and the *PCL-R* (11) (10 studies). These two instruments used for long term prediction performed moderately for the prediction of inpatient violence with median AUCs of 0.70 and 0.64, respectively.

The interRAI MH

The interRAI MH is an assessment system for persons hospitalized with mental health issues, to improve care-planning by the identification of problems, risks, and strengths of the patient (12–14). It is completed by front line clinical staff at each patient's admission to hospital (within the first 3 days in hospital), discharge from hospital, and every quarter (every 3 months) for long-stay patients. Its 460 items cover a broad range of content areas relevant to health, mental health, hospital care, social supports, and use of support services. Scale scores derived from interRAI MH items measure critically important areas of functioning of the mental health inpatient. An earlier version of the interRAI MH [known as the Resident Assessment Instrument –Mental Health (RAI-MH)] was mandated by the Ministry of Health and Long-Term Care for use in all mental health inpatient facilities in the Province of Ontario and has been in use in mental health inpatient settings in Ontario since 1999, initially as a research instrument, but increasingly as part of clinical practice. The interRAI MH has numerous advantages, including that it has received extensive psychometric development and evaluation (12, 15–19).

An additional advantage of the interRAI MH is the availability of Clinical Assessment Protocols (20). These assist the clinician in planning effective clinical interventions to ensure improved outcomes for patients (21–23). interRAI has designed 21 CAPs, divided into five clinically meaningful categories (safety, social life, economic issues, autonomy, and health promotion). Once an interRAI MH assessment has been completed, CAPs are "triggered" for an individual patient based on algorithms operating on the assessment data. Many of the algorithms utilize one or more of 15 clinical scales (e.g., Cognitive Performance, Depression Rating, Mania, Positive Symptoms, etc.) derived from interRAI MH raw data. For example, the Harm to Others CAP (16) is triggered for a patient when the Risk of Harm to Others (RHO) Scale is above a set trigger level. The RHO scale is an empirically validated scale based on a history of violence, positive symptoms, insight, delusions, among other factors. Then, depending on which CAPs have been triggered, the associated guidelines provide the clinician with helpful resources to assist with care planning, identifying relevant evidence-based practices, advice to ensure safety, and recommendations for choosing appropriate outcome measures. Individual patients may have multiple CAPs triggered, resulting in a care plan with multiple goals and objectives. Incorporation of risk assessment capacity in the interRAI MH responds to the need for risk information upon admission to hospital since the interRAI MH assessment is done within 3 days of admission to hospital.

There are many items and scales contained in the interRAI MH that are importantly related to forensic mental health, including the Aggressive Behavior Scale (24) and the aforementioned RHO scale. Additional relevant CAPs include Criminal Activity, Interpersonal Conflict, and Control Interventions (20). Previous research has used the interRAI MH to examine the needs of forensic patients (25, 26), however, we pursued the development of the FS in response to expressed need for additional forensic risk content in this system. Hirdes et al. (14) reviewed the vast literature on the interRAI MH and argued convincingly that the instrument represented a comprehensive and integrated assessment of the mentally ill person in a variety of inpatient and outpatient hospital settings, as well as for individuals in the community being assessed for mental illness (e.g., courts, police). These authors provided strong evidence that the interRAI MH provided clinical teams with the required information to plan treatment and evaluate outcomes in a variety of clinical settings. There were only two areas where the instrument was thought to provide incomplete information, namely forensic and addictions settings. Hirdes et al. state that two supplements to the interRAI MH were being developed to provide additional information on problem severity, readiness for change, health symptoms associated with substance abuse and static and dynamic forensic risk factors. The present report is the second published study based on data collected using the Forensic Supplement (FS) (25).

Use of the Term "Forensic"

In this article, we will be using the term "forensic" in two different ways: one general and one specific. Generally, a forensic patient is thought of a person with a mental disorder who is concurrently involved in the criminal justice system. For example, an outpatient receiving mental health services in the community may also be facing charges for a criminal offense. In the specific sense, different jurisdictions specify hospital patients as "forensic." In Canada, hospital patients are designated as "Not Criminally Responsible" (NCR), or "Unfit to Stand Trial" or they are sent to hospital by the courts for forensic assessment. Our first two samples, the Developmental Sample and the Forensic Sample are "forensic" in the specific sense. They have been found NCR or Unfit by the courts and hospitalized for treatment or are detained in hospital by an order of the court for an assessment. Our other two samples, the Correctional Sample and the Youth Sample are "forensic" in the general sense.

METHODS

Participants

The Developmental sample consisted of 168 mentally ill patients in medium and maximum secure forensic mental health inpatient units at two Ontario mental health facilities. The assessment was the RAI-MH (i.e., the earlier version of the interRAI MH) and a trial version of the Forensic Supplement with a detailed manual with instructions for scoring and training at each of the sites. These data also included participant scores on three risk assessment instruments that had a record of independent cross validation in forensic populations, namely: The Psychopathy Checklist-Revised (PCL-R) (11, 27, 28), The History, Clinical, Risk-20 (HCR-20) (10), and the Violence Risk Appraisal Guide (VRAG) (29). For the Developmental Sample, we collected: 109 VRAGs, 114 PCL-Rs, and 70 HCR-20s and used these data to develop the PBS and test for concurrent validity.

In addition, to provide for an evaluation of FS coding reliability, for 33 of these assessments, an independent second FS assessment was performed by a hospital Psychometrist based entirely on the hospital charts and records. These data were used to test FS item reliability.

Three separate samples were also used to validate the PBS, and to test its generalizability to other forensic populations. The first, the Forensic Sample, was a sample of 587 unique mental health patients across four forensic units/hospitals in Ontario. The second was a Correctional Sample consisting of a stratified, random, representative sample of mental health assessments in Michigan prisons (2). Prisoners were randomly sampled based on four strata: males in the general population, males in administrative segregation, males in special units, and females. A total of 618 incarcerated subjects were assessed using the interRAI Correctional Facilities Instrument which consisted of both interRAI MH and FS items. The final validity sample, our "Youth" sample, consisted of 90 youth between the ages of 16 and 18 in detention or custody in Ontario who consented to participate. This sample was a subset of a large sample ($N = 755$) of youth (Mean age = 16.75, SD = 0.81), 47% male, divided into three groups: inpatient and outpatient mental health, and in custody. The inpatient and outpatients were referred from 22 mental health agencies in Ontario, and the in-custody sample were referred from 10 secure custody sites across Ontario (3, 30). The interRAI instrument used for data collection with this sample was the interRAI Youth Justice Custodial Facilities Instrument (31), which is based on the interRAI Child and Youth Mental Health assessment system (32) and certain items have considerable overlap with items (with identical wording) in the interRAI MH.

Research Ethics Approval

Research on the Developmental and the Forensic Samples was approved by the REBs at the following institutions: the University of Waterloo, Waypoint Center for Mental Health Care, The Center for Addiction and Mental Health.

Research on the Michigan correctional sample was approved by the institutional Review Boards of the University of Michigan, the Michigan Public Health Institute, and the Michigan Department of Community Health.

Ethics approval for the Youth Justice Sample was provided by the University of Toronto, the Center for Addiction and Mental Health, the University of Western Ontario, the Ministry of Children and Youth Services (MCYS) Judicial Review, MCYS's internal ethics review and two facilities requiring separate ethics protocols. To be deemed competent, youth were required to understand the foreseeable risks, potential benefits, as well as the consequences of participating in the research study.

Procedure

We started our work examining the three risk assessment instruments – the PCL-R, HCR-20, and VRAG– to identify item domains that were missing from the interRAI MH. From the PCL-R, most of items contained in Factors 1-3 from the PCL-R's Four Factor Model [Hare (11), pg. 83] were missing. There were item domains missing from the HCR-20 and VRAG as well, including the development of antisociality, antisocial attitudes and failure on prior supervised release.

Then, we wrote items to capture forensic risk content according to the traditional interRAI item format paying particular attention to respecting the intellectual property rights of the original forensic instrument developers. The supplement itself was designed to add only one page to the current interRAI MH and an additional 5–10 min to the administration time.

A section on Mental State Indicators included: remorseless; impulsive; inappropriately blames others for problems; denies or minimizes harm done to others; and expressions supportive of criminal activity. A section on social relations included: manipulative; lacks empathy; and takes advantage of others. Other additions included: age at first police intervention for criminal activity; severity of crime; victims were women or children; use of a weapon; early behavior problems; and failure to comply with conditions of any release. Additional items included: issues relating to resources for discharge such as: understands and identifies sources of stress; enacts appropriate strategies; and unrealistic plans. With respect to juvenile delinquency, items added included: removed from home before age 18; and antisocial peer group.

Analytic Approach

To develop the Problem Behavior Scale, we chose 11 items from the FS and interRAI MH that represented item domains figuring prominently on the three risk assessment instruments cited above (VRAG, PCL-R, and HCR-20). To ensure that each item contributed equally to the scale, all the multi-level items were recoded into dichotomies representing "Present "or "Not Present." Then the item scores were added together to form a scale with total scale scores ranging from 0 to 11. We then conducted separate Binary Logistic Regression Analyses using the PBS scale to evaluate relations with patient experiences in the care setting (verbal abuse, use of restraints, seclusion, etc.) For each the Wald Statistic was tested for significance. In addition, we conducted a Receiver Operating Characteristic Analysis (ROC), again using the PBS score to predict hospital experiences. AUCs are reported in **Table 4**.

Computer Programs

Analyses of the Developmental and Youth Samples were performed using IBM SPSS Statistics Package, Version 25; analysis of the Correctional sample data was performed using SAS, Version 9.4 and of the Forensic Sample, SAS Version 9.3.

RESULTS

Participants

Developmental Sample

The mean age of the sample was 41 years of age. There were 146 (96%) males; 146 (92%) were English speaking; 104 (88%) were never married. With respect to education, 22 (14%) had grade eight or less, 76 (49%) had some high school, 35 (22%) had graduated high school, and 16 (10%) had at least some postsecondary education. For the remainder, education was minimal or not known.

Forensic Sample

The mean age of the sample was 41 years of age. There were 482 (83%) males and 100 (17%) females 0.540 (93%) were English speaking 0.429 (73%) were never married, 74 (13%) were married or had a live-in partner, and the remainder were separated/divorced/widowed. With respect to education: 36 (6%) had no schooling, 62 (11%) had grade eight or less, 127 (22%) had some high school, 114 (20%) had graduated high school, and 99 (17%) had at least some postsecondary education. For the remainder, education level was not known.

Correctional Sample

A total of 618 inmate participants were recruited and interviewed. An additional 262 inmates were approached by correctional staff but either declined to be interviewed or refused to give consent. Two interviews were stopped halfway when it was deemed that the subject was incompetent to provide useful information. Of all prisoners, 78% were between the ages of 20 and 50 years; median and modal age was between 30 and 39 years 0.96% were male and half were black with only a slightly smaller % white. Over half the sample had less than a high school level education.

Youth Sample

The sample ($N = 90$) was an in-custody subset of a larger sample ($N = 755$) of youth aged 16–19 years of age, involved in criminal justice and mental health facilities in Ontario, Canada. The in-custody participants were referred from 10 secure custody sites across the Province of Ontario. The average (mean) age was 17.24 years (SD = 0.89) and 77% of the sample was male.

Reliability of the Forensic Supplement and Problem Behavior Scale Items

FS Coding Reliability

Table 1 presents the results of the reliability study of the FS items. Items were divided into six categories listed in column one in the table. Both the mean category reliabilities and those of individual items were all acceptable, with many achieving excellent reliability. We used Cohen's categorization of Kappa's (33) that he suggests be interpreted as follows: values ≤ 0 as indicating no agreement, 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41–0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as excellent. Overall, using the smaller sample ($N = 33$), the 11 items that are utilized in the PBS (remorseless, impulsive, inappropriately blames others, denies, or minimizes harm, expressions supportive of criminal activity, manipulative, lacks empathy, takes advantage of others, inflated self worth, irritability, and anger) have a Cronbach's Alpha of 0.84. We view these measures of reliability as estimates of the lower bounds of overall interrater reliability, as one of the raters only had partial information (e.g., no access to direct observation, team meetings, etc.).

Characteristics and Psychometrics of the PBS Scale

Concurrent Validity

Table 2 presents intercorrelations among the risk assessment instruments scores and correlations between the PBS score and risk assessment scores. The shaded area in the table presents the three intercorrelations among the risk assessment scores. These correlations were remarkably high and range between 0.52 and 0.76, as one would expect from three validated risk instruments. The top row of the table presents the correlations between the PBS score and the various risk assessment scores. These range from 0.26 to 0.46. These correlations are moderately high and reflect a reasonable-to-high degree of concurrent validity.

Endorsement of PBS Items

The rate of endorsement of PBS items is shown in **Figure 1** and ranged from 6 to 70% over the 11 items. Rates in the Developmental and Forensic samples were similar. The rate of endorsement of the 11 items ranged from 5% (for "inappropriately blames others") in the Developmental sample, to 33% (for "irritability") in the Forensic sample. The other two samples showed a different pattern across these 11 items. For example, in the Correctional Sample, the rates for "manipulative," "lacks empathy," and "anger" were at least half those in the two hospital-based samples. Similarly, in the Youth Sample, the endorsement rate for "Impulsive"

TABLE 1 | Interrater reliability for items on the Forensic Supplement to the RAI=MH.

Item category	# of items	Mean % agreement	Mean kappa	Nominal reliability
Mental state indicators	5	67	0.55	4 moderate,1 substantial
Criminal involvement	7	82	0.56	3 moderate, 3 substantial, 1 excellent
Behavior	2	94	0.87	1 substantial, 1 excellent
Life events	1	81	0.67	1 substantial, 1 excellent
Social relations	4	83	0.63	2 moderate, 2 substantial
Resources for discharge	2	91	0.66	2 substantial

was seen over three times more frequently than in the hospital samples. Endorsements ranged from 5% for the item "takes advantage of others," to 36% for the items "impulsive" and "irritability." However, for the Youth Sample, rates of endorsement for these items were much higher. The lowest endorsement rate was 23% for the item "remorseless" and the highest endorsement rate is 70% for the item "impulsive." At least in terms of item endorsement, the youth sample was different from the adult sample in having a higher rate of endorsement of PBS items. These differences were reflected as well in the overall scale values with the Youth sample demonstrating higher values overall, including a higher mean (3.6 compared with >2.3 for the other three samples, see ANOVA results below).

Distributional Properties

As can be seen from **Figure 2**, the distributions were positively skewed; for all four samples, the mean scores were numerically higher than the median scores. In the Developmental Sample, the 90th percentile was reached at score five of 11, the mean score was 2.15 and the median score was 1.90. Only 10% of the Developmental Sample had scores above five and the number of scores for each of the remaining scores decreased to score 11. The three validity samples, like the Developmental sample, had positively skewed distributions. For example, for the Forensic Sample, the 90th percentile was reached at score 6, and the mean was 2.34 and the median was 2.03. Similarly, for the Correctional Sample, the 90th percentile was reached at score five on the PBS, the mean score was 2.04 and the median was 1.18. However, the youth sample was somewhat different, in terms of the mean PBS score and in the shape of the distribution. The mean score was 3.63 and the median was 1.96. The distribution of scores did not reach the 90th percentile until the PBS score of 9. This sample distribution showed less Kurtosis than the other three distributions with more of the sample scoring higher numbers on the scale.

It is apparent that that the Youth Sample had higher PBS scores than the other samples. A One-way Analysis of Variance shows that the means differed significantly [Mean Scale Values: Developmental 2.20, Forensic 2.34, Correctional 2.00, Youth 3.60, $F_{(3, 1435)} = 12.78$, $p < 001$]. Tukey's Honestly Significant Difference (HSD) test found an HSD of 0.397 indicating that the mean PBS score of the youth group was significantly higher than the other means, and that there were no significant differences among the other three means.

TABLE 2 | Inter-correlations among risk instrument scores and correlations between PBS scores and each risk score.

	PBS	VRAG	PCL-R	HCR-20	HCR-20 Clinical	HCR-20 Risk
PBS	XXX	0.278 **	0.260 **	0.370**	0.461**	0.386**
VRAG		XXX	0.764***	0.545***		
PCL-R			XXX	0.517***		
HCR-20				XXX		

**$p < 0.01$.

***$p < 0.001$.

Internal Consistency

We calculated the internal consistency of the PBS using Cronbach's Alpha, and these are presented in **Table 3**. For the Developmental sample, internal consistency was strong at 0.80. The three validation samples showed similar Alphas (0.81, 0.70, and 0.88 for the Forensic, Correctional, and Youth samples, respectively).

Validation of the PBS

PBS Related to Negative Hospital Outcomes

Table 4 presents data and outcomes from our evaluation of the PBS's ability to predict negative outcomes in hospital. The first column in the table lists negative outcomes. We used binary logistic regression to analyze the relationship between PBS scores and various hospital outcomes. The results of the logistic regressions are tabulated in **Table 4**. In addition, we calculated a ROC analysis, and AUC values are presented for each finding in the text. In the Developmental sample, we found three outcomes where the PBS score predicted outcomes: "verbal abuse" (AUC = 0.79, CI 0.70–0.88, $p < 0.0001$, "seclusion" (AUC = 0.77, CI 0.63–0.91, $p < 0.0001$), and "unaccompanied leave" (AUC = 0.75, CI 0.66–0.84, $p < 0.001$). Note that higher PBS scores were associated with increased "verbal abuse" and the use of "seclusion," whereas lower PBS scores were associated with increased unaccompanied leave). In terms of validation, "verbal abuse" was found to be significantly predicted in all three validity samples. In the Developmental sample, prediction of "physical and manual restraint" was not significant, but it was significantly predicted by the PBS in the Forensic Sample.

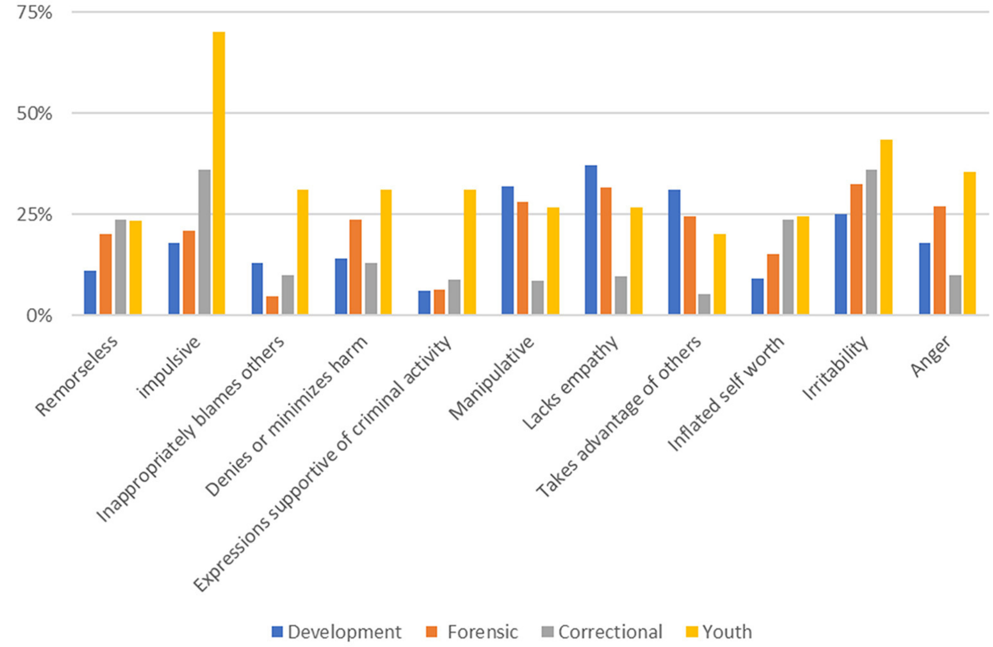

FIGURE 1 | Rates of endorsement of PBS items in four study samples.

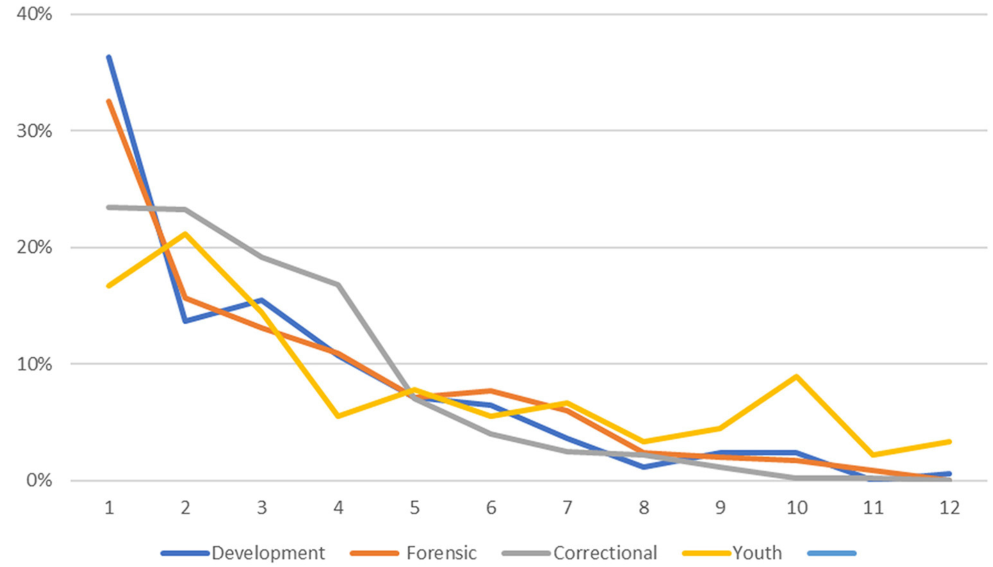

FIGURE 2 | Frequency histogram of PBS score values for four study samples.

"Seclusion" was significantly predicted in the Developmental and Forensic Samples (AUC = 0.79, CI 0.74–0.83, $p < 0.0001$ and AUC = 0.77, CI 0.63–0.91, respectively). The equivalent negative outcomes in corrections, "confinement to unit" (AUC = 0.63, CI 0.57–0.68, $p < 0.0001$), and "segregation" (AUC = 0.69, CI 0.64–0.73, $p < 0.0001$) were significantly predicted in the Correctional Sample. The Youth Sample showed no replication of "seclusion," however, in the Youth Sample, the PBS was predictive of "intimidation" (AUC = 0.67, CI 0.56–0.79, $p < 0.01$), "verbal abuse" (AUC = 0.93, CI 0.89–0.98, $p < 0.0001$) and "resists care" (AUC = 0.78, CI 0.63–0.92, $p < 0.0001$).

PBS Related to CAPS Triggered

Finally, **Table 5** describes our statistical analyses and outcomes in our prediction of Clinical Assessment Protocols (CAPs)

TABLE 3 | Internal consistency of the problem behavior scale (PBS) items (Coefficient Alpha with item deleted).

Samples	Developmental sample	Forensic sample	Correctional sample	Youth sample
Item				
Remorseless	0.78	0.80	0.68	0.86
impulsive	0.80	0.80	0.70	0.88
Inappropriately blames others	0.78	0.82	0.69	0.86
Denies or minimizes harm	0.77	0.79	0.66	0.86
Expressions supportive of criminal activity	0.79	0.81	0.69	0.87
Manipulative	0.78	0.79	0.66	0.87
Lacks empathy	0.78	0.79	0.65	0.86
Takes advantage of others	0.79	0.79	0.67	0.87
Inflated self worth	0.79	0.81	0.71	0.86
Irritability	0.80	0.80	0.72	0.87
Anger	0.80	0.80	0.69	0.87
Coefficient Alpha	0.80	0.81	0.70	0.88
			Average Alpha =	0.80

TABLE 4 | Convergent validity of the Problem Behavior Scale (PBS).

Negative outcomes	Outcome			Logistic regression				AUC analysis		
	N	%	B	SE	OR (CI 95%)	Wald	*P*	AUC	CI 95%	*P*
Developmental sample	168									
Verbal abuse		8.3	0.34	0.1	1.41 (1.16–1.71)	12.07	<0.001	0.79	0.70–0.88	<0.0001
Seclusion		7.1	0.34	0.1	1.4 (1.15–1.73)	11	<0.001	0.77	0.63–0.91	<0.0001
Unaccompanied leave		18.5	−0.64	0.18	0.53 (0.37–0.75)	12.41	<0.001	0.75	0.66–0.84	<0.001
Physical/Manual Restraint		4.8	0.128	0.128	1.14 (0.88–1.46)	0.999	0.317	0.36	0.20–0.52	ns
Forensic Sample	587									
Verbal Abuse		15.0	2.24	0.22	9.40(6.09–14.53)	101.97	<0.0001	0.86	0.84–0.88	<0.0001
Seclusion		5.1	1.07	0.33	2.91(1.53–5.55)	10.52	<0.001	0.79	0.74–0.83	<0.0001
Unaccompanied leave		16.4	−0.72	0.2	0.48 (0.32–0.72)	12.62	<0.001	0.61	0.58–0.63	<0.0001
Physical /Manual Restraint		4.8	1.94	0.35	6.97 (3.53–13.76)	31.26	<0.0001	0.8	0.75–0.84	<0.0001
Correctional sample	618									
Intimidation		17.7	0.3378	0.0542	1.40 (1.26–1.55)	38.77	<0.0001	0.72	0.66–0.76	<0.0001
Verbal abuse		23.3	0.5586	0.06	1.75 (1.55–1.97)	84.2375	<0.0001	0.77	0.73–0.82	<0.0001
Resists care		4.2	0.4643	0.0872	1.59 (1.34–1.89)	28.32	<0.0001	0.76	0.65–0.87	<0.0001
Physical/manual restraint		1.2	0.25	0.16	1.28 (0.94–1.76)	2.42	ns	0.73	0.58–0.88	0.0033
Unit confinement		20.6	0.2	0.05	1.22 (1.10–1.34)	14.71	<0.001	0.63	0.57–0.68	<0.0001
Segregation		29.4	0.37	0.05	1.45 (1.31–1.60)	52.21	<0.0001	0.69	0.64–0.73	<0.0001
Youth sample	90									
Intimidation		41.1	0.17	0.07	1.19 (1.04–1.36)	6.45	<0.02	0.67	0.56–0.79	<0.01
Verbal abuse		45.6	0.94	0.19	2.55 (1.75–3.71)	23.57	<0.001	0.93	0.89–0.98	<0.0001
Resists care		10.0	0.28	0.11	1.33 (1.07–1.64)	6.85	<0.01	0.78	0.63–0.92	<0.0001

being triggered. We used binary logistic regression to examine the relationship between PBS scores and CAPs according to rules laid out for each CAP in the CAPs manual see Hirdes et al. (20). For all three validity samples, CAPs predicted by the PBS were "Harm to Others," "Interpersonal Conflict," "Traumatic Llife Events," and "Control Interventions." Adult participants in forensic mental health care in Ontario, in jail in Michigan, and youth in custody in Ontario, who score higher on the PBS were more likely to "trigger" the same four clinical assessment protocols.

DISCUSSION

The interRAI MH is a "comprehensive standardized instrument for evaluating the needs, strengths and preferences of adults with mental illness in in-patient psychiatric settings" [(34), p.

TABLE 5 | Relationship of problem behavior scale to RAI-MH clinical assessment protocols (CAPs).

Validation samples	Clincal assessment protocols	Cap triggered		Logistic regression				
		N	**%**	**B**	**SE**	**OR (CI 96%)**	**Wald**	***P***
Forensic Sample		587						
	harm to others		39.76	0.97	0.11	2.64 (2.132–3.268)	79.35	<0.0001
	interpersonal conflict		50.94	1.34	0.11	3.82 (3.081–4.741)	148.58	<0.0001
	traumatic life events		11.75	0.26	0.15	1.301 (0.975–1.737)	3.19	ns
	control interventions		18.23	0.94	0.12	2.561 (2.021–3.246)	60.48	<0.0001
Correctional Sample		618						
	Harm to others		43.12	0.48	0.06	1.62 (1.44–1.82)	69.50	<0.0001
	Interpersonal conflict		61.04	0.96	0.09	2.60 (2.18–3.11)	112.95	<0.0001
	Traumatic life events		39.93	0.17	0.05	1.18 (1.08–1.30)	13.96	0.0002
	Control interventions		29.37	0.37	0.05	1.45 (1.30–1.60)	47.97	<0.0001
Youth Sample		90						
	Harm to others		48.90	0.20	0.05	1.26 (1.09–1.45)	15.54	<0.0001
	Interpersonal conflict		72.20	0.30	0.09	1.42 (1.14–1.77)	11.17	<0.0001
	Traumatic life events		56.70	0.22	0.06	1.26 (1.08–1.46)	12.00	<0.001
	Control interventions		34.40	0.16	0.06	1.15 (1.01–1.32)	8.90	<0.001

2–4]. It covers a broad range of content areas including mental health, health, hospital care and social supports. Completed by front-line clinical staff at admission, discharge and quarterly for longer-term patients, the RAI-MH provides for frequent assessment and monitoring of patients. In response to calls from forensic mental health settings to develop additional content domains that address the symptoms, behaviors and needs unique to these settings, the Forensic Supplement (FS) was developed in an Ontario Pilot Study. Based on and validated against other forensic risk assessment instruments, the FS is a short, 19-item instrument completed by front-line clinical staff. In a pilot study, the FS demonstrated an acceptable level of coding reliability.

Patient and staff safety is a special concern in mental health settings. Interpersonal violence and use of coercive interventions have been identified as the two most important safety concerns (4). These "negative outcomes" of mental health care can lead to serious physical injury for patients and staff and other negative health and psychological effects for patients stemming from the use of coercive interventions or seclusion. Combining items from the RAI-MH and the FS, a Problem Behavior Scale (PBS) was developed to assess patient risk for these negative outcomes while in a forensic mental health setting.

Comprised of eleven items, three from the RAI-MH and eight from the FS, the PBS demonstrated excellent overall scale reliability and moderately high correlation of risk scores with the VRAG, PCL-R and HCR-20 instruments, demonstrating good concurrent validity in a developmental sample. In validation of the PBS with the Forensic mental health sample, the Michigan State correctional validation sample and the Ontario Youth Custody validation sample, good internal consistency was demonstrated. The PBS significantly predicted negative outcomes in the Developmental Sample (verbal abuse, seclusion, unaccompanied leave), in the Forensic Sample (verbal abuse, seclusion, unaccompanied leave, physical/manual constraint), the Correctional Sample (intimidation, verbal abuse, resists care, unit confinement, segregation) and the Youth Sample (intimidation, verbal abuse, resists care). In addition, the PBS significantly predicted the triggering of four CAPS already included in the RAI-MH, including Harms to Others, Interpersonal Conflict, Control Interventions, and Traumatic Life Events.

The PBS demonstrated strong convergent validity for negative outcomes across a variety of forensic settings, including mental health, a state prison population, and youth in secure custody. Among the Youth in Custody, the endorsement of PBS items, internal consistency, and distribution of scores on the PBS was especially strong, a consequence of the historical significant decline in the number of youths sentenced to secure custody in Ontario, with a relatively small number of predominantly high-risk males aged 16 or 17 convicted of serious violent offenses now held in custody (35, 36).

The PBS accurately predicted scores on four related negative outcome CAPS included in the RAI-MH, suggesting that the combined use of the FS and RAI-MH items and calculation of the PBS may have utility as a risk assessment instrument for interpersonal violence and use of coercive interventions even in general mental health care settings, including youth, and in emergency care settings. At the same time, inclusion of the 11 items comprising the PBS on admissions screening instruments in adult and youth correctional settings shows promise for early intervention to prevent negative outcomes even in these settings.

The PBS was fashioned after forensic mental health risk scales, so the fact that individuals with higher PBS scores are more likely to trigger the Harm to Others CAP is no surprise. As we discussed in the introduction, control interventions (restraints, seclusion) are regularly used to control patients who are escalating in threatening and violent behavior, so the fact that participants with higher PBS scores are more likely to trigger the Control

Intervention CAP is also not surprising. It also makes sense that the PBS scale predicts the triggering of the Interpersonal Conflict CAP, especially after reviewing the items contained on the instrument. The triggering of the Trauma cap is not so obvious. It is true that the experience of being restrained or secluded may be traumatic. However, there is evidence that these patients have experienced trauma prior to hospitalization. According to Stewart et al., (3) the justice-involved youth in our Youth Sample, compared with both inpatient and outpatient mental health groups, had significantly higher rates of exposure to five potentially traumatic events: parental abandonment, death in the family, failing educational program, being a victim of a crime, and living in a violent community. These findings are consistent with previous literature (37, 38). One of the most oft cited interventions implemented in hospitals to reduce the use of restraints and seclusion is referred to as "Trauma Informed Care (5)." Zarse et al. (39) reviewed a large empirical literature based on data acquired using the Adverse Childhood Experiences Questionnaire. They concluded that exposure to various adverse childhood experiences accumulate in their effects increasing the risk for a wide array of causally interlinked mental illnesses, addictions, and multi-organ medical diseases. Clinical teams, following advice contained in the CAPs, will engage in evidence-based treatments to reduce the factors that lead to these negative outcomes.

CONCLUSIONS

We began this article with a discussion of the two most significant threats facing forensic mental health patients in hospital, namely interpersonal violence, and coercive interventions by staff. We have come to view these two features as a dyad (one thing with two parts; Cambridge English Dictionary). An illustrative scenario will demonstrate what we mean by this.

A male forensic patient has been recently admitted to the hospital unit. Shortly after, a staff member makes a request or gives a direction, and the patient takes exception. He begins to argue with the staff member and the argument escalates to verbal abuse. Staff begin to worry that the verbal abuse will escalate to violence. Staff attempt de-escalation techniques, but to little effect. At that point in time, the staff have a choice to make; To seclude or not. If they seclude in time, they may prevent a violent outburst and related staff and patient injuries. If they wait, the patient may escalate to violence, at which time seclusion is more difficult to effect.

So, whether an event such as this is recorded as an incident of violence, or a seclusion depends heavily on decision making by staff. Obviously, this decision making cannot be predicted through an assessment of the forensic patient.

Our research findings, described in this article, suggest that a risk assessment instrument written in interRAI MH format, and based on predominant forensic risk assessment instruments, is predictive of coercive interventions (seclusion in hospital and segregation in corrections). High priority future research should use a longitudinal design to assess predictive validity of the PBS. In addition, future research on the evaluation of risk assessment instruments used to predict negative outcomes in hospital should regard the dependent measure as interpersonal violence and/or coercive interventions. Doing so should increase predictive accuracy of such instruments.

The use of the PBS should never obviate or discourage the use of traditional forensic risk assessments. The VRAG, PCL-R and HCR-20 are currently used by credentialled forensic psychologists or psychiatrists, often in preparation for presentation and cross examination of risk assessment testimony where courts or review boards are considering the liberty interests of an accused person. These assessments require a detailed review of the patient's criminal history, police reports, court, and hospital records. Forensic risk assessments are based on an individual's record of lifetime behavior and experiences. These assessments often take several days to complete, and because of waiting lists and shortages of professional staff, results are often not available to program clinical staff for months. In contrast, the interRAI MH and FS can be completed at intake based on up to 3 days of behavioral observation by psychiatric nursing staff. Therefore, scientifically sound evidence relevant to patient safety might be used to manage the patient's clinical needs immediately. We are not suggesting that the interRAI MH and FS replace traditional risk instruments or become the sole tool for forensic decision-making. However, they can allow for the immediate implementation of preventive care planning and intervention to reduce need for coercive approaches at the beginning of an episode of care. Nevertheless, the traditional instruments are required for formal risk assessments and the communication of a diagnosis (e.g., psychopathy, personality disorder) essential for a comprehensive forensic assessment.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the youth data are not to be disclosed under any circumstances according to the REB approvals for that data set. Requests to access the datasets should be directed to Howardbarbaree@gmail.com.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the REBs at the following institutions: The University of Waterloo, Waypoint Centre for Mental Health Care, the Centre for Addiction and Mental Health, the University of Michigan, the Michigan Public Health Institute, the Michigan Department of Community Health, the University of Toronto, the Centre for Addiction and Mental Health, the University of Western Ontario, and the Ministry of Children and Youth Services (MCYS). Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

HB was responsible for first drafts of much of the manuscript, overall coordination of author's contributions including data analysis and manuscript drafting and editing. KM was responsible for data collection and analysis of the Forensic Sample and provided comments on earlier drafts. BF was responsible for data collection and analysis of the Correctional Sample, and he took major responsibility for editing and rewriting sections of the manuscript. GB wrote a first draft of the Discussion and provided comments on earlier drafts of the manuscript. SS was responsible for data collection and analysis of the Youth Sample and has provided comments on earlier versions of the manuscript. EH was responsible for data collection and analysis of the Developmental Sample and proofed and edited earlier drafts of the manuscript. JH provided critical comment on the manuscript as a whole and made crucial suggestions regarding the manuscript's Background. All authors contributed to the article and approved the submitted version.

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Determinants of Non-emergency Use of Control Interventions in Older Canadian Psychiatric Inpatients: Analysizing the InterRAI Mental Health Electronic Health Records

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Background: The use of control interventions (CIs; acute control medications, physical/mechanical restraint) is associated with negative physical and psychological outcomes, particularly in older adults who are physically vulnerable. The aims of this study were to: (i) report the rates of CI use in older psychiatric inpatients (age 65 – 84 and age 85+), and compare them with younger age groups (18 – 44, age 45 – 64); and (ii) identify the factors associated with non-emergency CI use in older psychiatric inpatients.

Methods: Routinely collected interRAI Mental Health assessments from 2005 – 2018 in Ontario, Canada, were analyzed to determine the rates of CI use. Logistic regression models were used to examine the sociodemographic and clinical determinants of non-emergency and any CI use.

Results: There were 226,119 (female: 48.6%) interRAI assessments, and 85% of those assessed were under 65 years of age. The rates of non-emergency CI use in the four age groups were: 18 – 44 = 9.4%, 45 – 64 = 8.3%, 65 – 84 = 9.9%, 85+ = 13.2%. The most significant determinants of non-emergency CI use in older adults were highest impairments in activities of daily living (ADL Short Form score 8–16: OR = 2.72, 95% CI = 2.42 – 3.06), highest levels of aggression (Aggressive Behavior Scale score 4 – 6: OR = 1.76, 95% CI = 1.57 – 1.98), and highest levels of positive psychotic symptoms (Positive Symptoms Scale score 9+: OR = 1.65, 95% CI = 1.43 – 1.90). Delirium, cognitive disorder diagnosis, cognitive impairment, and falls were also associated with increased CI use odds, as were having the reasons for admission be danger to self, danger to others or inability to care for self. Females were less likely to have non-emergency CI use (OR = 0.84, 95% CI = 0.73 – 0.95). Patients admitted from long-term care homes had significantly greater odds of non-emergency CI use compared with community admissions (OR = 1.18; 95% CI = 1.07 – 1.29).

Conclusion: The higher rates of non-emergency CI use in older psychiatric inpatients is concerning. Alternative non-pharmacological and person-centered management

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strategies should be considered to support older psychiatric inpatients with functional impairment, positive symptoms, aggressive behavior, cognitive impairment and delirium. The use of CIs could be incorporated as a quality improvement activity to monitor changes at various service provision levels.

Keywords: control interventions, geriatric psychiatry, restraints, aggression, delirium

INTRODUCTION

Control interventions (CIs) are often used as a last resort to maintain the safety of behaviorally disturbed psychiatric patients. These interventions include the use of acute control medications, mechanical restraints, chair that prevents rising, physical/manual restraint by staff and seclusion room. In addition to the management of aggression, physical restraints have been used in behaviorally disturbed older adults to carry out medical regimens and to prevent disruption of tubes and dressings, wandering and falls (1–3). Similar rationales for restraint use in a psychogeriatric inpatient unit that were previously reported include prevention of injury to patients, maintenance of treatment regimens, prevention of disturbance to other people, and protecting patients from harm (4). In psychiatry, reported risk factors most frequently associated with the use of coercive measures are male gender, young adult age, foreign ethnicity, schizophrenia, involuntary admission, aggression or trying to abscond and the presence of male staff (5). There is also evidence in the literature to suggest cognitive impairment and dementia are associated with restraint use in various clinical settings including nursing homes, medical wards and psychogeriatric inpatient units (3, 6–9).

The debate on balancing this form of control and possibly coercive treatment against patient autonomy is ongoing. A recent systematic review found the prevalence of restraint use with psychiatric inpatients was between 4 and 20% (5); whereas its prevalence ranged from 33 to 68% in general hospitals (10). While historical rates as high as 64% have been reported for nursing homes, the use of physical restraints and inappropriate use of antipsychotics has dropped precipitously in nursing homes as a result of widespread quality improvement (11, 12). National rates of physical restraint use in Canadian nursing homes are now below 5% (13). The rates of CI use vary a great deal between psychiatric units, regions and countries (14, 15). For example, the mean episodes of physical restraint in a 2-year period, adjusted for bed numbers and occupancy rates, were between 0 and 59.1% in five psychogeriatric admission wards in Victoria, Australia (12).

The use of CIs is associated with many negative physical and psychological outcomes, particularly in older adults who are physically vulnerable. These include falls, pressure injuries, depression, aggression, deep vein thrombosis/pulmonary embolism, longer length of hospital stay and death (2, 7, 16–18). A survey of Finnish psychiatric inpatients aged between 18 and 65 years found that patients were unsatisfied with their overall treatment following physical restraint or seclusion (19). In Canada, practice standards state that nurses should employ multi-dimensional and inter-disciplinary strategies to minimize use of restraints in all care settings (20).

Research on restraint practice in psychiatric services for older adults has received little attention (7). The interRAI Mental Health (interRAI MH) is a comprehensive standardized instrument for evaluating the needs, strengths and preferences of adults with mental illness in inpatient psychiatric settings (21). It provides an assessment of key domains of function, mental and physical health, substance use/behaviors, social support and service use. This present study used a large dataset of routinely collected interRAI MH assessments from 2005 – 2018 in Ontario, Canada. Although falls risk is considered to be one of the main risk factors associated with the use of physical and mechanical restraint in nursing homes, hospitals, and home care (2), none of the 49 studies included in a recent systematic review of restraint use in psychiatry included falls as a risk factor in their investigation (5). The use of interRAI MH in our study allowed an investigation of sociodemographic, physical, falls, cognitive, functional, and psychosocial factors associated with the use of CIs.

The aims of this study were to: (i) report the rates of emergency and non-emergency use of CIs in older psychiatric inpatients (age 65 – 84 and age 85+) and compare them with younger age groups (18 – 44, age 45 – 64); and (ii) identify factors associated with non-emergency use of CIs in psychiatric inpatients aged 65 and over. The emergency use of CIs could be justified to prevent harms in acute or emergency clinical situations, however, non-emergency use of CIs warrants further examination. A better understanding of the determinants of non-emergency use of CIs could potentially identify people who are at risk of being subjected to unnecessary coercive measures. Emergency and non-emergency CI use are differentiated in care planning guidelines associated with interRAI's suite of mental health instruments; (22, 23) and restraint use can be benchmarked as a mental health quality indicator using these instruments (24).

METHODS

Setting and Participants

The study sample includes psychiatric inpatients (aged 18+) with completed interRAI MH admission assessments[1] between the last quarter of 2005 and the first quarter of 2018 in Ontario, Canada. The study sample was stratified into four age groups: age 18 – 44, age 45 – 64, age 65 – 84 and age 85+. Beginning in 2005, an

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[1] Note in Ontario, an earlier version of the interRAI MH known as the Resident Assessment Instrument Mental Health (RAI-MH) is used. The interRAI MH replaced the RAI-MH as the international standard in 2007.

interRAI MH assessment is routinely required for each patient within 72 h of admission, at discharge and every 90 days for longer stays by all Ontario psychiatric inpatient hospitals and units. There were 82,411 discharges from 74 psychiatric hospitals and psychiatry units located in general hospitals in Ontario in 2018 (25).

Ethics approval was obtained through the Office of Research at the University of Waterloo (ORE # 30372 and #15436).

The interRAI MH assessment is designed for use by mental health professionals such as nurses, social workers, psychiatrists, psychologists and occupational therapists (21). The assessment process involves clinical consideration of multiple sources of data including communication with the person, the primary support person and other members of the clinical team, observation of the person, review of medical records and other relevant documents (21, 22, 26, 27). All items include standardized definitions, statements of intent, coding guidelines, and illustrative examples to be used by assessors. There are 21 sections in the interRAI MH Assessment Form which includes the domains of intake and initial history, mental state indicators, substance use, harm to self and others, behavior, cognition, functional status, communication, and vision, health conditions, stress and trauma, medications, service utilization and treatments, nutritional status, social relations, employment, education, and finances.

Outcome and Independent Variables

A number of clinical outcome scales and Clinical Assessment Protocols (CAPs) are embedded in the interRAI MH assessment (28). CAPs are used to identify specific clinical conditions or situations to help and inform care plans. In emergency situations, the CI CAP is triggered when a person who (i) has experienced a physical restraint (mechanical, chair prevents rising, or physical or manual restraint by staff), seclusion or acute control medications in the 3 days prior to the assessment; and (ii) was in a psychiatric emergency situation, as indicated by one or more of the following: suicide attempt in the 3 days prior to the assessment, violence toward others in the 3 days prior to the assessment, score of 13 or higher on the long version of the interRAI Positive Symptoms Scale, extreme behavior disturbance in the 7 days prior to the assessment, command hallucinations in the 3 days prior to the assessment, and Aggressive Behavior Scale score of six or higher (28). In non-emergency situations, the CI CAP is triggered when a person who has experienced restraints, seclusions, or acute control medications use in the 3 days prior to the assessment but were not in a psychiatric emergency situation as described above, or has had a long-term history of ongoing restraint use, perhaps in another care setting (28).

The following independent variables and scales listed below were chosen based on the existing literature on CI summarized elsewhere (29).

Clinical and Sociodemographic Variables

Age, gender, ethnicity, marital status, reasons for admission, admission source, legal admission status, capacity to consent to treatment, legal guardian/substitute decision-maker, Diagnostic and Statistical Manual of Mental Disorders-IV diagnosis and past mental health admission.

Clinical Outcome Scales and CAPs

A summary of available CAPs and scales for the interRAI mental health instruments is provided elsewhere (22, 24). Those considered in the current study include: Activities of Daily Living (ADL) Short Form, Aggressive Behavior Scale, Risk of Harm to Others Scale, Severity of Self-harm, Self-care Index, Cognitive Performance Scale, Depressive Severity Index, Positive Symptoms Scale, Falls CAP (28).

ADL Short Form – provides a summary measure of the person's ability to perform ADLs based on four items: personal hygiene, toilet use, locomotion and eating. The scale has a range of 0 – 16, with higher values indicating greater difficulty in performing activities.

Aggressive Behavior Scale – measures the frequency and diversity of aggressive behaviors including verbal abuse, physical abuse, socially inappropriate behavior, disruptive behavior, and resisting care. Scores range from 0 to 12, with higher scores indicating greater frequency and diversity of aggressive behavior (0 = no signs of aggression; 1 – 4 = mild to moderate aggression; 5 + = more severe aggression).

Risk of Harm to Others – reflects risk of harm to others with scores range from 0 to 6 (higher scores indicate increased risk of harm to others).

Severity of Self-harm – reflects risk of harm to self with scores range from 0 to 6 (higher scores indicate increased risk to self-harm).

Self-care Index – reflects risk of inability to care for self due to psychiatric symptoms with scores range from 0 to 6 (higher scores indicate decreased ability to care for self).

Cognitive Performance Scale – describes the person's cognitive status and scores ranged from 0 to 6 (0 = intact; one = borderline intact; two = mild impairment; three = moderate impairment; four = moderate to severe impairment; five = severe impairment, six = very severe impairment).

Depressive Severity Index – is a measure for depressive symptoms with higher scores indicating more depressive symptoms (scores range from 0 to 15).

Positive Symptoms Scale (Long Form) – measures the frequency of positive psychotic symptoms such as hallucinations, delusions, abnormal thought process, inflated self-worth, hyperarousal, pressured speech and abnormal/unusual movements. Scores range from 0 to 24 with higher scores indicating higher levels of positive symptoms.

Falls CAP – is triggered when the person has had one of more prior falls.

Statistical Analysis

Data were analyzed using the Statistical Analysis Service (SAS) 9.4 software. Descriptive statistics for clinical and sociodemographic variables were obtained for the four age groups. Bivariate analysis with chi-squared tests was used to investigate the significance of the relationships between independent clinical and sociodemographic variables and non-emergency CI use (dependent variable) in older psychiatric inpatients (age 65+). All independent variables that proved to be statistically significantly ($p < 0.05$) in the bivariate analysis were entered into logistic regression models predicting non-emergency use of CIs as well as any of CIs. We also included assessment year as a covariate in the models. Results are presented as odds ratios (OR, with 95% confidence intervals, CI) which should be interpreted as the effect that an independent variable has on the odds of CI use. C-statistics were used to provide information on the explanatory power of the models.

As described earlier, the non-emergency situation CI CAP is triggered when a person was not in a psychiatric emergency or has had a long-term history of restraint use in another care setting. The Aggressive Behavior Scale (score $\leq$5) and Positive Symptoms Scale (score $\leq$12) are considered in the definitions of non-psychiatric emergency situations being in the lower range of the scales. However, we included these two scales as independent variables because there may still be predictive value using these scales despite their distributions being attenuated based on the CAP coding rules.

RESULTS

A total of 226,119 unique adults aged 18+ were assessed at admission with the interRAI MH during the study period, and about 85% of those assessed were under 65 years of age (n = 191,402 under 65 compared with 34,717 aged 65 years or more). About half the sample (48.6%) was female (n = 109,981). **Table 1** provides a profile of the use of CIs, clinical attributes, and sociodemographic characteristics of the sample divided into four age groupings (young adults aged 18 – 44: n = 114,976; middle-aged adults aged 45 – 64: n = 76,426; older adults aged 65 – 84: n = 30,138; oldest-old adults aged 85+: n = 4,579).

The rates of CI use showed a slight curvilinear pattern in the four age groups with rates dropping off slightly from young adults to middle-aged adults, followed by steady increments of use in the two oldest adult groups. Rates were more than doubled from a low of 6.4% in middle-aged adults to a high of 15.1% in the oldest-old for emergency use of CI. Similarly, the rates of non-emergency use of CIs were lowest in the middle-aged group (8.3%) and highest in the oldest-old (13.2%).

Acute control medications were the most commonly used CI in all age groups, and they followed the abovementioned trend in age differences. Use of seclusion rooms was most prevalent among young adults; however, mechanical restraints, chairs that prevent rising, and physical/manual restraint by staff were all most likely used with the oldest-old inpatients.

Compared with other age groups, the oldest-old were most likely to be female, admitted due to inability of care for self or danger to others, admitted from a long term care facility, incapable of providing consent, have a legal guardian/substitute decision-maker. However, they were also most likely to not have had a prior mental health admission.

In terms of clinical characteristics, the older age categories were associated with more severe levels of risk of harm to others, aggressive behavior, problems with self-care, falls, cognitive impairment, and ADL impairment. On the other hand, older age groups tended to have lower or comparable scores for self-harm, depressive symptoms and positive psychotic symptoms compared with younger age groups.

With respect to provisional psychiatric diagnoses at admission, older adults and the oldest-old adults tended to have higher rates of cognitive disorders and delirium compared with younger and middle-aged adults. The converse was true for mood disorders, schizophrenia, substance use disorder, personality disorder, anxiety, and intellectual disability.

Table 2 shows the results of the logistic regression analysis examining the sociodemographic and clinical determinants of non-emergency CI use and any CI use. Having established that CI use was higher in older persons compared with young and middle-aged adults in **Table 1**, we narrowed our multivariate analyses to the subset of inpatients aged 65 and older (n = 34,716 for any CI use and n = 29,646 for non-emergency CI use vs. no CI use). The models showed good overall performance with a c-statistics of 0.78 and 0.83 for non-emergency and any CI use, respectively.

The specification of the final models was based on the variables found to be significant for non-emergency use. That set of covariates was then applied to the model for any CI use to determine whether the covariates were differentially important for the two patterns of use.

Non-emergency CI use among older persons in psychiatry was affected by a combination of person-level factors as well as health system considerations. Function, cognition, and behavior were important clinical attributes associated with greater odds of CI use. For example, the odds were highest for the highest impairments in activities of daily living (ADL Short Form score 8 – 16: OR = 2.72, 95% CI = 2.42 – 3.06), highest levels of aggression (Aggressive Behavior Scale score 4 – 6: OR = 1.76, 95% CI = 1.57 – 1.98), and highest levels of positive psychotic symptoms (Positive Symptoms Scale score 9+: OR = 1.65, 95% CI = 1.43 – 1.90). Delirium, cognitive disorder diagnosis, cognitive impairment, and falls were also associated with increased odds, as were having the reasons for admission be danger to self, danger to others or inability to care for self. Females were less likely to have non-emergency CI use (OR = 0.84, 95% CI = 0.73 – 0.95).

However, after adjusting for all of these person-level clinical and demographic variables, there was an independent health-system effect related to source of admission. Those admitted from long-term care homes had significantly greater odds of non-emergency CI use compared with community admissions (OR = 1.18; 95% CI = 1.07 – 1.29) after controlling for reason for admission, cognition, ADL impairment, falls, behavior, positive symptoms, and delirium. We also found a historical trend that was statistically significant as of 2011, using 2005 as a reference point. This time period does not correspond to any change in legal framework of non-emergency use of CI; however, it does correspond with the launch of the Mental Health and Addictions Quality Initiative (MHAQI) (30). MHAQI was founded as a collaborative network among hospitals with inpatient psychiatric beds with the aims of pursuing joint quality improvement

TABLE 1 | Comparison of the use of control interventions, clinical and sociodemographic profiles of psychiatric inpatients across 4 age groups (18–44 years, 45–64 years, 65–84 years, 85+ years).

	18–44 years *N* = **11,4976**	**45–64 years** *N* = **76,426**	**65–84 years** *N* = **30,138**	**85+ years** *N* = **4,579**
Control Interventions CAP				
Triggered (emergency situation)	9,646 (8.4)	4,888 (6.4)	3,071 (10.2)	691 (15.1)
Triggered (non-emergency situation)	10,807 (9.4)	6,352 (8.3)	2,986 (9.9)	603 (13.2)
Types of control interventions				
Acute control medications	16,423 (14.3)	8,884 (11.6)	3,961 (13.1)	751 (16.4)
Mechanical restraint	3,149 (2.7)	1,528 (2.0)	1,711 (5.7)	453 (9.9)
Chair prevents rising	146 (0.1)	379 (0.5)	1,608 (5.3)	509 (11.1)
Physical/manual restraint by staff	2,561 (2.2)	1,205 (1.6)	1,191 (4.0)	292 (6.4)
Seclusion room	5,683 (4.9)	2,677 (3.5)	947 (3.1)	127 (2.8)
Gender (Female)	52,004 (45.3)	38,739 (50.7)	16,547 (54.9)	2,691 (58.8)
Marital status				
Married	24,439 (21.3)	30,077 (39.4)	13,737 (45.6)	1,625 (35.5)
Never married	79,552 (69.2)	24,110 (31.6)	4,660 (15.5)	384 (8.4)
Reasons for admission				
Threat or danger to self	59,718 (51.9)	36,028 (47.1)	11,631 (38.6)	1,703 (37.2)
Threat or danger to others	21,146 (18.4)	10,595 (13.9)	6,947 (23.1)	1,457 (31.8)
Inability to care for self	35,652 (31.0)	27,305 (35.7)	16,253 (53.9)	2,738 (59.8)
Admission from long term care facility	1,225 (1.1)	2,308 (3.0)	5,439 (18.1)	1,715 (37.5)
Inpatient status at time of assessment				
Application for assessment	17,235 (18.8)	10,852 (18.0)	3,722 (16.1)	529 (15.6)
Voluntary	44,464 (48.5)	32,668 (54.1)	11,458 (49.6)	1,566 (46.1)
Informal	633 (0.7)	509 (0.8)	1,272 (5.5)	353 (10.4)
Involuntary	26,790 (29.2)	15,386 (25.5)	6,506 (28.1)	946 (27.9)
Forensic	2,534 (2.8)	1,010 (1.7)	167 (0.7)	2 (0.1)
Incapable of consenting to treatment	7,161 (6.2)	5,549 (7.3)	6,808 (22.6)	1,713 (37.4)
Has legal guardian/substitute decision-maker	5,926 (5.2)	5,112 (6.7)	8,052 (26.7)	2,124 (46.4)
DSM-IV Diagnosis				
Cognitive disorder	943 (0.8)	2,968 (3.9)	10,735 (35.6)	2,955 (64.5)
Delirium	27,334 (23.8)	19,164 (25.1)	12,458 (41.3)	2,334 (51.0)
Mood disorder	58,005 (50.5)	43,861 (57.4)	15,624 (51.8)	1,829 (40.0)
Schizophrenia	35,239 (30.7)	20,640 (27.0)	6,223 (20.7)	556 (12.1)
Substance use disorder	38,316 (33.3)	20,216 (26.5)	2,775 (9.2)	91 (2.0)
Personality disorder	12,652 (11.0)	5,584 (7.3)	1,012 (3.4)	85 (1.9)
Anxiety disorder	19,040 (16.6)	12,009 (15.7)	3,207 (10.6)	331 (7.2)
Intellectual disability	4,731 (4.1)	2,554 (3.3)	864 (2.9)	143 (1.7)
No past mental health admission	47,034 (40.9)	26,741 (35.0)	13,521 (44.9)	3,028 (66.1)
Aggressive Behavior Scale				
0	88,600 (77.1)	60,497 (79.2)	19,505 (64.7)	2,434 (53.2)
1–3	15,015 (13.1)	9,203 (12.0)	5,241 (17.4)	939 (20.5)
4–6	7,778 (6.8)	4,577 (6.0)	3,047 (10.1)	637 (13.9)
7–9	2,887 (2.5)	1,655 (2.2)	1,602 (5.3)	361 (7.9)
10–12	696 (0.6)	494 (0.7)	743 (2.5)	208 (4.5)
Risk of Harm to Others Scale				
0	32,899 (28.6)	24,418 (32.0)	9,424 (31.3)	1,317 (28.8)
1–2	51,590 (44.9)	35,324 (46.2)	11,580 (38.4)	1,488 (32.5)
3–4	17,044 (14.8)	10,034 (13.1)	4,340 (14.4)	720 (15.7)
5–6	13,443 (11.7)	6,650 (8.7)	4,794 (15.9)	1,054 (23.0)

(Continued)

TABLE 1 | Continued

	18–44 years ***N* = 11,4976**	**45–64 years** ***N* = 76,426**	**65–84 years** ***N* = 30,138**	**85+ years** ***N*=4,579**
Severity of Self-harm				
0	26,752 (23.3)	18,704 (24.5)	5,112 (17.0)	366 (8.0)
1–2	35,460 (30.8)	25,728 (33.7)	15,767 (52.3)	2,953 (64.5)
3–4	21,702 (18.9)	12,423 (16.3)	5,067 (16.8)	821 (17.9)
5–6	31,062 (27.0)	19,571 (25.6)	4,192 (13.9)	439 (9.6)
Self-care Index				
0	40,597 (35.3)	24,918 (32.6)	5,047 (16.8)	379 (8.3)
1–2	51,055 (44.4)	33,519 (43.9)	13,675 (45.4)	2,109 (46.1)
3–4	14,494 (12.6)	11,529 (15.1)	7,077 (23.5)	1,334 (29.1)
5–6	8,830 (7.7)	6,460 (8.5)	4,339 (14.4)	757 (16.5)
Falls CAP				
Triggered	4,632 (4.0)	5,891 (7.7)	4,927 (16.4)	1,120 (24.5)
Cognitive performance scale				
0	87,011 (75.7)	52,271 (68.4)	11,011 (36.5)	767 (16.8)
1–2	23,803 (20.7)	19,152 (25.1)	10,434 (34.6)	1,517 (33.1)
3–6	4,162 (3.6)	5,003 (6.6)	8,693 (28.8)	2,295 (50.1)
Depressive Severity Index				
0	29,239 (25.4)	17,828 (23.3)	8,327 (27.6)	1,386 (30.3)
1–3	36,090 (31.4)	23,827 (31.2)	10,723 (35.6)	1,667 (36.4)
4–7	30,128 (26.2)	20,614 (27.0)	6,724 (22.3)	948 (20.7)
8–15	19,590 (17.0)	14,157 (18.5)	4,364 (14.5)	578 (12.6)
Positive Symptoms Scale				
0	55,094 (47.9)	38,156 (49.9)	13,041 (43.3)	1950 (42.6)
1–3	22,651 (19.7)	15,165 (19.8)	7,243 (24.0)	1238 (27.0)
4–8	22,747 (19.8)	14,406 (18.9)	6,526 (21.7)	963 (21.0)
9–24	14,484 (12.6)	8,699 (11.4)	3,328 (11.0)	428 (9.4)
ADL Short Form				
0	107,452 (93.5)	67,410 (88.2)	17,265 (57.3)	1,413 (30.9)
1–2	4,723 (4.1)	4,569 (6.0)	3,859 (12.8)	666 (14.5)
3–4	1,613 (1.4)	1,939 (2.5)	2,344 (7.8)	515 (11.3)
5–7	599 (0.5)	977 (1.3)	2,245 (7.5)	577 (12.6)
8–16	569 (0.5)	1,531 (2.0)	4,425 (14.7)	1,408 (17.8)

initiatives. Restraint use was an important initial focus of this network.

When the same covariates were applied to a logistic regression model for *any* CI use, there were few substantively important changes in the magnitudes of these associations. None of the odds ratios became non-significant and none changed direction in their relationships with CI use.

DISCUSSION

Although the association of age and CI use was reported as mixed in the literature (5, 7, 9), we found a clear trend of increasing CI use with age in this large Canadian psychiatric inpatient sample. Whether considering non-emergency use or any use of CIs, this approach to care was most common in older adults with a peak among the oldest-old. Previous research has not investigated the association between falls and the use of CIs in psychiatric settings (5), but our findings point to this as an important relationship. We found that clinical characteristics of older inpatients affected the use of non-emergency CIs, especially impaired ADLs, cognition, aggression and delirium. However, the use of CIs was also affected by where the person was admitted from after controlling for clinical, demographic, and diagnostic covariates.

The association of impaired ADLs and CI use found in this study is consistent with other international studies. A nationwide survey of institutions for older adults in Norway found that force or pressure was the most frequently used restraint method when performing activities of daily living of their residents (31). Inability to perform ADL activities was also found to increase the frequency of restraint use in a study of psychogeriatric inpatients in Germany (9). Impaired ADL in older adults can be associated with cognitive impairment, and practical guidance on the use of physical restraints with people with Alzheimer's disease has emphasized the consideration of the perceived benefits and potential harms of CI use, regular review of continued restraint

TABLE 2 | Logistic regression models examining the sociodemographic and clinical determinants of any use of control interventions (CIs), and use in non-emergency situations only.

Variables	Non-emergency CI use *N* = 29,646	*p* value	Any CI use *N* = 34,716	*p* value
	Odds Ratio (95% CI)		**Odds Ratio (95% CI)**	
Age 85+ (ref = 65 – 84)	0.96 (0.86 – 1.06)	0.40	0.95 (0.87 – 1.04)	0.25
Female gender (ref = male)	0.83 (0.77 – 0.90)	<0.0001	0.79 (0.74 – 0.84)	<0.0001
Admitted from Long Term Care (ref = no)	1.19 (1.08 – 1.31)	0.0003	1.15 (1.07 – 1.24)	0.0002
Reasons for admission (ref = no)				
Threat or danger to self	1.18 (1.09 – 1.28)	<0.0001	1.24 (1.17 – 1.32)	<0.0001
Threat or danger to others	1.19 (1.08 – 1.31)	0.0003	1.35 (1.26 – 1.45)	<0.0001
Inability to care for self	1.40 (1.28 – 1.52)	<0.0001	1.26 (1.18 – 1.33)	<0.0001
Cognitive Disorder diagnosis (ref = no)	1.40 (1.28 – 1.53)	<0.0001	1.35 (1.25 – 1.46)	<0.0001
Any delirium indicators present (ref = no)	1.41 (1.29 – 1.54)	<0.0001	1.43 (1.33 – 1.54)	<0.0001
Falls CAP triggered	1.21 (1.10 – 1.33)	<0.0001	1.18 (1.10 – 1.28)	<0.0001
Aggressive Behavior Scale (ref = 0)				
1 – 3	1.50 (1.37 – 1.65)	<0.0001	1.67 (1.54 – 1.81)	<0.0001
4 – 6	1.77 (1.57 – 1.99)		3.40 (3.10 – 3.73)	
7 – 9	NA[a]		5.58 (4.95 – 6.29)	
10+	Na[a]		8.74 (7.31 – 10.46)	
Cognitive Performance Scale (ref = 0)				
1 – 2	1.14 (1.02 – 1.28)	<0.0001	1.14 (1.04 – 1.26)	<0.0001
3 – 6	1.50 (1.31 – 1.72)		1.54 (1.38 – 1.73)	
Positive Symptoms Scale (ref = 0)				
1 – 3	1.24 (1.13 – 1.37)		1.27 (1.17 – 1.38)	
4 – 8	1.51 (1.36 – 1.67)		1.62 (1.49 – 1.76)	
9+	1.74 (1.51 – 2.00)	<0.0001	2.07 (1.87 – 2.29)	<0.0001
ADL Short Form				
1 – 2	0.97 (0.86 – 1.20)	<0.0001	1.00 (0.90 – 1.10)	<0.0001
3 – 4	1.04 (0.90 – 1.20)		1.10 (0.98 – 1.23)	
5 – 7	1.22 (1.06 – 1.41)		1.24 (1.11 – 1.40)	
8 – 16	2.66 (2.37 – 3.00)		2.38 (2.15 – 2.62)	
Year (ref = 2005)[b]				
2006	0.80 (0.59 – 1.09)	<0.0001	0.87 (0.67 – 1.12)	<0.0001
2007	0.74 (0.54 – 1.00)		0.73 (0.56 – 0.95)	
2008	0.72 (0.53 – 0.98)		0.77 (0.59 – 1.00)	
2009	0.74 (0.54 – 1.00)		0.76 (0.59 – 0.99)	
2010	0.77 (0.57 – 1.05)		0.78 (0.60 – 1.01)	
2011	0.73 (0.54 – 0.99)		0.70 (0.54 – 0.91)	
2012	0.56 (0.41 – 0.77)		0.61 (0.47 – 0.80)	
2013	0.52 (0.38 – 0.72)		0.55 (0.42 – 0.72)	
2014	0.46 (0.34 – 0.63)		0.50 (0.38 – 0.65)	
2015	0.54 (0.40 – 0.73)		0.54 (0.42 – 0.71)	
2016	0.48 (0.35 – 0.65)		0.52 (0.40 – 0.68)	
2017	0.43 (0.31 – 0.58)		0.45 (0.35 – 0.58)	
2018	0.43 (0.30 – 0.62)		0.45 (0.34 – 0.61)	
Likelihood ratio chi-square	1261.2	<0.0001	8987.1	<0.0001
C statistic	0.76		0.83	

[a] *Non-emergency CAP trigger level excludes persons with Aggressive Behavior Scale ≥6 or Positive Symptoms Scale ≥ 13.*
[b] *2005 and 2018 include the last and first calendar quarters, respectively.*

use, limiting the use of restraint to a minimal level, and educating clinicians about the risks of physical restraint and safe practice when restraining a person (32).

It is particularly concerning to find that delirium was associated with non-emergency CI use in this analysis. It has been shown that physical restraints can lead to delirium, therefore, should not be used for patients at risk of delirium or have already developed delirium (33). The management of delirium requires addressing both the medical and psychiatric care needs of the patient. A previous study found that patients with delirium admitted directly to a collocated geriatric and psychogeriatric unit, where nurses were dually qualified in medical and psychiatric conditions, had better outcomes and shorter lengths of stay than patients who were transferred to other wards in the hospital (34). Other key components in preventing and managing delirium include staff education, systematic screening, multidisciplinary approach and a focus on non-pharmacological interventions (33). Antipsychotics are often used as an acute control medication in hyperactive delirium. This class of medication can sometimes be effective in treating aggression and agitation in older people with dementia; however, they are not without side effects and could potentially worsen the clinical course of delirium. Interestingly, a previous study found nursing home residents taking antidepressant medication had lower level of aggression (3). It was highlighted that aggression in nursing home residents could be a manifestation of untreated agitated depression. In the same study, pain and other common geriatric physical problems such as constipation and urinary tract infection could trigger aggression in older people with cognitive impairment.

The use of alternatives to physical restraints from the perspectives of older people and staff requires further research (35). Canadian long-term care homes have undergone a large scale reduction in restraint use over the last two decades demonstrating that such a change is entirely feasible (36, 37).

A Canadian qualitative study explored the views of family members of older people in long-term care facilities regarding alternatives to physical restraints and seclusion (38). Family members believed the need for restraint and seclusion could be reduced by creating a stimulating environment in the care facility, introducing individualized occupational therapy programs along with listening, communicating, and assessing the needs of the older people. Patients often thought their opinions were not included in their treatment planning (16). Staff working in acute old age psychiatry inpatient units in Australia thought aggressive behavior in their patients was related to the environment and aggression occurred because staff did not listen to patients (39). Another Australian study found nurses working in acute old age psychiatry inpatient units felt that there were no effective alternatives to the use of physical restraints and seclusion (40), a similar finding reported in a Hong Kong study (4).

An increase in staffing does not necessarily translate to a lower rate of restraint use (31). The reverse also being found that high workload and low percentage of registered nurses was not associated with greater restraint use in a study of 15 Dutch psychogeriatric nursing home wards (6). Restraint reduction programs can be effective in reducing the rates of physical restraint use. A meta-analysis of nine randomized controlled trials (RCTs)/cluster RCTs found significant effects with restraint reduction programs (41). These programs typically used education to improve the care provided to older people by helping carers to identify alternatives to restraint use and by providing information about the care of older people with dementia (42). Other interventions included providing a change-agent or an expert for ongoing consultations (41). For example, a restraint reduction program in a convalescent medical ward in Hong Kong resulted in the rates of restraint use reduced from 13.3 to 4.1% (8). Assessing communication and baseline behaviors could prevent CI use in people with dementia, in particular those behaviors that place a patient at risk of CI use, for example, falls risk, interference with treatment devices such as feeding tubes, intravenous lines, urinary catheter (43). In addition, appropriate education and support has been recommended to address the ethical and workplace cultural issues associated with the practices of restraint and seclusion (40).

There are four main applications in the use of interRAI instruments: care planning, outcome measurement, resource allocation and quality improvement (22). When the non-emergency CI CAP is triggered, appropriate person-level intervention to address the associated factors found in this study should follow as part of the care planning. The use of CIs, particularly in non-emergency situations, can be used as a quality indicator for performance monitoring at service/facility and population levels. Multimodal interventions involving leadership, policies, staff training and education are shown to reduce physical restraint use in inpatient psychiatric settings (44). There have also been quality improvement initiatives that effectively reduce physical restraint use in hospital settings (45, 46).

Quality of care should not be considered within health sectors alone. A more person-centered approach is to employ a health systems perspective to examine how individuals are cared for in different settings. The finding that prior long-term care placement was an independent predictor of non-emergency and any CI use, while controlling for numerous other covariates, is of great concern. These results raise the possibility of care driven not by personal needs, but by system-level factors that should be irrelevant to care strategies. This then begs the question of whether the care of persons who are transferred from long-term care to inpatient psychiatry facilitates received improved or worsened care for their mental health needs.

The main limitation of this study is that different types of CIs are collectively analyzed as one category of interventions. The determinants of each individual CI could be different. For example, Mah et al. found 72% of an earlier cohort of Ontario psychiatry inpatients restrained with a chair that prevents rising were 65 years and older (14). Chair restraint was the most frequently CI used in older inpatients, followed by mechanical/physical restraint and acute control medication (14). Future studies could examine the determinants of each type of CIs separately. Nevertheless, this study provides evidence about CI use rates that can serve as a baseline and monitored over time as a quality indicator at a population level. It also serves as a first step in highlighting the higher rates and the factors associated with CI use in older psychiatric inpatients. Indeed, immediate action should be taken to publicly report on the use of CIs in inpatient psychiatry in Canada, as is already done in the long-term care sector through the Canadian Institute for Health Information's public reporting portal (13).

CONCLUSION

This study found higher rates of CI use in older psychiatric inpatients who are the most vulnerable group in our society. Non-emergency use of CIs in inpatient psychiatric units was associated with older people who had impaired ADLs, aggression, positive psychotic symptoms, cognitive impairment, delirium and falls. The use of alternative strategies such as non-pharmacological and person-centered management strategies to meet the needs of older people with these presentations should be implemented first. Staff education and support programs could improve practice and ultimately protect our older people from potential maltreatment. The use of CIs in inpatient psychiatric units should be incorporated as a quality improvement activity to monitor changes at various service provision levels. The use of CIs should be reported publicly as is already done in long-term care.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: The data used in this study are made available to interRAI fellows for research use (not commercial use) under an existing license agreement between interRAI and the Canadian Institute for Health Information. The data in this study cannot be transmitted to third parties or made available to others. Request to access and use the data can be made directly to the Canadian Institute for Health Information. https://www.cihi.ca/en/access-data-and-reports/make-a-data-request. Requests to access these datasets should be directed to https://www.cihi.ca/en/access-data-and-reports/make-a-data-request.

ETHICS STATEMENT

Ethics approval was obtained through the Office of Research at the University of Waterloo (ORE # 30372 and #15436). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

GC and JPH designed the study and wrote the paper. JPH carried out the statistical analysis. TMM and YB critically reviewed the paper and contributed to writing the paper. All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Brief Report: Characteristics and Needs of Persons Admitted to an Inpatient Psychiatric Hospital With Workers' Compensation Coverage

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The rise of mental health issues in the workplace is widely known. Though mental health issues were not covered by the Workplace Safety Insurance Board (WSIB) in Ontario (Canada) until 2018, it was listed as responsible for payment of inpatient psychiatric hospital stays between 2006 and 2016. This population-level observational analytic study compares the clinical and service needs of 1,091 individuals admitted to inpatient psychiatry with WSIB coverage to all other admissions ($n = 449{,}128$). Secondary analysis was based on the interRAI Mental Health assessment. The WSIB group differed from all other admissions on almost all characteristics considered. Most notably, depression (65.08 vs. 57.02%), traumatic life events (25.48 vs. 15.58%), substance use (58.02 vs. 46.92%), daily pain (38.31 vs. 12.15%) and sleep disturbance (48.95 vs. 37.12%) were much higher in the WSIB group. Females with WSIB coverage had more depression (74.36 vs. 59.91%) and traumatic life events (30.00 vs. 22.97%), whereas males had more substance issues (63.62 vs. 47.95%). In addition, persons under the age of 55 had more substance issues (<25 = 75.47%; 25–54 = 61.64%: 55 ± 40.54%) and traumatic life events (<25 = 26.41%; 25–54 = 28.18%; 55 ± 15.31%), while those 25–54 years had more daily pain (41.67% vs. <25 = 3.77% and 55 ± 34.23%) and sleep disturbance (50.74% vs. <25 = 33.96% and 55 ± 45.94%). All variables differed significantly by sex and age within the comparison group, though not always following the patterns observed in the WSIB group. Future research examining mental health needs and outcomes among injured workers receiving inpatient psychiatric services is needed, and should take into account sex and age.

Keywords: interRAI, mental health, inpatient psychiatry, worker, trauma, pain, substance use, depression

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INTRODUCTION

That mental health conditions are on the rise is widely known. These affect hundreds of millions of people internationally, and are now recognized among the leading causes of disability (1). By 2030, the global cost of mental illness will surpass six trillion dollars (2). In Canada, the annual economic burden of mental illness is ∼50 billion dollars, and is projected to reach 307 billion by 2041 (2).

The rise of mental health issues in the workplace is equally widely known. A systematic review and meta-analysis found that ∼18% of workers met the criteria for common mental health conditions (i.e., mood, anxiety, substance-related disorders), with a lifetime prevalence of just under 30% (3). It is not surprising then, that programs and policies targeting mental health in the workplace have become a focus for employers and governments around the world.

In Canada, workers' compensation started with the 1913 Meredith Report; it outlined an arrangement in which workers ceded their right to sue in return for benefits (4). The main tenets of the original workers' compensation laws still exist: no-fault compensation, collective liability, security of payment, exclusive jurisdiction, and independent board. In spite of having common principles, Canadian provinces and territories have their own Workers' Compensation Board (WCB), apart from the Northwest Territories and Nunavut, which share a WCB. Governments in each jurisdiction create Workers Compensation legislation, which is administered by the WCB. The benefits provided to workers most commonly fall into one of five categories: health care, wage loss benefits, permanent disability benefits, fatal and dependency benefits (survivor benefits), and rehabilitation. The levels of coverage and benefit amounts vary by WCB. For example, the percentage of earnings that benefits are based on vary: 85% net in Prince Edward Island and Ontario, and 90% net in Quebec, Manitoba, Saskatchewan, Alberta, British Columbia, and Northwest Territories and Nunavut. Federally, all government employees are governed under the Federal Government Employees Compensation Act.

While for some, mental health conditions may not originate in the workplace, there is considerable evidence that the workplace may itself contribute to mental illness (5). This led to changes in Ontario's Workplace Safety and Insurance Board (WSIB); its new chronic mental stress policy and revised traumatic mental stress policy came into effect on January 1, 2018. Ontario's WSIB previously compensated chronic mental health injuries until Bill 99 removed this coverage in 1998. In 2016, Bill 163 was passed that recognized post-traumatic stress disorder in first responders to be a work-related injury, unless proven otherwise. However, there was still no coverage for mental health injuries developed over time. In 2017, the Ontario government passed Bill 177, which amended the Act to cover chronic and traumatic mental stress as long as the stress is not caused by "decisions or actions of the worker's employer relating to the worker's employment, including a decision to change the work to be performed or the working conditions, to discipline the worker or to terminate the employment" (6).

Though mental health issues were not explicitly covered by the WSIB until 2018, it was listed as responsible for payment of inpatient psychiatric stays between January 1, 2006 and December 31, 2016. This study compares the clinical and service needs of the 1,091 individuals admitted to inpatient psychiatry in this 11-year period to all other admissions. Given that the nature and experience of work-related injuries and disabilities are known to differ by sex and age (7, 8), within and between-group comparisons by age and sex will be made.

MATERIALS AND METHODS

Data

This observational analytic study employed secondary analysis of anonymized population-level clinical data in the Ontario Mental Health Reporting System (OMHRS) collected between January 1, 2006 and December 31, 2016 on all persons admitted to an adult inpatient psychiatric bed or unit. Anonymized data are held on a secure server at the University of Waterloo as part of a data-sharing agreement between the Ontario Ministry of Health and interRAI, a not-for-profit research consortium. Exemption from review for secondary analysis of anonymized data was granted by the Lakehead University Research Ethics Board, as per the Tri-Council Policy Statement (9).

Instrument

Data are based on the RAI Mental Health assessment (10–12), which contains over 300 items targeting key domains: personal information, mental health service history, mental state, substance use, injurious behaviors, social roles and relationships, psychiatric diagnoses, cognition, functioning, health conditions and medical diagnoses, medications, life stressors, service use, and informal supports. Items are also grouped into various scales, algorithms, and protocols framed on recovery principles that support evidence-informed individual-level care planning and shared decision-making processes about services (12, 13). It is completed at admission and discharge (if the stay lasts at least 7 days); reassessments are completed every 90 days if still in hospital.

Study Population/Variables

Admission assessments were completed on 449,128 unique individuals in the study period; if individuals had more than one admission, the most recent assessment was used. The group of interest are workers who experience mental health issues, defined as those for whom WCB/WSIB was listed as a source responsible for payment. The comparison group represents all other admissions.

Items related to personal information (i.e., age, sex, marital status, living arrangements) and stay (i.e., reasons for admission, length of stay) were used, as were DSM-V diagnostic categories (actual or provisional diagnoses). All embedded scales available in the assessment were used to describe clinical characteristics: Activities of Daily Living Hierarchy (ADLH) (14), Aggressive Behavior Scale (ABS) (15), Cognitive Performance Scale (CPS) (16), Depression Rating Scale (DRS) (17), substance use (CAGE scale) (12), Mania Scale 10, Positive Symptoms Scale (12), Social Withdrawal Scale (SWS, formerly called Negative Symptoms Scale, NSS) (12), and Pain Scale (18). Previously-established cut-offs were used for each scale to indicate problems in that area (e.g., higher severity, frequency). A succinct description of the items and coding used in embedded scales is available elsewhere (19).

Just as scales represent the combination of items to provide information on overall status in different areas, items are also combined to flag issues. These are called clinical assessment

TABLE 1 | Number of WSIB admissions between January 1, 2006 and December 31, 2016.

Year	Total admissions (*N*)	WCB/WSIB N (% of all admissions)
2006	38,655	103 (0.27%)
2007	38,984	88 (0.23%)
2008	38,399	90 (0.23%)
2009	39,426	83 (0.21%)
2010	40,206	56 (0.14%)
2011	40,636	95 (0.23%)
2012	41,551	104 (0.25%)
2013	41,490	107 (0.26%)
2014	42,432	109 (0.26%)
2015	43,110	127 (0.29%)
2016	44,239	129 (0.29%)
Total	449,128	1,091 (0.24%)

protocols (CAPs), and identify needs related to safety (i.e., harm to self and others, suicidality and purposeful self-harm, self-care), social life (i.e., social relationships, informal support, support systems for discharge, interpersonal conflict, traumatic life events, criminal activity), economic issues (i.e., personal finance, education, and employment), autonomy (i.e., control interventions, medication management and adherence, rehospitalization), and health promotion (i.e., smoking, substance use, weight management, exercise, sleep disturbance, pain, falls) (12, 13, 20).

Analysis

The prevalence of persons admitted with WSIB coverage is shown annually and overall. Descriptive statistics (%, mean, standard deviation) inform on all variables, and relevant tests of significance were used to report on differences within and between groups (chi-square, *t*-test, ANOVA). Given the very large number of admission assessments, a strict Type I error rate was used (i.e., alpha = 0.001); only findings that meet this criteria are described. The same reporting format is used for all results: (a) description of between group differences, (b) description of within-WSIB group differences by age and sex, and (c) description of within-Other group differences by age and sex that differ from what was found in the WSIB group. As such, within-Other group differences by sex and age that are not described are similar to those within the WSIB group.

RESULTS

There were 1,091 assessments that had WSIB listed among responsible sources of payment, representing 0.24% of all admissions (**Table 1**). Such admissions ranged between 56 and 129 per year; they decreased between 2006 and 2010 and then steadily increased.

Study Population Characteristics

Table 2 shows personal and admission characteristics; multiple reasons may be listed for each admission.

Between Group Differences

The WSIB mean age was higher [45.37 years (SD = 12.4) vs. 42.91 years (SD = 17.0); $p > 0.001$] than the other group. The majority of people in both groups were male (WSIB: 64.25%; $p < 0.001$; Other: 50.99%; $p < 0.001$), equal proportions lived alone and the majority lived in a private home. However, more people in the WSIB group were married, lived with a spouse and other(s), whereas more in the other group had never been married, lived with non-relatives or other relatives, and had been admitted from an acute or other setting. The WSIB group was less often admitted for all reasons listed, with one exception: this group had more admissions due to problems with addiction or dependency. The mean length of stay was about 4 days, and did not significantly differ between groups [WSIB: 3.89 days (SD = 10.9); Other: 4.05 days (SD = 18.9); $p = 0.77$].

Within-WSIB Group Differences by Sex and Age

Within the WSIB group, the youngest group (i.e., under 25 years) tended to have never been married, whereas most in the oldest group (i.e., 55 years or more) were married; there were equal proportions among those 25-54 years who had never been married and who were currently married. Females more often lived with a child only compared to males, the youngest with other relatives (e.g., parent or guardian), and the two older groups most often lived alone. Females were more likely to be admitted due to threat or danger to self, inability to care for self, and specific psychiatric symptoms. Males were more often admitted due to problems with addiction or dependency and involvement with the criminal justice system. The youngest group was most often admitted for being a danger to others, while admission due to inability to care for self was highest among the oldest group. Admission for specific psychiatric symptoms was most frequent among those aged 25 to 54 years; the proportion admitted for addiction and dependency was similar among those under 25 years and between 25 and 54 years. There were no sex differences for mean age ($p = 0.09$), marital status ($p = 0.16$), place admitted from ($p = 0.22$), admission for threat/danger to others ($p = 0.06$), and mean length of stay ($p = 0.58$). There were no age differences for admission due to threat or danger to self ($p = 0.07$), justice system/forensic ($p = 0.69$), other reasons ($p = 0.26$), and mean length of stay ($p = 0.22$).

Within-Other Group Differences by Sex and Age

Some notable differences existed by sex and age in the other group. Compared to males, females were older, and more commonly lived with their spouse and children. They were also more often admitted from a private home, and fewer had been homeless. Males were more often admitted for being a danger or threat to others. Unlike the WSIB group, there were age-related differences for all reasons for admission. In particular, the youngest group was most often admitted for threat or danger to self and involvement with the justice or forensic system, while those 25-54 years were more often admitted due to inability to care for self. For their part, the oldest group was most often admitted due to specific psychiatric symptoms and for reasons other than those listed. The mean length of stay was statistically significantly higher among males and in the oldest age group,

TABLE 2 | Univariate distribution (%) of personal characteristics of persons admitted overall, and by WSIB status, sex, and age.

	WSIB						Other					
	All	Sex		Age group			All	Sex*		Age group		
		F	M	<25	25-54	55+		F	M	<25	25-54	55+
N	1,091	401	734	53	816	222	448,037	219,504	228,408	73,723	265,205	109,109
Marital status[a,c,d,e]												
Never married	34.83	35.65	34.38	94.34	36.15	15.77	54.16	44.71	63.22	95.83	55.34	23.13
Married	35.84	34.36	36.66	1.89	36.40	41.89	22.71	26.82	18.77	1.83	22.50	37.33
Partner	4.86	4.87	4.85	1.89	5.51	3.15	3.43	4.04	2.85	1.57	4.36	2.44
Widowed	2.38	3.59	1.71	1.89	0.49	9.46	4.10	6.29	2.00	0.07	1.04	14.27
Separated/Divorced	22.09	21.54	22.39	0	21.45	29.73	15.60	18.14	13.16	0.72	16.76	22.83
Who lived with[a,b,c,d,e]												
Alone	31.62	32.31	31.24	15.09	32.11	33.78	32.41	31.96	32.84	16.78	34.64	37.54
Spouse only	16.50	17.18	16.12	1.89	14.46	27.48	11.96	14.54	9.48	2.11	9.55	24.49
Spouse + other/s	22.18	17.18	24.96	5.66	24.75	16.67	11.17	13.52	8.90	2.12	15.12	7.68
Child (not spouse)	5.32	9.49	3.00	0	5.39	6.31	4.55	7.88	1.35	1.04	5.08	5.63
Other relative	20.26	20.77	19.97	69.81	19.98	9.46	28.89	23.48	34.10	69.07	26.25	8.17
Non-relative(s)	4.12	3.08	4.71	7.55	3.31	6.31	11.02	8.62	13.33	8.89	9.36	16.49
Admitted from[a,c,d,e]												
Home/apt/room	76.71	79.93	75.00	64.71	78.69	72.41	59.22	61.90	56.67	58.59	61.17	55.13
Psychiatric hospital/unit	1.27	1.46	1.16	2.94	1.36	0.057	2.67	2.44	2.89	2.65	2.91	2.41
Homeless	1.39	0.36	1.94	2.94	1.20	1.72	3.25	2.27	4.19	3.40	3.92	1.59
Acute unit/hospital	12.66	11.31	13.37	26.47	11.51	13.79	23.33	23.67	23.00	22.00	23.93	26.91
Other	7.97	6.94	8.53	0	4.30	5.17	11.53	9.72	9.38	3.88	3.83	3.74
Reasons for admission**												
Threat/danger to self[a,b,d,e]	44.18	49.47	41.08	58.49	42.77	49.95	48.36	50.24	46.54	57.77	48.55	41.52
Threat/danger to others[a,c,d,e]	13.66	11.03	15.12	32.08	12.01	15.32	20.17	13.69	26.40	24.95	19.42	18.76
Inability to care for self[a,b,c,d,e]	23.92	31.03	19.97	28.30	21.69	31.08	40.26	41.01	39.54	37.87	49.35	35.38
Addiction/dependency[a,b,c,d,e]	38.86	29.23	44.22	41.51	42.16	26.13	25.27	18.94	31.35	29.91	28.73	3.72
Psychiatric symptoms[a,b,c,d,e]	69.94	73.59	67.90	62.26	71.94	64.41	73.14	75.79	70.59	72.11	73.22	73.64
Justice/forensic system[a,b,d,e]	3.67	1.79	4.71	3.77	3.92	2.70	6.36	3.00	9.59	7.64	7.41	2.93

**An additional N = 125 identified their sex as "other"; **Multiple reasons may be listed for each admission; [a]Significant difference between the WSIB and Other group (p < 0.001); [b]Significant difference by sex within the WSIB group (p < 0.001); [c]Significant difference by age category within the WSIB group (p < 0.001); [d]Significant difference by sex within the Other group (p < 0.001); [e]Significant difference by age category within the Other group (p < 0.001).*

though the actual differences were minimal [4.16 days (SD = 22.9) vs. 3.95 days (SD = 13.6) among females; 4.33 days (SD = 24.5) vs 3.97 days (SD = 17.2) among 25–54 years and 4.00 days (SD = 22.9) among under 25 years].

Clinical Characteristics

Table 3 reports on DSM-V diagnostic categories and clinical characteristics as measured by embedded scale scores.

Between Group Differences

Differences existed between the two groups for all but personality disorder diagnosis ($p = 0.02$), mania ($p = 0.17$), social withdrawal ($p = 0.10$), and ADL impairment ($p = 0.09$). A higher proportion of those in the WSIB group had substance-related, mood, and anxiety disorders, whereas schizophrenia/psychotic disorders were more prevalent in the other group. More persons in the WSIB group exceeded the cut-off scores for depression, possible substance problem, and pain; moderate or worse cognitive impairment, severe aggression, and positive symptoms were more common in the other group.

Within-WSIB Group Differences by Sex and Age

In the WSIB group, more females had a mood disorder diagnosis and exceeded the cut-offs for depression and social withdrawal, whereas more males had a substance-related diagnosis and exceeded the cut-off for possible substance problem. There were no sex differences for the other diagnostic categories (schizophrenia/psychotic: $p = 0.39$; anxiety: $p = 0.70$; personality: $p = 0.08$) and scales (CPS: $p = 0.73$; ADLH: $p = 0.86$; ABS: $p = 0.09$; Mania: $p = 0.14$; PSS: $p = 0.49$; Pain: $p = 0.33$). More persons in the youngest group had schizophrenia/psychotic disorder, severe aggression, possible substance problem, and positive symptoms, while more in the 25-54 years group had diagnoses related to substances, mood, and anxiety disorders and exhibited signs of daily pain. The oldest most often had moderate or worse cognitive and ADL impairment. Age differences did not

TABLE 3 | Univariate distribution (%) for clinical characteristics overall, and by WSIB status, sex, and age.

	WSIB						Other					
	All	Sex		Age category			All	Sex*		Age category		
		F	M	<25	25-54	55+		F	M	<25	25-54	55+
N	1,091	401	734	53	816	222	448,037	219,504	228,408	73,723	265,205	109,109
DSM-IV categories												
Substance-related^{a,b,c,d,e}	36.66	25.90	42.65	16.98	40.93	25.68	24.90	17.73	31.79	29.59	28.38	13.29
Schizophrenia/psychotic^{a,c,d,e}	16.41	15.13	17.12	35.85	15.32	15.77	36.27	29.80	42.48	39.30	38.66	28.38
Mood^{a,b,c,d,e}	60.49	71.28	54.49	43.40	62.62	56.76	50.81	59.10	42.85	45.78	50.18	55.77
Anxiety^{a,c,d,e}	31.07	31.79	30.67	24.53	34.93	18.47	12.87	15.54	10.29	12.85	13.30	11.83
Personality^{d,e}	8.07	10.00	6.99	11.32	8.58	5.41	10.13	12.76	7.60	13.29	11.10	5.63
Other**												
Moderate or worse cognitive impairment (CPS 3+)^{a,c,d,e}	4.12	3.85	4.28	7.55	2.70	8.56	8.27	8.09	8.45	5.04	5.00	18.42
Moderate or worse ADL impairment ADLH 3+)^{3,4,5}	4.22	4.36	4.14	1.89	3.09	9.01	5.38	5.53	5.25	2.18	2.64	14.22
Severe aggression (ABS 5+)^{a,c,d,e}	4.49	5.90	3.71	9.43	3.55	6.76	9.48	8.90	10.05	10.74	8.35	11.40
Possible depression (DRS 3+)^{1,2,4,5}	65.08	74.36	59.91	54.72	66.91	60.81	57.02	65.01	49.34	54.86	56.65	59.38
Possible substance problem (CAGE 2+)^{a,b,c,d,e}	25.30	15.90	30.53	28.30	27.82	15.32	17.79	13.66	21.76	19.55	20.64	9.69
Any sign of mania (Mania Scale 1+)^{d,e}	54.72	57.69	53.07	62.26	54.66	53.15	56.76	56.54	56.98	59.76	56.61	55.10
Any positive symptom (PSS 1+)^{a,c,d,e}	28.23	29.49	27.53	54.72	25.61	31.53	48.61	45.46	51.65	50.77	48.60	47.20
Any social withdrawal (SWS 1+)^{b,d,e}	61.69	66.15	59.20	62.26	62.62	58.11	59.22	61.49	57.04	57.83	58.89	60.97
Daily pain (Pain Scale 2+)^{a,c,d,e}	38.31	36.41	39.37	3.77	41.67	34.23	12.15	13.89	10.47	4.78	12.48	16.31

**An additional N = 125 identified their sex as "other"; **Includes all other possible DSM-V categories; ^{a}Significant difference between the WSIB and Other group ($p < 0.001$); ^{b}Significant difference by sex within the WSIB group ($p < 0.001$); ^{c}Significant difference by age category within the WSIB group ($p < 0.001$); ^{d}Significant difference by sex within the Other group ($p < 0.001$); ^{e}Significant difference by age category within the Other group ($p < 0.001$).*

exist for personality disorder diagnosis ($p = 0.21$), depression ($p = 0.06$), social withdrawal ($p = 0.47$), and mania ($p = 0.49$).

Within-Other Group Differences by Sex and Age

Different patterns of sex and age-related findings were noted in the other group. Males were more often diagnosed with schizophrenia/psychotic disorder and exceeded cut-offs related to cognition, aggression, mania, and positive symptoms, whereas this was true for anxiety and personality disorders, ADL impairment, and pain among females. In this group, the oldest more often had mood disorder diagnoses and exceeded cut-offs for aggression, depression, social withdrawal, and pain, while signs of mania, substance-related disorders, and personality disorders were most common in the youngest. A potential problem with substances was highest for those 25 to 54 years.

Areas of Need

Table 4 reports on areas of need as measured by CAPs.

Between Group Differences

CAPs for traumatic life events, substance use, weight management, sleep disturbance, and pain were more often triggered in the WSIB group; harm to others, self-care, supports for discharge, criminal activity, personal finances, education and unemployment, control interventions, medication management and adherence, rehospitalization, and smoking were more common in the comparison group. There were no differences for suicidality and purposeful self-harm ($p = 0.06$), social relationships ($p = 0.52$), interpersonal conflict ($p = 0.07$), exercise ($p = 0.71$), and falls ($p = 0.09$).

Within-WSIB Group Differences by Sex and Age

Females in the WSIB group more often had needs related to suicidality and purposeful self-harm, social relationships, interpersonal conflict, and traumatic life events. Males more often triggered CAPs for criminal activity, smoking, and substance use. There were no differences by sex for all other CAPs (p-values ranged from 0.07 to 0.84). The youngest group more frequently triggered almost all CAPs, including harm to others, suicidality and purposeful self-harm, self-care, criminal activity, personal finances, education and employment, medication management and adherence, rehospitalization, and substance use. Traumatic life events, smoking, sleep disturbance, and pain were most common among those aged 25 to 54 years. There were no age differences for social relationships ($p = 0.20$), support for discharge ($p = 0.09$), interpersonal conflict ($p = 0.06$), control interventions ($p = 0.06$), weight management ($p = 0.30$), exercise ($p = 0.26$), and falls ($p = 0.20$).

Within-Other Group Differences by Sex and Age

In the other group, the triggering of all CAPs differed by both sex and age. Different than what was found in the WSIB group, females in this group more frequently triggered CAPs for weight management, exercise, sleep disturbance, pain, and falls. Males more often had needs related to harm to others, self-care, supports for discharge, interpersonal conflict, personal finances, education and employment, control

TABLE 4 | Univariate distribution (%) for areas of need overall, and by WSIB status, sex, and age.

	WSIB						**Other**					
	All	**Sex**		**Age category**			**All**	**Sex***		**Age category**		
		F	**M**	**<25**	**25-54**	**55+**		**F**	**M**	**<25**	**25-54**	**55+**
N	1,091	401	734	53	816	222	448,037	219,504	228,408	73,723	265,205	109,109
Harm to others[a,c,d,e]	20.71	19.49	21.40	39.62	19.11	22.07	32.96	27.70	38.02	38.92	32.37	30.37
Suicidality/purposeful self-harm[b,c,d,e]	41.34	47.95	37.66	60.38	42.90	31.08	38.59	42.06	35.24	46.74	39.98	29.69
Self-care[a,c,d,e]	34.10	35.39	33.38	47.17	40.99	31.37	51.14	48.94	53.26	47.58	47.51	62.34
Social relationships[b,d,e]	55.00	59.49	52.50	62.27	55.76	56.45	54.01	54.75	53.31	61.27	54.39	48.20
Supports for discharge[a,d,e]	27.13	27.95	26.68	26.42	25.61	32.88	33.37	30.83	35.80	30.20	33.59	34.97
Interpersonal conflict[b,d,e]	36.75	41.03	34.38	49.03	37.26	31.98	39.36	38.18	40.51	43.93	38.91	47.39
Traumatic life events[a,b,c,d,e]	25.48	30.00	22.97	26.41	28.18	15.31	15.58	19.94	11.37	16.12	17.06	11.60
Criminal activity[a,b,c,d,e]	22.18	14.10	26.68	30.19	23.65	14.86	32.15	22.35	41.57	37.52	35.16	21.21
Personal finances[a,c,d,e]	18.79	20.52	17.83	54.72	15.31	30.18	25.59	24.62	26.53	20.79	21.97	37.64
Education and employment[a,c,d,e]	30.89	31.28	30.67	33.96	33.83	19.37	33.90	30.75	36.91	57.98	35.86	12.85
Control interventions[a,d,e]	12.10	14.10	10.98	18.86	10.78	15.32	20.98	18.88	22.99	25.66	20.48	19.03
Medication management and adherence[a,c,d,e]	32.45	34.61	31.24	45.28	30.15	37.84	45.62	43.57	47.59	43.23	42.86	53.94
Rehospitalization[a,c,d,e]	29.61	29.23	29.81	49.06	30.52	21.62	42.18	41.25	43.07	39.31	44.47	38.56
Smoking[a,b,c,d,e]	50.23	43.84	53.78	49.06	54.41	35.13	52.37	36.22	49.13	43.45	49.32	26.54
Substance use[a,b,c,d,e]	58.02	47.95	63.62	75.47	61.64	40.54	46.92	39.28	54.27	63.76	50.96	25.73
Weight management[a,d,e]	46.57	50.25	44.50	43.40	47.91	42.34	37.45	43.87	31.29	33.54	38.66	37.18
Exercise[d,e]	24.29	25.39	23.68	20.75	23.40	28.38	23.80	24.99	22.67	19.69	21.61	31.90
Sleep disturbance[a,c,d,e]	48.95	51.03	47.79	33.96	50.74	45.94	37.12	39.11	35.19	33.64	37.37	38.84
Pain[a,c,d,e]	38.32	36.41	39.37	3.77	41.66	34.24	12.15	13.89	10.47	8.68	12.48	16.32
Falls[d,e]	8.74	8.02	9.11	0	8.19	3.51	5.47	6.11	4.87	4.48	10.56	2.64

**An additional $N = 125$ identified their sex as "other"; [a]Significant difference between the WSIB and Other group ($p < 0.001$); [b]Significant difference by sex within the WSIB group ($p < 0.001$); [c]Significant difference by age category within the WSIB group ($p < 0.001$); [d]Significant difference by sex within the Other group ($p < 0.001$); [e]Significant difference by age category within the Other group ($p < 0.001$).*

interventions, medication, and rehospitalization. The youngest group had additional needs around social relationships and control interventions, while this was true for rehospitalization, weight management, and falls among those 25-54 years. The oldest more often had needs related to self-care, supports for discharge, interpersonal conflict, personal finances, medication management and adherence, exercise, sleep disturbance, and pain.

DISCUSSION

This study reports on over a thousand Ontarians whose psychiatric admission was the responsibility—partially or fully—of the WSIB between 2006 and 2016; which is up to 12 years prior to its coverage for chronic mental stress. As such, it is suspected that WSIB was the payor due to a comorbid workplace physical injury or illness, or to severe traumatic experience. Approximately one quarter of individuals in this group had experienced trauma, and presumably, the remainder received coverage related to physical injuries. While those with WSIB coverage represent a small minority of psychiatric admissions, it has been a growing one. As the WSIB expanded coverage to chronic mental stress in 2018, it is expected that the number of admissions will continue to grow. Future studies should examine the profiles of persons admitted since the change in legislation.

In this study, the WSIB group tended to be comprised of males, which is consistent with the distribution of WSIB claims; for example, between 2006 and 2016, males represented 57–64% of all WSIB claims (21). Similar distributions have been reported in other provinces (22). The age distribution across all WSIB claims within the same time frame, however, is different. While the majority of claims were made by individuals between 40 and 54 years of age in both populations, those in this age bracket represented 40.35% of all WSIB claims and 49.86% of the study population. The biggest difference was seen amongst people under the age of 25, who represented 12.22% of claims and 4.51% of the study population (21). In Ontario, longer claim duration was associated with older age (23), and longer unemployment is associated with psychological distress (24). Future studies that use data linkage between WSIB claims and interRAI are needed to better understand the timing of injury, claims, and admissions. This would help to understand whether those in this study were older because they were older at the time of their injury, or because they were off of work for a longer duration and experienced negative mental health consequences because of longer unemployment.

The personal characteristics of the WSIB group were different than that of the comparison group. There were more people in the WSIB group who were married and living with a spouse than in the group not covered by the WSIB. This may help to explain the finding that fewer people in the WSIB group triggered for potential problems with availability of a support system after discharge, though it is important to note that more than one quarter did. Further, eligibility for coverage by WSIB means that these individuals had been employed, making them less likely to trigger the two CAPs related to economic issues. Again though, it needs to be noted that almost a third of individuals in the WSIB group did have issues related to education and employment, and so return to work—to either previous or new employment, or possibly retraining/education remain areas of concern.

In terms of the clinical characteristics and areas of need, the findings reported in this study are in line with the literature showing increased depression (24–26), substance use (27–29), and pain (30) among those who have experienced workplace injury. The literature has also described the co-occurrence and relationships between workplace injury, pain, depression, and substance use (30). While beyond the scope of this descriptive study, such relationships could easily be examined in the data. For example, subsequent analyses (not shown) revealed that 31.74% in the WSIB group experienced daily pain, and this increased to 47.88% among those admitted for addiction or dependency; that about two thirds of males in the WSIB group had needs related to substance use, and this increased to 72.46% among those with daily pain. That pain, depression, and substance use each represent chronic conditions provide impetus for further exploration of these relationships in the data cross-sectionally and longitudinally. Given that the interRAI instrument also collects information related to service use and is completed at the time of discharge, evaluation of adequate pain management on outcomes and the extent to which it may potentially reduce the likelihood or severity of mental health issues are possible, as is looking at impact on length of stay.

The use of sex- and age-based analyses further describes the specific needs of injured workers admitted to inpatient psychiatry. In particular, that almost three quarters of females in the WSIB group showed signs of clinically relevant depression, as well as more traumatic life events and issues related to social relationships, interpersonal conflict, and suicidality and purposeful self-harm represents a very different profile than males. Many of these needs were also shown to be more prevalent in the youngest group (i.e., under 25 years). More specifically, they had more needs related to safety (suicidality and purposeful self-harm, harm to others, self-care), social life (criminal activity), economic issues (personal finance, education and employment), and autonomy (medication management and adherence, rehospitalization), and displayed more severe aggression, positive symptoms, and issues with substances. While in and of itself, it is not surprising that the youngest group would more often experience some of these issues (e.g., related to education, personal finances), it is somewhat surprising that they are experiencing higher rates of *most* issues assessed in the instrument. While a recent systematic review examined associations between work-related stressors and the mental health of young workers (31), to our knowledge, the focus of research on younger injured workers remains largely on the physical aspects of the injuries. This study points to the need for additional focus on the mental health needs and outcomes among young injured workers. Further research that examines clinical needs among males and females of different ages is recommended. In addition, longitudinal research is needed on outcomes over time, including rehospitalization, to better understand the factors influencing recovery. That just under half of those under the age of 25 years were at risk for rehospitalization further points to the complexity of issues facing this group and the need to intervene as soon as possible.

The interRAI instrument contains over 300 items on the strengths, preferences, needs, and service use in inpatient psychiatry, but it does not cover work-related disability specifically. As such, it does not provide information on the timing or nature of the work-related injury. Similarly, the instrument assesses for presence of traumatic events, depression, self-harm, substance us, and pain, for example, but does not have specific information on the timing of onset. Intersectoral collaboration is needed to develop mechanisms to link WSIB and inpatient psychiatry data to better understand the mental health needs of injured workers, and to explore the causal pathways involved.

A major strength of this study is the scope of variables included. The instrument's items, scales, and CAPs have demonstrated reliability and validity, and allow researchers to analyze a range of characteristics, thus providing a comprehensive description of the study population. A second strength is the population-based nature of the data. All persons admitted into a psychiatric facility or psychiatric unit in a hospital are required to be assessed with this instrument. Therefore, the entire population of interest is included in this study. A limitation, however, is that there is no way to know why the person was covered by the WSIB, nor when this occurred. They could have had a physical injury or a severe traumatic experience at work that resulted in work disability, which could have happened 5 years ago or 1 year ago. As stated previously, future studies linking WSIB claims and interRAI inpatient psychiatry population data are recommended. This will become increasingly important given the 2018 policy change to include coverage for chronic mental stress. Another drawback includes the inability to assess the timeline of the mental illness that led to the admission of the individual at a psychiatric facility and the injury that resulted in WSIB coverage. It would be interesting to see the effects of time off work on mental health illness, as well as the order of events between work injury and mental health illness.

CONCLUSION

This paper provides a description of individuals who had their inpatient psychiatric stay paid for by WSIB (at least partially) over an 11-year period. Future studies should examine impacts of the policy introduced in January 2018 to determine whether changes are observed in the characteristics and needs of individuals admitted to inpatient psychiatry for (or related to) work-related mental health injuries. Sex- and age-based analyses are also needed to further elucidate the relationships observed. Data linkage with WSIB claims would allow further understanding of the circumstances of the workplace injury, as well as potentially enable understanding of causal pathways between workplace injury and mental health.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: The data are made available to interRAI Fellows for research use under an existing license agreement interRAI has with the Canadian Institute for Health Information; note that the agreement is for research only, not commercial use. Students working under the supervision of an interRAI Fellow can apply for free access to the data, but are subject to terms of use. As part of interRAI's agreement with the Canadian Institute for Health Information, the data may not be transmitted to third parties; therefore, the data used in this study cannot be made available to others. Those interested in using the data can apply directly to the Canadian Institute for Health Information for access. Requests to access these datasets should be directed to https://www.cihi.ca/en/access-data-and-reports/make-a-data-request.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The ethics committee waived the requirement of written informed consent for participation.

AUTHOR CONTRIBUTIONS

MH conducted the analyses of the data, with input from the LM and VK. MH drafted the initial version of the manuscript, with major writing contributions by the LM. VL finalized the manuscript. All authors contributed to the development of the study topic and design, and provided valuable and important feedback on the manuscript to its completion.

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BRIEF RESEARCH REPORT
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Longitudinal Trends and Risk Factors for Depressed Mood Among Canadian Adults During the First Wave of COVID-19

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Background: The COVID-19 pandemic has raised serious concerns about the mental health impact of people directed and indirectly affected by the virus. Because this is a rapidly evolving situation, our goal was to explore potential risk factors and trends in feelings of anxiety and depression among the general population in Canada over the first 5 months of the pandemic.

Methods: We completed on-line surveys of 3,127 unique individuals representative of the Canadian general population at 4 discreet periods every 6 weeks from April 15th to July 28th 2020. We assessed feelings of anxiety, depression and loss of interest with the interRAI self-reported mood scale using a multivariable generalized estimating equation model to examine factors associated with having a 5+ score on the scale (indicating potentially depressed mood). We also investigated potential longitudinal trends to examine temporal variation in mood scores.

Results: More than 30% of participants felt highly anxious, depressed, and disinterested in everyday activities in the first survey (April), but this number decreased to about 20% over 4 months. Feeling lonely, younger age, feeling overwhelmed by one's health needs, having financial concerns, and living outside of Québec were significantly associated with depressed mood.

Interpretation: The prevalence of depressed mood during the pandemic was between 2 and 3 times the pre-pandemic rate (especially among young people), but it can change rapidly in response to social changes. Thus, monitoring of psychological distress among vulnerable groups that may benefit from additional supports should be a priority.

Keywords: mental health care, depression mood, anxiety, general population, coronavirus–COVID-19

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INTRODUCTION

There has been a growing concern that, without focused mitigation efforts, the COVID-19 pandemic has the potential to increase mental health problems worldwide (1–12). In addition to fear of contracting COVID-19, lock-downs, uncertainty, self-isolation and social distancing are disrupting everyday lives, creating personal, social and economic challenges with potential negative psychological effects (10, 11) despite the fact that public health guidelines, such as face mask use, can have positive effects on stress and anxiety (3). Quarantine has been reported to cause post-traumatic stress symptoms, confusion, and anger with potentially long lasting effects (4) and depression and anxiety were estimated to be higher among quarantined individuals during the initial stages of COVID-19 in China (10). In addition, risk factors for mental health problems during COVID-19 are reported to include female gender, younger age, presence of chronic and psychiatric illnesses, unemployment, student status, and frequent exposure to social media or news concerning the pandemic (5–10). This means that the general population can also be adversely affected by mental health consequences of pandemics and mental health considerations should be taken into account in addition to the physical effects of the virus (4, 10, 13).

Although these studies provide good evidence of the importance of understanding the mental health impact of COVID-19 on the general population, it is still not clear how these negative effects might change with the dynamics of COVID-19 and the changes in the public health policies aiming to contain its spread. This is important because most of these studies were conducted as cross-sectional snapshots at varying time periods of the pandemic, making comparison among studies difficult (10). The objective of this study is to examine the mental health impacts of COVID-19 as well as longitudinal changes in the general Canadian population.

METHODS

Web-Based Survey

We conducted longitudinal web-based interviews with the general adult population in Canada from April to July in four discrete surveys, 4–6 weeks apart from each other (**Table 1**). We used a professional polling company to obtain a sample that was representative of the Canadian population (**Table 1**) when applying survey weights. Participants were recruited via phone (60%), invitation (25%), social media (5%), offline recruitment (5%), partnerships and campaigns (5%). Among the 3,127 participants, ∼80% were present in two or more surveys and 1,510 (66%) were present in all surveys (**Table 1**). Mental health status was assessed with three questions from the interRAI self-reported mood scale, which assesses levels of anxiety, depression, and loss of interest (14). The questions were: "In the last 3 days, how often have you felt: (a) anxious, restless, or uneasy, (b) sad, depressed, or hopeless and (c) little interest or pleasure in things you normally enjoy." Each item has scores ranging from 0 (not present) to 3 (daily), and scores for the three items are summed to create a scale with a value between 0 and 9. Higher scores representing more frequent and varied mood symptoms (Cronbach's alpha = 0.81). We set a threshold for having substantially depressed mood at 5 or more based on previous analyses that indicate this threshold to be associated with suicide-related ideation in community mental health populations (results available on request). Socio-demographic variables and main concerns before and during the pandemic (e.g., financial concerns, food insecurity levels, and loneliness) were also assessed during the interviews (**Tables 1**, **2**).

Statistical Analysis

To understand the risk factors associated with the mental health impact of COVID-19, we used a bivariate regression with the percentage of respondents with a 5+ score in the self-reported mood scale as response variable and socio-demographic factors as explanatory variables (**Tables 1**, **2**). This threshold has been shown to be associated with clinical depression and self-harm ideation in community mental health populations (results available on request). We compared Quebéc with the rest of Canada because of known differences in mental health state of populations of these two geographic regions (15, 16), which may be a result of cultural differences (i.e., Québec is mainly francophone while the rest of Canada is predominantly anglophone). For simplicity, we only used data from survey 1 for an initial logistic regression model given that the levels of depression, anxiety and loss of interest were stronger at this stage (**Figure 1**). We then examined a longitudinal interaction between age and survey in a generalized estimating equation model to investigate potential temporal trends in the mental health impact among different age groups. We focused on age because of the great physical health burden that COVID-19 has on older adults (10, 17). We did not find a significant interaction between age and survey wave. Therefore, we presented the model with main effects only. We weighted all analysis using the survey weights to match the sample to population distributions in the latest Statistics Canada census according to gender, age, region, education, mother tongue, living arrangements, and presence of children in the household. We used data from a general population survey done in the Waterloo Region in 2011 (data available upon request) to compare our results with a base level of the same indicators for the general population before the beginning of the COVID-19 pandemic. The baseline level of scores of 5+ on the self-reported mood scale in those surveys ranged between 6.5% in 2011, which is comparable to anxiety (6.3–50.9%, including mild to severe levels) and depression levels (3.6–7.2%) reported in other studies conducted before the pandemic (18). To provide contextual information, daily COVID-19 cases (**Figure 1**) were obtained from Berry et al. (19) and figures were produced with the *ggplot2* package in R (20).

RESULTS

We found that up to 44.3% of the participants had substantial level of depressed mood based on indicators of anxiety, depression and loss of interest in the April survey. Only education and ethnicity were not significant risk factors in the bivariate analysis (**Table 2**). The final multivariable model indicated that age [$F_{(4, 2216)} = 7.26$, $P < 0.001$], province [$F_{(1, 2219)} = 6.14$, $P = 0.013$], feeling overwhelmed by one's health needs [$F_{(1, 2219)} = 29.56$, $P = 0.001$], loneliness [$F_{(1, 2217)} = 52.37$, $P < 0.0001$], and financial concerns [$F_{(1, 2218} = 7.13$, $P < 0.001$] were significantly associated with depressed mood [$F_{(11, 2209)} = 56.74$, $P < 0.001$; c-statistics = 0.836]. The odds of having a depressed mood were 2.62 times higher in young

TABLE 1 | Profile of the participants in each survey.

	Survey 1 April 15–20th	Survey 2 May 6–13th	Survey 3 June 3rd–9th	Survey 4 July 22–28th
N*	2,200	2,264 (314)	2,280 (352)	2,201 (241)
Recontacts in previous survey	na	86%	84%	87%
Gender				
Male	48%	48%	49%	49%
Female	52%	52%	51%	51%
Age				
18–34	27%	27%	26%	24%
35–54	34%	34%	36%	37%
55–64	17%	17%	17%	17%
65–74	12%	12%	12%	12%
75+	9%	9%	9%	9%
Province				
British Columbia	14%	14%	14%	14%
Alberta	11%	11%	11%	11%
Manitoba/Saskatchewan	6%	6%	7%	7%
Ontario	38%	38%	38%	38%
Quebec	23%	23%	23%	23%
Atlantic	7%	7%	7%	7%
Region				
Quebec	23%	23%	23%	23%
Rest of Canada	77%	77%	77%	77%
Area type				
Urban	88%	89%	90%	90%
Rural	12%	11%	10%	10%
Mother tongue				
French	21%	20%	20%	20%
English	67%	66%	66%	65%
Other languages	12%	13%	14%	14%
Ethnic origin				
Caucasian (White)	83%	81%	81%	80%
Aboriginal/First nations	1%	1%	1%	1%
Black	2%	2%	2%	2%
Chinese	3%	5%	5%	5%
Other	9%	10%	10%	10%
Children in the household				
Yes	28%	28%	28%	28%
No	72%	72%	72%	72%
Living situation				
Alone	20%	20%	21%	21%
With spouse (partner only)	32%	31%	32%	32%
With spouse/partner and other(s)	27%	27%	26%	26%
With child(ren) (no spouse/partner)	5%	5%	6%	6%
With parent(s) or guardian(s)	9%	11%	10%	10%
With sibling(s)	1%	1%	1%	1%
With other relative(s)	2%	2%	2%	2%
With nonrelative(s)	3%	3%	3%	3%
Vulnerable senior				
Yes	na	2%	2%	2%
No	na	98%	98%	98%

(Continued)

TABLE 1 | Continued

	Survey 1 April 15–20th	Survey 2 May 6–13th	Survey 3 June 3rd−9th	Survey 4 July 22–28th
Education				
Elementary/High school	33%	31%	32%	30%
College	40%	41%	41%	43%
University	27%	27%	27%	27%
Occupation				
Office/services/sales	na	23%	22%	23%
Manual worker	11%	10%	10%	9%
Professional	19%	19%	20%	20%
Homemaker	3%	4%	4%	4%
Student	7%	7%	7%	6%
Retired	27%	27%	28%	28%
Unemployed	5%	5%	5%	4%

**Number of participants added to each survey: 314, 352, and 241 in surveys 2, 3, and 4, respectively.*

(18–24) than older adults [65+; 95% confidence interval (CI) 1.58–4.32, $P < 0.001$], 1.64 times higher in people from other provinces compared to Québec (95% CI 1.11–2.43, $P = 0.013$), 3.92 times higher in people who felt overwhelmed by their health needs (95% CI 2.39–6.41, $P < 0.001$), 16.65 times higher in people who felt lonely daily compared to those that did not feel lonely (95% CI 10.49–26.42, $P < 0.0001$) and 1.93 times higher in people that had financial concerns before and after the pandemic than people without financial concerns (95% CI 1.35–2.77, $P < 0.001$; **Figure 1** and **Table 2**). We found a significant temporal trend in the generalized estimating equation model, suggesting a decrease in the odds of depressed mood over time compared with the initial stage of the survey done in April 2020 (**Figure 1** and **Table 3**).

DISCUSSION

Interpretation

Our study provided a longitudinal view of the mental health impact of COVID-19 on about 3,000 participants followed over a 4-month period. The impact was most pronounced on the mental health of younger Canadians and those who reported feeling lonely. In addition, the odds of serious mood disturbance were strongest at the beginning of the pandemic (April), with a rapid decrease from April to July. However, the absolute levels in July were still 2 times higher compared to the pre-pandemic levels. Although there appears to be potential for resilience and fast recovery in part of the population, the absence of complete recovery could result in even higher levels of anxiety and depression during new waves of the pandemic.

Our results are in line with other studies on the mental health effects of COVID-19, both in the strength of the association and key risk factors (7, 10, 21–23). A meta-analysis found that during the pandemic, prevalence of depression symptoms was 33.7% (95% confidence interval 27.5–40.6) and 31.9% for anxiety [95% CI 27.5–36.7; (10)]. As in our study, these levels were, in average, higher than the pre-pandemic levels we noted in earlier studies based on our measure (between 6.5 and 9.7%) as well as comparable rates reported by others (10). Other longitudinal studies have reported a mix of results, with small increases in feelings of depression and decreased anxiety (24) or no trend overall (25). We showed roughly a 30% decrease in the odds of disturbed mood spanned a 4-month period, whereas other longitudinal studies investigated trends over a much shorter time period (24, 25). Some of the discrepancies reported in the published literature could be explained by the phase of the pandemic when the study was conducted.

We also observed that young respondents were among the most affected groups, even after controlling for potential confounding factors such as employment status, gender, health, and economic status. This may reflect a true age-group difference in the COVID-19 experience, but it may also reflect generational differences in comfort related to reporting mental health symptoms. Student status and gender have been identified as risk factors in other studies (10, 26), but these were only significant in our bivariate model. Although student status was strongly associated with age, which may explain it not persisting as a predictor of mood disturbance in the multivariable model, it is less clear why gender was not a significant risk factor when we controlled for other sociodemographic variables.

Although the levels of anxiety and depression reported here are in line with the published literature (10, 17), COVID-19 happened during a time of changing public sentiment about global political, economic, and climate stability with increased focus on natural disasters like wild fires (e.g., bushfires in Australia and California), flooding (e.g., Fort McMurray, Canada), and an increase in public protest related to racial equality. These events might be local and sometimes outside of Canada, but the coverage was widespread and persistent in the media at the time they occurred, which may have negatively affected mental health of Canadians (27). Thus, it is unclear from our results whether the pandemic was the primary driver of changes in mood that we observed or it was only one of the

TABLE 2 | The association between score of 5+ on self-reported mood scale and a number of risk factors.

	Bivariate analysis unadjusted OR			**Multivariable analysis adjusted OR**		
	OR	**95% CI**	***P*-value**	**OR**	**95% CI**	***P*-value**
Age (years)			**< 0.001**			**< 0.001**
18–24 vs. ≥ 65	5.61	3.43–9.17	< 0.001	2.62	1.58–4.32	< 0.001
25–34 vs. ≥ 65	3.52	2.37–5.22	< 0.001	1.96	1.21–3.17	0.006
35–44 vs. ≥ 65	3.39	2.28–5.03	< 0.001	2.67	1.73–4.14	< 0.001
45–64 vs. ≥ 65	2.31	1.69–3.15	< 0.001	1.88	1.30–2.72	< 0.001
Gender			**0.004**			
Female vs. Male	1.49	1.13–1.95	0.004			
Province			**< 0.001**			**0.01**
Others vs. Quebec	2.1	1.49–2.94		1.64	1.11–2.43	
Language			**< 0.001**			
English vs. French	1.89	1.33–2.69	< 0.001			
Bilingual vs. French	3.21	1.59–6.47	0.001			
Others vs. French	1.90	1.08–3.35	0.03			
Education			0.70			
College vs. Elementary/High school	0.94	0.66–1.33	0.73			
University vs. Elementary/High school	1.07	0.77–1.47	0.69			
Living with			**< 0.001**			
Spouse/partner vs. Alone	0.75	0.52–1.08	0.12			
Parent/guardian vs. Alone	1.99	1.16–3.40	0.01			
Other relatives vs. Alone	1.23	0.86–1.76	0.25			
Non-relatives vs. Alone	2.16	0.98–4.77	0.06			
Occupation			**< 0.001**			
Homemade vs. Manual worker	0.94	0.41–2.12	0.88			
No answer vs. Manual worker	5.33	1.46–19.49	0.01			
Retired vs. Manual worker	0.43	0.32–0.57	<0.001			
Student vs. Manual worker	1.78	1.04–3.04	0.04			
Unemployed vs. Manual worker	1.31	0.69–2.49	0.42			
Ethnicity			0.07			
Caucasian vs. Other	1.01	0.69–1.48	0.94			
No answer vs. Other	3.49	1.17–10.43	0.03			
Health before Covid19			**< 0.001**			
Fair vs. Excellent/good	1.93	1.35–2.80	0.003			
Poor vs. Excellent/good	3.81	1.57–9.26	< 0.001			
Health in the past month			**< 0.001**			
Fair vs. Excellent/good	2.73	1.98–7.36	< 0.001			
Poor vs. Excellent/good	6.15	3.01–12.52	< 0.001			
Family overwhelmed by one's health needs						< 0.001
Yes vs. No	4.87	3.13–7.56	< 0.001	3.92	2.39–6.41	
Feel lonely			**< 0.001**			**< 0.001**
Only in specific situations/I do not feel lonely	2.84	1.75–4.62	**< 0.001**	2.20	1.31–3.70	0.003
Occasionally/I do not feel lonely	4.74	3.1–7.22	**< 0.001**	3.80	2.45–5.91	< 0.001
Daily/I do not feel lonely	21.31	13.66–33.26	**< 0.001**	16.65	10.49–26.42	< 0.001
Financial status–difficulty making ends meet			**< 0.001**			
Before and after COVID-19 vs. None	3.37	2.45–4.64	< 0.001	1.93	1.35–2.77	0.003
Before or after COVID-19 vs. None	2.39	1.70–3.37	< 0.001	1.69	1.11–2.58	0.02
Have a way–get food and medication			**< 0.001**			
Yes vs. No	2.77	1.65–4.66	**< 0.001**			

(Continued)

TABLE 2 | Continued

	Bivariate analysis unadjusted OR			Multivariable analysis adjusted OR		
	OR	**95% CI**	***P*-value**	**OR**	**95% CI**	***P*-value**
Feel safe and comfortable in home			**< 0.001**			
Sometimes vs. Never	0.56	0.20–1.56	0.27			
Always vs. Never	0.12	0.05–0.32	< 0.001			
Have people–count on			**< 0.001**			
Sometimes vs. Never	0.54	0.31–0.96	0.04			
Always vs. Never	0.27	0.16–0.44	< 0.001			
Can get help if needed			**< 0.001**			
Sometimes vs. Never	0.53	0.32–0.87	0.01			
Always vs. Never	0.23	0.15–0.36	< 0.001			

Odds ratio were calculated with a bivariate (unadjusted) and multivariable (adjusted) analysis in survey 1 (April 10–15th).
Bold values represent significant values at $\alpha = 0.05$.

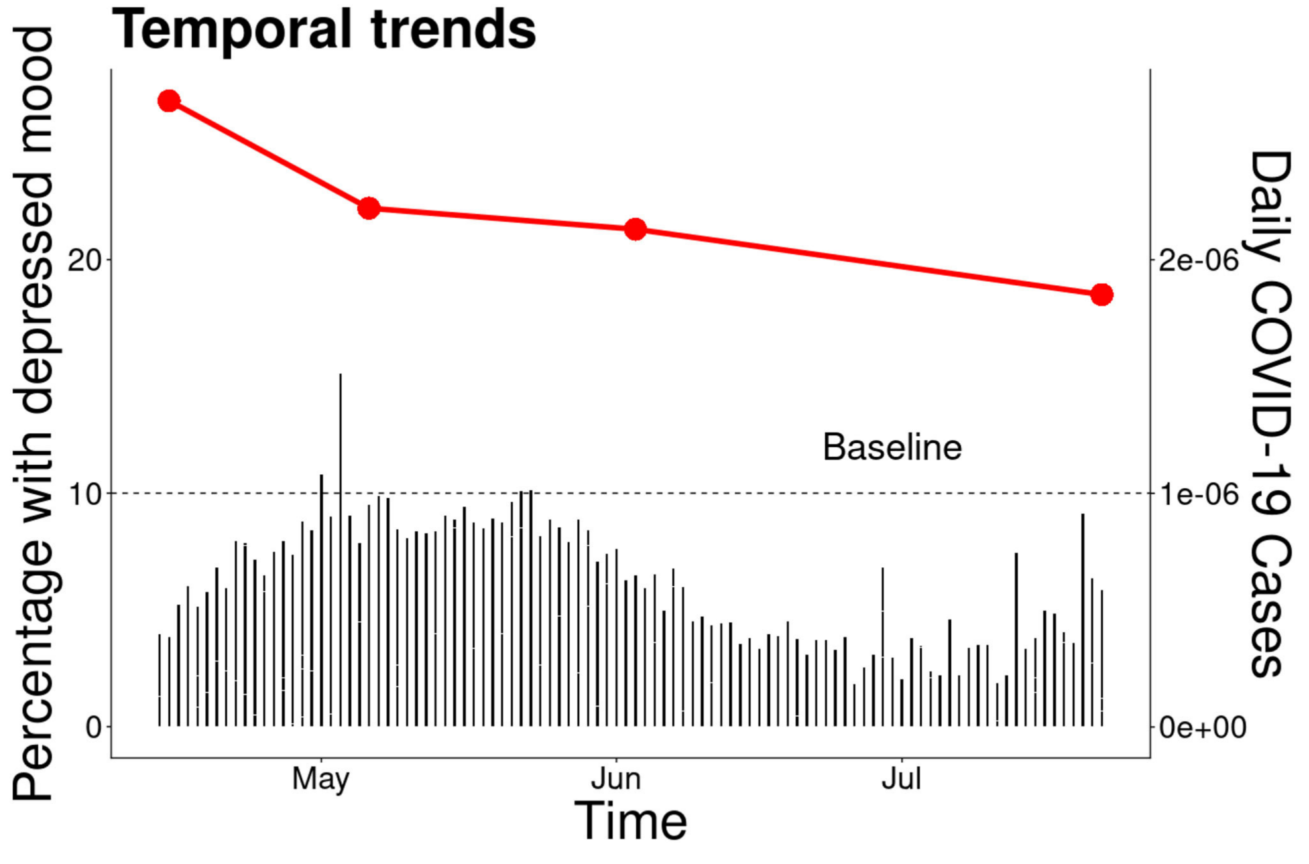

FIGURE 1 | Longitudinal trends in percentage of participants with 5+ score on the self-reported mood scale by study survey.

many contributors, potentially acting as an amplifier of these other source of stress (28).

The negative effects of COVID-19 on the mental health we observed are in agreement with studies conducted in other countries. However, the pandemic also brought some opportunities to improve mental health services via virtual care. For example, a recent meta-analysis strongly suggest that digital cognitive behavioral therapy for insomnia is highly effective (29) and telemedicine and virtual software can help to stop the spread of COVID-19, decrease the use of hospital resources while

TABLE 3 | The association between the self-report mood scale score of 5+ and a number of risk factors over four study waves.

Parameter	Estimate	95% CI		*Z*	*P*-value	Adjusted OR	95% CI	
Intercept	−2.761	−3.126	−2.398	−14.87	<0.001			
Age group (ref = 18–24)								
25–34	0.12	−0.20	0.45	0.74	0.45	1.13	0.82	1.56
35–44	−0.23	−0.58	0.12	−1.28	0.20	0.79	0.56	1.13
45–64	−0.25	−0.54	0.03	−1.73	0.08	0.78	0.58	1.03
65+	−0.79	−1.07	−0.51	−5.56	<0.001	0.45	0.34	0.60
Province (ref = Quebec)								
Others	0.26	0.05	0.46	2.46	0.01	1.30	1.05	1.59
Health status (ref = no concerns)								
Overwhelmed by one's health needs	1.33	1.05	1.62	9.16	<0.001	3.80	2.85	5.05
Loneliness (ref = not lonely)								
Lonely only in specific situations	0.74	0.45	1.03	4.94	<0.001	2.09	1.56	2.80
Lonely occasionally	1.39	1.14	1.64	10.83	<0.001	4.02	3.13	5.17
Lonely daily	2.96	2.69	3.22	22.11	<0.001	19.29	14.84	25.07
Financial status (ref = no worries)								
Financial worry before and after COVID-19	0.69	0.48	0.89	6.56	<0.001	2.00	1.62	2.45
Financial worry before or after COVID-19	0.62	0.38	0.86	5.09	<0.001	1.86	1.46	2.35
Study wave (ref = Survey 1)								
Survey 2	−0.23	−0.46	0.01	−1.89	0.06	0.80	0.63	1.01
Survey 3	−0.27	−0.52	−0.03	−2.20	0.03	0.76	0.60	0.97
Survey 4	−0.32	−0.57	−0.07	−2.52	0.01	0.72	0.56	0.93

Odds ratio were calculated with a longitudinal multivariable generalized estimating equation model.

treating patients (30). Therefore, virtual care could improve the accessibility of treatments even during lockdowns and potentially increase the use of these services after the pandemic.

We observed clear trends on mental health indicators on a period of 4 months, but we still do not know what the long-term consequences of COVID-19 will be nor what policies will successfully mitigate its mental health impacts. Information on the long-term impact of past pandemics, such as the Spanish Flu, is scarce. However, some studies reported that people developed psychiatric disorders several years after the 2003 SARS-CoV-1 pandemic (31). Moreover, studies on natural disasters, such as hurricane, fires and earthquake also point to long-term effects where lifetime post-traumatic stress disorder rates can be up to 40% higher in disaster survivors compared to controls (32, 33). Finally, studies have shown that the pandemic have exacerbated racial, social, and economic disparities (34, 35), which could also persist for many years after the pandemic. Given the substantially elevated levels of distressed mood compared with pre-COVID-19 levels, it is important to monitor whether long-term mental health effects persist in the general population.

Limitations

Our overall response rate was in the 35% range and the assembled sample was representative of Canadians. In addition, by repeatedly sampling more than 80% of the same individuals over time, we are confident that temporal trends were accurately measured. Despite this, vulnerable groups may not have been well represented. For instance, older socially isolated adults, persons in facility-based settings (e.g., long-term care), and marginalized groups may not have internet access or may not be able to participate because of other barriers (36–38). In addition, depressive symptoms tend to decrease with age (39, 40). Thus, the absolute values of our mental health indicators might be biased, specifically among older adults (65+), despite the fact that socio-demographic factors were weighted in the statistical analysis. Fortunately, non-response to surveys does not substantially harm the ability to estimate associations among variables including to investigate temporal trends (36). Another limitation in our web-survey approach is the small subsample sizes of minority groups who may be deferentially affected by mental health concerns. Future efforts to examine the impact of COVID-19 on race and ethnicity should over-sample minority groups to allow for adequate subsample sizes.

CONCLUSIONS

In our survey, we showed that the pandemic increased feelings of anxiety, depression, and loss of interest symptoms 2–3-fold, especially in young people. We also documented that these changes can rapidly decrease in a short period of time. One potential explanation for these changes is the influence that external social trends can have on mental health, such as implementation of broad social policies related to epidemic control (2, 3), communications from media (27), health experts, and political leadership. Future studies should focus not only on the description of the mental health consequences, but also in establishing evidence of possible causal relationships between the dynamic of the disease, public health policies and mental health indicators. For example, it would be important to tease apart the effects of fear of disease, subjective and objective aspects of social isolation, economic uncertainty, and other challenges to mental health.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors on request, contingent on approval of the University of Waterloo Office of Research Ethics.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University of Waterloo's Research Ethics Committee (ORE#42932). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JH, CP, NH, and PH designed the study. JH and RA analyzed the data. GB wrote the first draft of the manuscript. All authors discussed the ideas and commented on subsequent drafts of the manuscript.

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Health Patterns Reveal Interdependent Needs of Dutch Homeless Service Users

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Background: Homelessness is an increasing problem in Western European countries. Dutch local authorities initiated cross-sectional reviews to obtain accurate health and needs information on Homeless Service (HS) users.

Methods: The Homeless People Treatment and Recovery (HOP-TR) study uses a comprehensive assessment strategy to obtain health data. Using a naturalistic meta-snowball sampling in 2015–2017, 436 Dutch HS users were assessed. The lived experience of HS users was the primary data source and was enriched with professional assessments. The InterRAI Community Mental Health questionnaire and "Homelessness Supplement" provided information in different areas of life. The approach for mental health assessments was transdiagnostic. Raw interview data were recoded to assess health and needs. The positive health framework structured symptomatic, social, and personal health domains relevant to recovery.

Results: Most subjects were males, low educated, with a migration background. The majority were long-term or intermittently homeless. Concurrent health problems were present in two domains or more in most (95.0%) subjects. Almost all participants showed mental health problems (98.6%); for a significant share severe (72.5%). Frequent comorbid conditions were addiction (78%), chronic physical conditions (59.2%), and intellectual impairments (39.9%).

Conclusion: The HOP-TR study reveals significant concurrent health problems among Dutch HS users. The interdependent character of different needs requires an integrated 3-D public health approach to comprehensively serve symptomatic, social, and personal dimensions, required to facilitate recovery.

Keywords: homelessness, marginalization, mental and physical health, transdiagnostic approach, interRAI community mental health questionnaire, comorbidity rates, inclusion health, public mental health

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INTRODUCTION

Homelessness is one of the most extreme forms of social marginalization in contemporary society (1–3). Lacking a place to live adversely affects people's life expectancy, health, autonomy, and quality of life (4–7). The literature on health and risk profiles of homeless populations reveals exclusion mechanisms, resulting in extreme inequities. The transgenerational impact of homelessness is documented in a Danish register-based cohort study (8). Fazel, Geddes, and Kushel published a critical overview article on homelessness's health consequences in high-income countries (5). Homelessness is a multi-problem issue, often including mental illness, substance abuse, and physical illness. Access to care is low, and regular homeless services fail to monitor crucial life domains such as health. More recent publications incite a dialog on social injustice and plead for inclusion health, to ascertain that socially excluded citizens also have access to the highest care standards (9).

For several reasons, knowledge of health problems in homeless populations is fragmented and incomplete. First, the welfare system is the primary care network for homeless people. Medical records are unavailable since professionals assess people without knowledge or skills to systematically collect and interpret health information. Second, homeless people have other survival priorities. Financial problems often interfere with care access and engagement. Third, traditional censor data often use addresses as sampling frames. Consequently, people without an address are excluded from monitoring and underrepresented in health surveys. Finally, the categorical nature of dominant psychiatric classifications (such as the Dsm-5 system) hinders the collection of relevant mental health data (10). As a result, information on comorbid conditions and other needs relevant to recovery is masked.

Scientific evaluations of homelessness interventions in the past decade increasingly comprised indicators of behavior, quality of life, resilience, and personal perceptions (11–13). Still, mental health data are mainly collected from the perspectives of healthcare professionals. The literature on health problems in homeless populations that combines both HS users' and professional views is scarce.

In the Netherlands, the number of homeless people has doubled since 2009 (14). Recent monitoring data on homelessness is unavailable after discontinuing the National Strategy Plan for Social Relief in 2014 (15, 16). The figures of Netherlands Statistics (CBS) only include the most visible, nuisance-giving roofless part of the Dutch homeless population (17). By contrast, the definition of the European Typology of Homelessness and housing exclusion (ETHOS) is broader and contains people who are roofless, houseless, or living in insecure or inadequate homes (18). Thus, CBS statistics underestimate the prevalence compared to ETHOS categories. CBS health data (19) are limited to the care prevalence of mental health issues, as registered in insurance declarations (in 2012–2016; present in 46%).

The CODA-G4 study[1], a multisite cohort study for monitoring the Dutch national action plan to end homelessness (2011–2013), collected health data on Homeless Service (HS) users. The cohort was designed to identify predictors of quality of life and stable housing (20, 21). More than 500 homeless people participated in the initial assessments, that included health using inventories and questionnaires. Compared to the general population, the homeless people scored high on somatization, depression, and anxiety on the Brief Symptom Inventory-18 (22). In the adult HS user group (23 years and older), 42.7% reported cannabis use, and 28.5% drinking five or more alcoholic drinks at one occasion in the previous month. Substance use was absent in 42.3%. Intellectual disability was suspected in 29.5% of cases (23). The results for young and older adults were described separately. Comorbid overlap was unavailable. The only documented comorbidities were Intellectual Disability (ID) and substance use. Half the persons with suspected ID also reported regular substance use within the last 12 months (51.8%).

The HOP-TR study was initiated by local authorities to provide service planning information. The primary study objective was to optimize services and enable sustainable recovery of marginalized individuals with complex needs. An integrated assessment strategy was developed to collect relevant health data. It contains a broad assessment of health aspects in different areas of life. The screening focus shifts from marginalization trajectories to recovery processes. Human rights provided context to assess health and needs. Different domains are reviewed to gain insight into the interaction of homeless people with care networks. The positive health framework structures the data domains and their mutual relations: symptomatic (physical and mental), social, and personal health (24, 25). A complete description of the design and assessment approach was described in a separate paper (26). This paper presents the results in this study on the symptomatic health domains.

METHODS

Design and Participants

The HOP-TR study was initiated to fulfill local needs for accurate management information on HS users' health and needs. Between March 2015 and November 2017, a multistage cross-sectional design was used to collect data on Dutch HS users in different shelters and homeless services. A double snowball sampling was used to obtain data: sampling of settings and sampling of individuals within settings. In the selection of consecutive locations (naturalistic meta-snowball of services), the regional spreading and facility types were monitored until saturation occurred. In each facility, a participatory approach was used to recruit the original HS users (snowball sampling of individuals). They were asked to name similar subjects and these were also interviewed until the sample was representative. Sixteen facilities in seven cities and 436 HS users participated in the study.

Instruments

A comprehensive assessment strategy was developed to collect health data in semi-structured interviews. All interviews were conducted by an independent researcher with a professional background as a medical doctor (first author: CvE). The lived experience of HS users was the primary source of data. Additional professional assessments were added. Open questions were used to collect personal biographies, including homelessness history, social context, care history, and personal goals. The ETHOS Typology of all subjects was assessed (18).

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[1] "Cohortonderzoek Dak- en thuislozen in de G4" (Cohortstudy of homeless people in the G4); the G4 acronym indicates the four big Dutch cities: Amsterdam, Rotterdam, The Hague and Utrecht.

The interRAI Community Mental Health questionnaire [CMH; (27, 28)] and the Homelessness Supplement were employed to define indicators for different life domains. For instance, the CMH variable "Cognitive skills for daily decision making" takes all mental health issues and related behavior into consideration; the quality and safety of daily decisions relates to the presence and degree in which supervision is needed. On indication, cognitive and intellectual disability screeners were used (26).

Collected data were entered in digital case report forms. The CMH algorithms were applied to calculate the CMH scales and Clinical Assessments Protocols (CAPs). Interview data were structured in the health domains of the positive health framework. Physical health data include symptoms, functioning, disease, and duration (chronic status). Mental health data comprise mental state indicators, traumatic life events, substance use and behavior, cognition, intellectual impairments, transdiagnostic features, and (HS user's) information on mental health diagnoses.

Interview data on physical and mental health, care use, and the CMH CAPs and scales were reviewed to assess recoded variables. The recoded variables were considered necessary to assess modern state-of-the-art health and care needs in a rights-based, recovery-oriented perspective (26). The transdiagnostic features of mental health are the main recoded variables in this paper. A transdiagnostic approach evaluates clinically significant complaints or behaviors (vulnerabilities and symptoms), which characterize the current health problems and the course of subjects' disability (10, 26, 29, 30). Only current transdiagnostic features were scored. Past symptoms and vulnerabilities which do not impact actual daily functioning were not reported. A decision tree based on the Dutch consensus definition of Serious Mental Illness EPA[2] was added to summarize the presence and character of mental health-related needs (31). The probability estimates of alcohol abuse were based on the peak number of alcoholic drinks (five or more at one occasion in the last 2 weeks).

Analysis

The information about different settings and sources was integrated into one database. Statistical analyses were done in Stata 13. Most consisted of descriptive analyses. For example, frequencies and percentages reflect prevalence estimates of physical disorders or the overlap in substance use patterns. Additionally, chi-square and *t*-tests were run to compare the demographic features of the sample to the CODA-G4 and official CBS homelessness figures. They assess the representativeness of our sample.

Ethical Statement

The commissioning organizations gave permission for the scientific use of the management-data. The research ethics committee of the Radboud University Nijmegen Medical Center certified that the research does not fall within the remit of the Medical Research Involving Human Subjects Act (file number 2018-4463). Individual subjects were informed about the study aims and provided informed consent. A small reward was provided.

TABLE 1 | Background characteristics of the sample (in %).

Gender	Male	81.0
	Female	19.0
Age	18–29	19.3
	30–49	46.6
	50–64	29.6
	65 or older	4.6
Migration background	Netherlands	47.9
	Other western countries	13.1
	Non-western countries	39.0
	First generation	39.2
	Second generation	12.8
Education: highest level completed	Low	82.3
	Middle	14.9
	High	2.8
European typology on homelessness and housing exclusion (ETHOS)	Roofless: rough sleepers	7.6
	Roofless: night shelters	67.4
	Houseless: in homeless accomodation	21.1
	Houseless: long term homeless supported living	1.8
	Houseless: independent living with long term support	2.1
Homelessness history	Previous homelessness (ETHOS)	78.8
	Residential instability in past 2 years	91.7

RESULTS

The interviews provided the raw data on the health results presented in this section.

Unless stated differently, all numbers are percentages. All percentages express the share of the total sample in which the feature was observed.

Sample Profile

Table 1 portrays the background characteristics of the study sample.

Most subjects were males, low educated, with a migration background. Their mean age was 42.9 years (males 43.1; females 41.8; range 18–75). All HS users met the ETHOS criteria. Most HS users were roofless (75.0%): they had slept rough or in night shelters. A smaller share was houseless (25.0%): those subjects had a place to sleep in crisis shelters, hostels or supervised appartments. The high proportions on "previous homelessness" and "residential instability" indicate the long-term or intermittent character of homelessness. Only few HS users had a regular job (2.8%). Financial problems were common. Two out of three perceived obstructions in the purchase of essential goods in the last month (65.8%). Some residents had no income, and

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[2] The Dutch acronym to indicate SMI.

TABLE 2 | Physical health status (in %).

Physical symptoms	Current presence	Total presence	Chronic physical conditions	Presence
Headache	12.6	17.9	Neurological	12.6
Dizzyness	8.3	12.2	Visual	3.9
Acid reflux	7.6	10.8	Auditory	3.4
Nausea	4.1	5.3	Endocrine	6.9
Vomiting	2.8	3.5	Gastrointestinal	13.5
Constipation	5.3	6.7	Infectious	2.8
Diarrhea	2.8	4.1	Respiratory	9.2
Blurred vision	3.9	4.4	Cardiovascular	12.2
Dyspnea	16.7	16.7	Musculoskeletal	0.9
Chest pain	2.5	6.2	Malignancy	1.8
Peripheral edema	2.5	3.0	Under-/overweight	41.7
Difficulty urinating	10.6	11.7		
Skin problems	9.2	9.2		
Foot problems	13.1	13.1		

The left column depicts the presence of common physical symptoms in the past 3 days and in total. The right column shows the prevalence estimates of chronic physical conditions.

were not compensated by a social security allowance (14.9%). One out of four did not have a health insurance at the moment of the interview; four out of five (79%) had not visited any physician within the last 3 months.

The sample characteristics of the HOP-TR sample were compared with reference data [CODA-G4 and CBS 2015-2017; (22, 32)] to assess its representativeness (**Supplementary Tables 1, 2**). No differences were found for gender, but subjects in the HOP-TR sample were significantly older and had less frequently a migration background. Compared to the CBS samples, the education level of subjects in the HOP-TR sample was lower.

Health

Half the subjects considered their health as sufficient: excellent (5.7%) or good (47.5%); half as insufficient: fair (27.8%) or poor (18.8%). Results regarding physical and mental health are described. Additionally, symptoms related to behavior, social interaction and functioning in daily life are presented.

Physical Health

The left column of **Table 2** shows the presence of common physical symptoms. 51.6% of respondents report fatigue, 32.8% pain, and 26.4% gastrointestinal complaints. Emergent conditions, such as fever or injuries, were present in 12.8%.

The right column shows prevalence estimates of physical disorders. The results depict severe chronic physical conditions, related to higher morbidity, mortality, and impairments rates. Chronic conditions of the gastro-intestinal (13.5%), neurological (12.6%) and cardiovascular (12.2%) dirorders are most prevalent. Gastrointestinal disorders include esophagitis or gastritis (7.3%), chronic liver disease (5.7%), and chronic pancreatitis or m. Crohn (0.5%). Neurological disorders comprise polyneuropathy (8.3%), stroke (2.3%), and a rest group including severe conditions such as multiple sclerosis and epilepsy (2.1%). Cardiovascular disorders consist of hypertension/hypercholesterolemia (7.1%), chronic heart disease (4.6%), and intermittent claudication (0.5%).

Chronic conditions of the respiratory, endocrine and infectious disorders are less prevalent. Respiratory disorders taper to asthma and COPD (9.2%). Endocrine disorders (6.9%) involve diabetes (5.5%) and thyroid disease (1.8%). Infectious disorders include viral hepatitis or HIV (2.8%).

Impairments in the ability to see (3.9%) and to hear (3.4%) are rarely observed. The prevalence of chronic musculoskeletal disorders is low (0.9%), since it is tapered to leg amputations and to chronic musculoskeletal conditions causing severe impairments. Malignancies are scarcely reported (1.8%). Instead, weight abnormalities were most prevalent (41.7%), and usually are related to overweight (36.2%), rarely underweight (5.5%).

Mental Health

Figure 1 depicts symptom frequencies on mental health. The Self-Reported (SR) mood reflects the character and severity of perceived mental health symptoms. Most subjects experience anxiety (66.1%), sadness (54.4%), or loss of interest (51.1%). Also, subjects report decreased energy (64.0%), hopelessness (53.4) or irritability (52.3%). Intrusive thoughts are observed in one out of three (31.0%). Panic and unrealistic fears are less common (both 17.2%).

Psychotic symptoms were prominent. Hyperarousal (22.7%), delusions (24.3%), abnormal thoughts (17.2%), and hallucinations (17.4%) are most common. Command hallucinations were reported less frequently (4.8%). The Positive Symptoms Scale scale assesses the presence and severity of psychotic symptoms. One out of two (46.3%; mean score 3.8; range 0–12) had a positive score.

Patterns in mental health features were assessed in a transdiagnostic approach. Transdiagnostic features reflect the presence of major complaints and behaviors, which qualify current mental health. Therefore, the transdiagnostic features in **Table 3** are prevalences over the past 3 months. Addiction is the most prevalent (78.0%): prior use (15.1%) and active substance use (62.8%).

Similarly, the transdiagnostic features anxiety (75.2%), trauma (69.3%), and depression (67.0%) are frequently present. At times, a psychotic vulnerability is observed (30.5%). Agitation (64.2%) and personality problems are common too (64.5%). More than one third of respondents had intellectual disabilities (39.9%) or neurocognitive impairments (28.4%). Occasionally, transdiagnostic features of somatization are present (16.7%).

A decision tree based on the Dutch consensus EPA was used to assess the presence and character of care needs related to mental health problems. In one out of twenty (5.3%) mental health related care needs were absent. Subjects had no mental problems or displayed a sufficient personal resilience and social

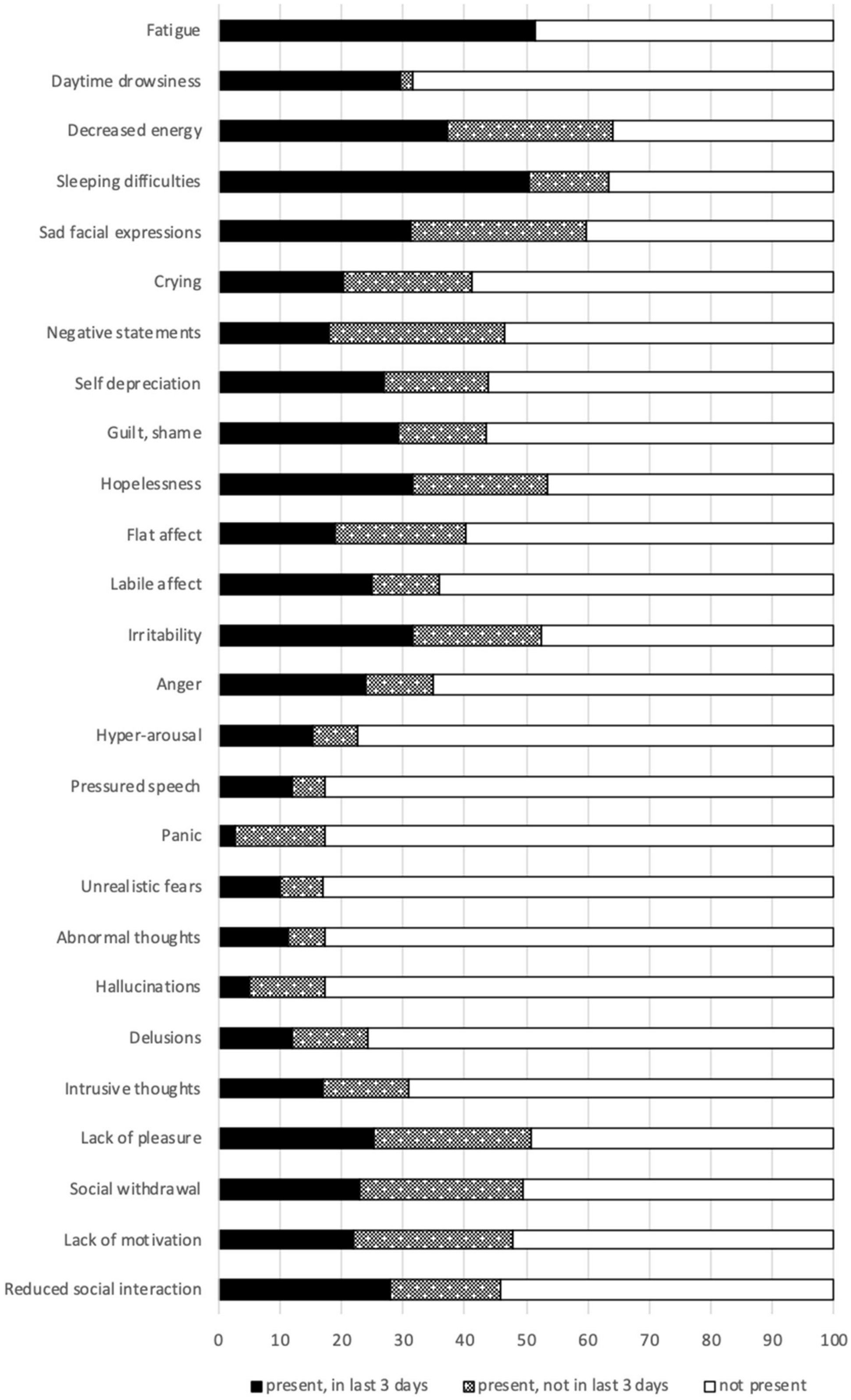

FIGURE 1 | Mental health status. SR indicates Self-Reported mood symptoms.

support to overcome the mental problems observed. A significant part needs mental care, but no longterm multidisciplinary care (22.3%) – a requirement in the Dutch EPA criteria. Most (72.5%) subjects in the HOP-TR study do have a long-term need of integrated multidisciplinary care, because of the pervasive nature and circular character of the mental illness and social disabilities.

Comorbidity

Cumulative numbers and overlap of concurrent health problems over different domains are presented in **Table 4**. Panel 4A presents the number of transdiagnostic mental health features, physical conditions, and the number of health domains affected. Almost all subjects have some health problems (99.3%). Transdiagnostic mental health features are highly prevalent (98.6%), while physical health problems are common (59.9%).

Nearly all subjects had health problems in two or more health domains (95.0%). In six out of ten, health problems are present in three or four domains (61.9%). The combination of mental illness with addiction is most frequent (78.0%). Chronic physical conditions nearly always occurred as a comorbid condition with mental illness or intellectual impairments.

TABLE 3 | Prevalence estimates of transdiagnostic features (in %).

Addiction	78.0
Anxiety	75.2
Trauma	69.3
Depression	67.0
Psychosis	30.5
Agitation or aggression	64.2
Problematic personality	64.5
Intellectual impairments	39.9
Neurocognitive impairments	28.4
Somatization	17.4

Behavior and Daily Performance

Table 5 and **Figure 2** present the results on substance use. Over the previous month, 60.6% reported any substance abuse. Alcohol abuse (five drinks or more at one occasion) was reported by 29.4%. Recurrent drunkenness was 10.8% for 2–8x/month and 6% for 9 or more. 50.5% reported drug use over the past month.

Figure 3 portrays the lifetime prevalence of trauma. Almost all subjects (99.1%) reported one or more lifetime traumas (mean 6;

TABLE 5 | Substance use patterns (in %).

	Never	Ever	Last year	Last month	Last week
Daily tobacco use					74.5
Cannabis use	31.2	68.8	49.5	43.1	36.2
Hard drugs use	55.7	44.3	28.2	20.6	16.3
Injecting drugs use		4.6		0.2	
Drugs use	28.7	71.3	56.0	50.5	43.1
Alcohol abuse				29.4	
Any substance use				60.6	
No substance used				39.5	

Frequencies of substance use, expressed in percentages as proportions of the whole sample. No alcohol abuse is defined as having used no alcohol (5 drinks or more at one occasion in the last 2 weeks). No substance used is defined as having no alcohol abuse and no cannabis or hard drugs in the last month.

TABLE 4 | Cumulative numbers and overlap of concurrent health problems (in %).

Cumulative numbers		**Mental health: transdiagnostic features**		**Physical conditions**		**Health domains**	
		(range: 0–10)		**(range: 0–6)**		**(range: 0–4)**	
		Absent	**Present**	**Absent**	**Present**	**Absent**	**Present**
Any		1.4	98.6	40.8	59.9	0.7	99.3
One			2.1		31.7		4.4
Two			3.9		14.4		33.0
Three			8.9		9.2		42.4
Four or more			83.7		4.6		19.5
Overlap		**Mental illness**		**Addiction**		**Intellectual impairments**	
		Absent	**Present**	**Absent**	**Present**	**Absent**	**Present**
Addiction	Absent	2.1	20.0				
	Present	0.0	**78.0**				
Intellectal impairments	Absent	1.4	58.7	14.7	45.4		
	Present	0.7	**39.2**	7.3	**32.6**		
Physical conditions	Absent	0.9	39.2	7.3	32.8	23.9	16.3
	Present	1.1	**58.7**	14.7	**45.2**	36.2	**23.6**

Addiction and intellectual impairments are included in the transdiagnostic features in panel 4A; they are not included in 'mental illness' in panel 4B. The right column of panel 4A shows the number of health domains affected (mental illness, addiction, intellectual impairments and physical disease). Panel 4B presents the overlap of the various health domains in bold.

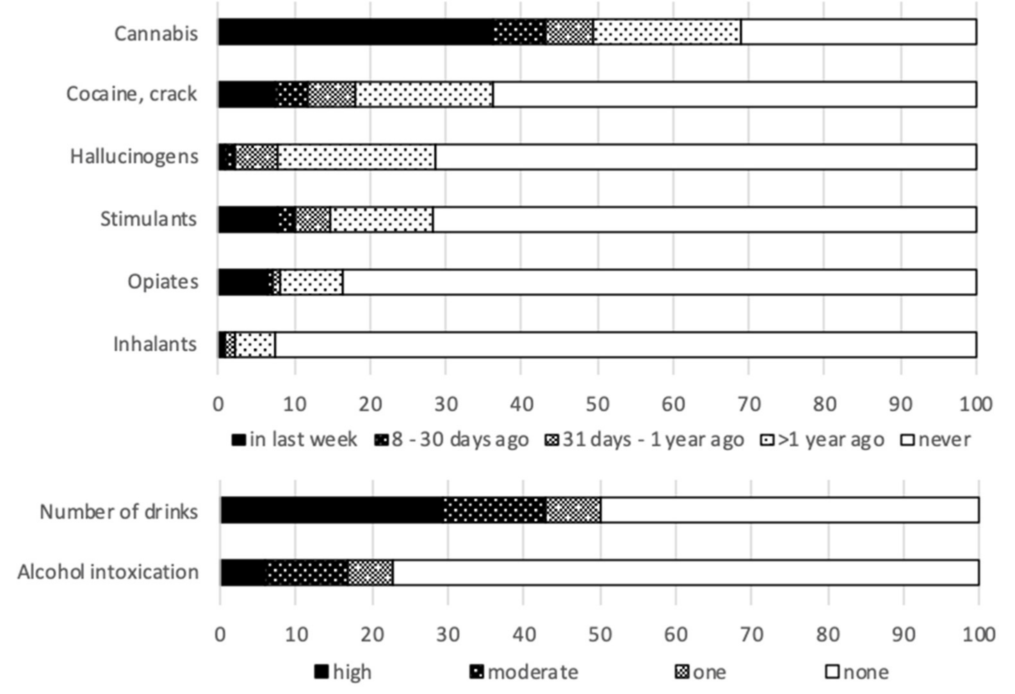

FIGURE 2 | Substance use frequency. Number of alcoholic drinks in the last fortnight: one; 2–4 (moderate); 5 or more (high). Number of days to point of intoxication in the last month: one; 2–8 (moderate); 9 times or more (high).

range 0–14). Income related traumas are most common: financial troubles and income uncertainty occurred in 72.7% over the last year.

Prior traumas still have significant impact on daily life. A substantial part of subjects reported intrusive thoughts (31.0%), intense fear (34.9%) or immediate safety concerns (7.3%). **Figure 4** presents the results on indicators of violent behavior. One out of ten subjects considered self-injury in the last month (11.4%) and 10.3% exhibited violent behavior.

With respect to cognitive skills, concentration loss was observed in 22.7% of the subjects. 35.1% had short-term memory problems and 7.3% procedural memory problems. Most subjects were capable of making independent, safe, and reasonable decisions (58.9%). Some have problems in new situations (8.0%). By contrast, a significant number (22.0%) recurrently made poor or unsafe decisions, and one out of 10 needed structural supervision due to impaired daily decision making (10.8%).

The interRAI CAPs are designed to translate observations into meaningful risk indicators. **Figure 5** shows the results on some CAPs reporting on behavior and performance. Limited personal autonomy is common (57.0%). By contrast, insufficient selfcare only sometimes produces severe risk (4.0%).

DISCUSSION

The HOP-TR study is a recent large study among Dutch HS users. This paper presents the study sample and provides insight into HS users' physical and mental health.

Most HS users were males, low educated, with a migration background. Additionally, even more important in the light of recovery, most HS users were long-term or intermittently homeless. The assessment of mental and physical discomfort shows extensive multi-domain disabilities. Mental symptoms in daily life are most prominent, but physical health problems are also prevalent. Health problems tend to co-occur. Almost all subjects have problems in two domains (94.7%); a large subgroup has comorbidity in three or four domains. Mental illness and addiction frequently co-occur (78.0%). Comorbid severe chronic physical conditions are present in more than half the HS users (59.2%); intellectual impairments in 39.9%. These results illustrate the presence of health problems in different interdependent domains in Dutch HS users. Symptoms and disabilities trigger each other; for example, past traumas impact on daily life. Although most subjects are capable of making independent, safe, and reasonable decisions, the accumulation of health problems and vicissitudes limits their ability to find adequate care in modern over organized and extensive siloed care systems.

The sample profile confirms prior findings on shelter use in high-income countries. In the early nineties, Kuhn and Culhane were the first ones to cluster service users on administrative data (33). In the shelters of New York City and Philadelphia, they identified three clusters: transitional, episodic and chronic shelter users. The prevalences of SMI, substance use and medical problems were substantially higher in subjects of the episodic and chronic clusters. The chronic cluster (10%) consumed half of all shelter days.

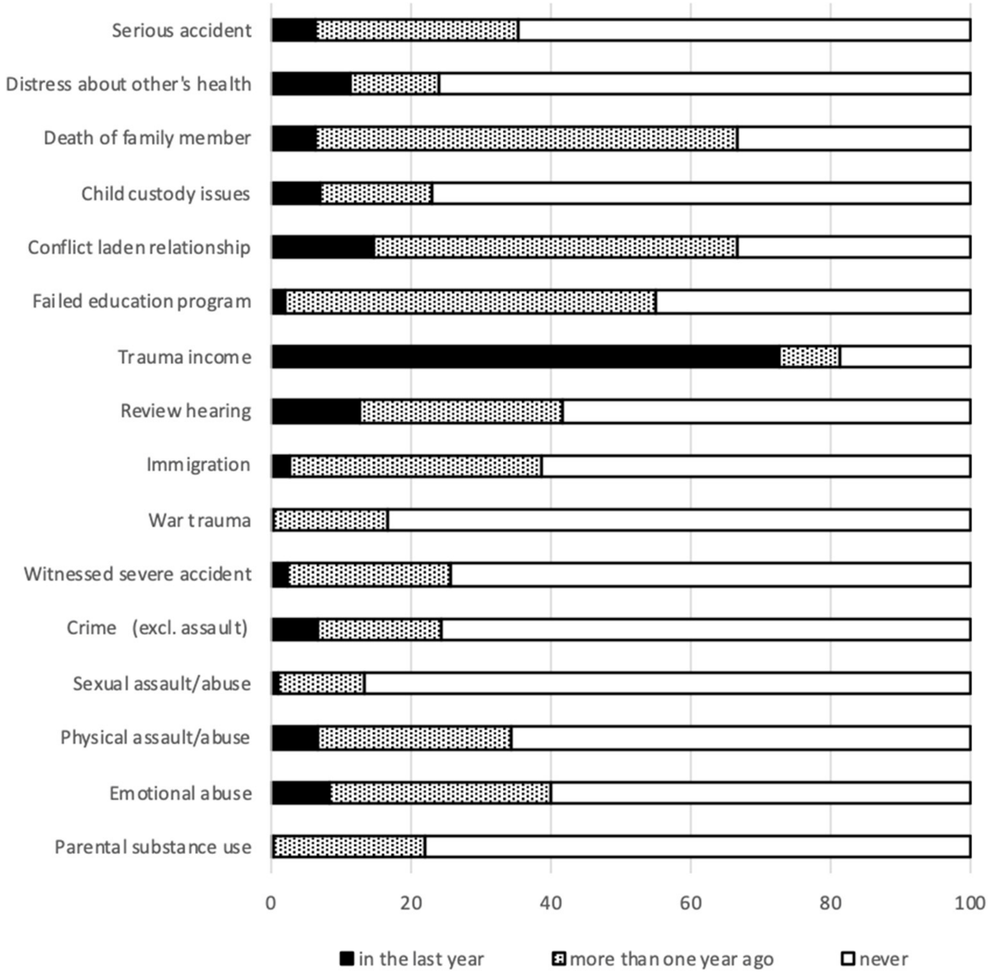

FIGURE 3 | Lifetime prevalence of trauma.

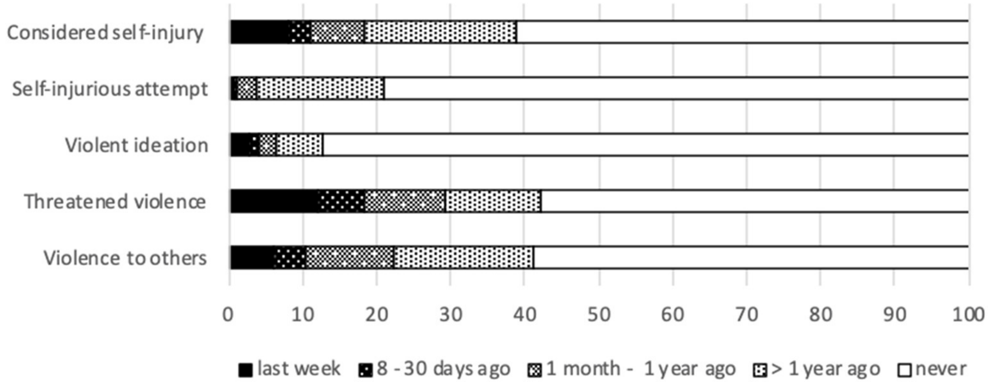

FIGURE 4 | Indicators of violent behavior.

Later, replications of this approach in Canada and Denmark revealed similar patterns (34, 35). The high share of long-term or intermittently homeless subjects in this sample supports that in high-income countries, with elaborated care systems, homelessness mainly affects people with complex needs (35).

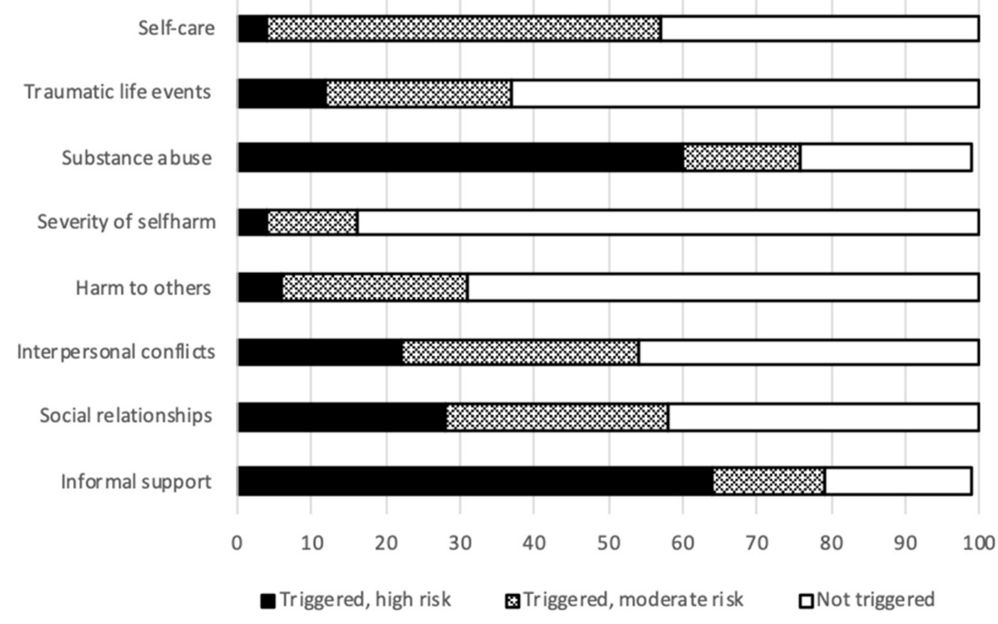

FIGURE 5 | Triggering rates for eight safety CAPs.

The epidemiological homelessness literature reports an accumulation of risk factors and exclusion mechanisms (2, 35–37). The relevance of (severe) mental illness to the risk of marginalization is generally accepted (5, 38–42). In the early nineties, homeless people with SMI and addiction were part of the "special populations" targeted in case management care such as Assertive Community Treatment (ACT) or Intermediate Case Management (ICM) (43, 44). Housing First, including ACT or ICM, proved to be successful for mentally ill homeless individuals (45). Sylvestre, Nelson and Aubry consider housing as a starting point for social integration, community participation, recovery and citizenship (46).

Still, specialized care is organized in siloed services, which are insufficiently capable to serve complex patterns of problems and needs in marginalized groups (47–49). Denmark has one of the largest Housing First (HF) programs in Europe, but this still only serves 5% of homeless (50). Even among chronic homeless, HF with some form of case management, is marginally offered (11%). In the Netherlands, Slockers et al. used a register based 10-year follow up study among HS users in Rotterdam to evaluate the municipal policy before and after the start of the national Dutch homelessness strategy (51). Despite improvement of the living conditions, mortality rates did not decrease. Regarding the need of additional measures in addition to housing and local services, they recognized the intermittent or persistent character of the homelessness.

Recently, Rosen, Gill, and Salvador-Carulla addressed the failure of mental healthcare systems to meet complex multisectoral care needs, such as in homeless populations (52). They revised the literature on critical elements at the individual and regional/national level. They argued to reframe community healthcare in a healthcare ecosystem approach, targeted at balanced care (53) and rooted on the keystones of community mental health (person-centeredness, recovery, human rights, challenging stigma and discrimination).

How to create better conditions – in addition to housing – for social integration, community participation, recovery and citizenship? In the Netherlands, the HOP-TR study started a public health dialogue at different ecosystem levels. The regional assessments fulfilled the information needs of local service administrators. In each region, the transparent results stimulated reflection and discussion about care provision, network cooperation, care access, and quality of care. At the same time, the regional dialogues pushed the national debate and kept the meta-snowball rolling. More local authorities commissioned a study of their own local situation. In some cities the data were used to forge long-term commitment for care improvement.

This paper presents the extent of health-related needs of the Dutch HS users beyond housing. The results underline the need for an integrated, rights-based, 3-D recovery-oriented public health approach. The significant part of previously homeless subjects emphasizes the urgency of comprehensive care. The high prevalence of SMI/EPA underscores that integrated mental health is a cornerstone service for HS users in need of a place to live in the community.

The assessment strategy in the HOP-TR study was designed to explore new perspectives on recovery in marginalized populations with interdependent needs. The strategy adds new elements to the (predominantly descriptive) homelessness literature.

First, mental health is assessed transdiagnostically, using the HS users' perspective as the primary data source. The strategy shows a high prevalence of anxiety, trauma and depression. Still, the trend in most prevalence estimates is comparable to the literature on chronic and intermittent homeless populations (5, 12, 23, 38, 39). Additionally, it introduces the SMI/EPA concept as a quality indicator of the need of integrated care. Finally, it comprehensively assesses symptomatic, social, and existential health aspects relevant to recovery in homeless populations. It comprises both the perspective of HS users and professionals, and helps us to understand how HS users engage with services.

Limitations – In this study, a dual snowball sampling was applied to recruit a saturated sample of settings and subjects. In comparison to reference populations, the subjects in this study were older, lower educated and less often migrants. The higher age might point to a real trend in the population, but might also be an artifact of differences in settings and recruitment procedures. The lower prevalences of physical symptoms (**Table 2**), compared to mental symptoms (**Figure 1**), suggests underreported physical symptoms. The cross-sectional design overrepresented individuals with complex health problems by assessing the most needing individuals who stay in the facilities the longest time. Considering the hidden nature of this population, the HOP-TR recruitment strategy is the best possible approach to comprehensively assess a representative sample of the Dutch adult HS users in 2015–2017.

Also, all data were collected in single interviews by a single researcher. Corrobative medical information was not available. Four out of five subjects had not visited any physician within the last 3 months. This shortcoming was cared for using individual assessments by a researcher with an MD professional background. Single person assessments might induce a bias but offer best health estimates of a hidden part of the Dutch HS population. Finally, the data quality is limited to information collected during a single encounter. Better care access and additional checkups certainly would provide more reliable descriptive health data.

CONCLUSIONS

This paper presents factual empirical health data on a representative sample of Dutch HS users. Most subjects were long-term and intermittently homeless. The prevalences of physical and mental health problems, addiction, and intellectual impairments are comparable to other publications in homeless populations. The key results are the high rates of health problems, their interrelations, and reciprocity. Almost all HS users had health problems in two or more health domains (94.7%). A significant part had severe mental health problems (72.5%).

The high comorbidity in this difficult to access populations emphasizes the need for integrated, rights-based and 3-D recovery oriented public health services. The HOP-TR approach appears useful to foster the dialogue at different healthcare ecosystem levels how to improve care.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

CE, PP, KV, and PD participated in the conceptual design of the study. CE drafted the manuscript, collected the data, and performed the analyses. All the authors critically revised the manuscript, contributed to interpretation of the data, read, and approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.614526/full#supplementary-material

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REVIEW
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The interRAI Child and Youth Suite of Mental Health Assessment Instruments: An Integrated Approach to Mental Health Service Delivery

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Various biological, social, psychological, and environmental factors impact children and youth living with mental health problems across their lifespan. To meet the wide-ranging challenges of mental illness, service system integration is needed to improve efficiencies and reduce fragmentation. Unfortunately, the mental health system has been plagued by the lack of coordination across services. There is a general consensus that mental health service delivery must ensure a child or youth's needs are addressed in a collaborative, coordinated, and seamless manner. A key element to successful integration is the development of a comprehensive standardized screening and assessment system. Numerous assessments have been developed to assess child mental health and functioning, but they typically have a very narrow focus with limited use and utility. Not only does this reduce the ability to take a life course perspective to mental health, but this uncoordinated approach also results in redundancies in information collected, additional resources, and increased assessor burden for children, youth, and their families. The interRAI child and youth mental health assessment suite was developed in response to the need for an integrated mental health system for young persons. This suite includes screening and assessment instruments for in-patient and community settings, emergency departments, educational settings, and youth justice custodial facilities. The instruments form a mental health information system intentionally designed to work in an integrated fashion beginning in infancy, and incorporate key applications such as care planning, outcome measurement, resource allocation, and quality improvement. The design of these assessment tools and their psychometric properties are reviewed. Data is then presented using examples related to interpersonal trauma, illustrating the use and utility of the integrated suite, along with the various applications of these assessment systems.

Keywords: children's mental health, care planning, outcomes, quality indicators, case-mix systems, psychometric properties, service integration, interpersonal trauma

INTRODUCTION

Mental health and wellness begins in infancy, as the persistence, stability, and negative long-term consequences of early mental health problems are evident across the lifespan (1). Infants who experience serious adversity in the first few years of life, such as exposure to violence or trauma, are more likely to demonstrate emotional and behavioral problems (2). Young persons with mental health issues are at increased risk for poor academic achievement, underemployment, substance abuse, and impaired social and emotional functioning (3, 4). Additionally, childhood mental illness has been associated with suicide, homicide, criminal activity, as well as institutionalization and incarceration (5, 6). Despite approximately 10–20% of children and youth experiencing a mental health problem, the majority go undiagnosed and untreated (7, 8).

Untreated mental health problems in childhood can persist into adulthood with approximately 70% of adult mental health issues beginning in childhood and adolescence (9). While there has been a substantial amount of research examining the natural progression of child psychopathology, studies exploring the continuity of mental health symptoms across the lifespan are limited, often due to issues regarding appropriate measurement. Some researchers have found that while the overall prevalence of disorders may be comparable, the patterns of specific disorders vary based on age (10–12).

Theoretical frameworks to conceptualize children and youth mental health have been investigated over several decades. A comprehensive approach to understanding children's mental health is appropriate considering the strengths and needs of young persons are shaped by interactions of intrapersonal and interpersonal factors over time (13). Examples include, but are not limited to, physical health, disability, social relationships with family and peers, and education. Mental health concerns in young persons are becoming increasingly prevalent with approximately 10% of those referred for services presenting with increasing complexity (14, 15). These children account for a significant and disproportionate amount of mental healthcare spending and often require 'episodic, chronic, and ongoing care' from multiple service sectors, including costly residential and in-patient services (12, 16–21).

Mental health disorders have a societal and economic impact, with direct and indirect costs exceeding $59 billion annually (22). Given the sequalae of untreated mental health problems, coupled with the corresponding economic costs, it is critical for children, youth, and their families to be identified early and have access to timely and integrated services (23, 24). To improve the responsivity of mental health services, it is imperative to adopt an orientation addressing all aspects implicit in shaping a child's educational, physical, socio-emotional, and developmental well-being (13)[1].

Early identification of mental health needs is essential, as it fosters early intervention and prevention, thereby reducing the need for intensive resources and crisis services (25, 26). Investments made before birth have a higher return, highlighting that prevention is more cost effective than later remediation (27, 28). Early identification and intervention have the potential to decrease impairment, diminish distress, and reduce the number of young persons who require treatment services later in life. As a result, these children and youth are afforded a greater opportunity to be productive contributors within their communities.

The mental health system has been plagued by high fragmentation and low funding, particularly in children's mental health (25). At the jurisdictional level, mental health programs and services are typically delivered with little coordination among governmental agencies (8, 29). As the number of service providers involved increases, it becomes more difficult to coordinate services due to a lack of communication and integration (21). Tragically, these compounding factors create steep barriers for families to access appropriate mental health services (30). To alleviate some of the stress experienced by families navigating the system, the development of an integrated standardized mental health assessment system that uses a common language linking community agencies, hospitals, child welfare, youth justice facilities, and educational settings while providing opportunities for transitional care into adulthood is needed (31).

In response to the call for an effective mental health information system for adults, interRAI has developed a number of assessment and screening instruments [e.g., (32)]. For an in-depth review of the adult mental health suite of instruments, please see our previously published work (33). Despite advances within the adult system, children's mental health has continued to lack a harmonized approach to service delivery, in part, due to the lack of psychometrically sound instruments spanning service sectors. While various assessments have been developed to assess child mental health and functioning, these measures typically have a narrow focus with limited utility. As a result, multiple assessments are often required to evaluate the child or youth's strengths and needs in various settings and to capture the wide array of features typically associated with the presenting problem (34). This uncoordinated approach to assessment often results in redundancies in information collected, additional resources, and increased assessor burden on the child/youth and their families (34, 35). Critically, previous assessment measures have yet to create a coordinated, cross-sector approach to children's mental healthcare, or facilitate a lifespan approach to mental health service delivery.

This paper provides an overview of the interRAI child and youth suite of mental health assessment instruments, which was developed in response to the need for an integrated mental health system for young persons. These instruments were designed to facilitate a standardized, comprehensive, and coordinated approach to the delivery of mental health services for infants, children, and youth, ultimately supporting a life course approach to assessment. The paper begins with a discussion of the various factors that must be considered to support a person-centered

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[1] Stewart SL, Toohey A. Screening and assessment of mental health problems in students: utilizing an integrated assessment-to-intervention approach to enhance integrated care. In: Andrews J, Shaw S, Domene J, McMorris C editors. *School, Clinical, and Counseling Psychology: Mental Health Assessment, Prevention, and Intervention*. New York, NY: Springer (under review).

approach to care. The remainder of the paper describes the design, psychometric properties, and applications of interRAI child/youth mental health assessments using examples related to interpersonal trauma.

Physical Health and Disability

There is a bi-directional relationship between mental and physical health problems. Particularly, children with chronic health conditions are more likely to have mental health issues, and those with mental health problems are more likely to experience physical health problems (36, 37). For example, a large genomic cohort study revealed young persons with physical health problems (i.e., an autoimmune/inflammatory or central-nervous system condition) were more likely to be diagnosed with a mood or neurodevelopmental disorder (37). Furthermore, children with a serious mental health problem were 13% more likely to have a chronic health condition compared to children with no mental health problem (36). While research suggests that comorbid mental and physical health problems persist into adulthood, some studies have found that interventions targeting mental health issues in childhood improve physical health outcomes (38, 39). Taken altogether, the increase in disability and severity in children and youth with comorbid mental and physical health problems suggests the need for a comprehensive mental health assessment and greater coordination between all service providers, particularly medical and mental health professionals, in order to successfully address this "hidden morbidity" (40, 41).

Family and Social Relationships

There is also a reciprocal relationship between family dynamics and children's mental health. Specifically, a child or youth's mental health issue might play a role in family conflict with caregivers and siblings, potentially contributing to the development of ineffective or inappropriate parenting techniques and detrimental family interactions (42). In turn, high family conflict and poor parenting practices can worsen the child's mental health issue (43–46).

Parenting practices have a direct impact on attachment in young children. Attachment to a primary caregiver is a key developmental goal in early childhood for survival, safety, and security. However, disruptions in attachment behavioral patterns can have a detrimental impact on the physical and mental health of children (e.g., brain development and long-term functioning) (47–49). Earlier assessment and intervention of attachment issues can significantly reduce the negative sequalae associated with these relationship difficulties and improve overall socio-emotional functioning. Family financial security and socioeconomic status can also have a significant impact on mental health outcomes. For example, a systematic review examining the relationship between socioeconomic inequalities and mental health problems in children and adolescents reported that low parental education and household income had a greater impact on mental health problems compared to parental unemployment or low occupational status (50).

With respect to social relationships, children who struggle in their peer relations often experience mental health issues in adulthood (51). A longitudinal study reported predictive links between early social isolation, poor peer acceptance, and perceptions of social incompetence with subsequent internalizing problems, while early aggression and peer rejection were predictive of subsequent externalizing problems (52–55). Social support can mitigate the negative impact of mental illness as peer connectedness may be a strong protective factor against anxiety, depression, and suicide, thereby bolstering positive self-esteem and general mental well-being (56). Assessment of factors in relation to parenting, family relationships, attachment, financial security, as well as social relations are all crucial in identifying the strategies for effective intervention and treatment. Interactions between social and familial factors often occur simultaneously, creating a more complex approach to address assessment and system needs (57).

Substance Use

Children and youth with poor family and social relationships are at greater risk for substance use (58, 59). Substance use among young people is a significant public health concern, as it is one of the most commonly cited reasons for admission into a mental health setting (60). The overall prevalence of co-occurring problems in adolescents is just under 3%, with young people between the ages of 15–24 years being more likely to experience substance use disorders (SUD) and/or mental illness compared to any other age group (61, 62). Studies have shown that individuals who suffer from mental health or addiction issues are more likely to die prematurely, with mental illness decreasing a person's life expectancy by 10–20 years (63).

There are a variety of elements influencing substance use among children and youth, such as peer pressure, trauma, an insecure attachment with caregivers, as well as the presence of a mental health problem (64–67). Youth with both substance use and mental health problems are at risk of serious short- and long-term consequences. For instance, youth with co-occurring disorders are more likely to have impaired functioning, a history of criminal activity, and are typically less responsive to treatment (6, 68–70).

The relationship between substance use and mental illness is a complex one. While numerous theories have been proposed over the years attempting to explain this comorbidity, such as self-medication, the reverse-causal pathway, and shared vulnerability, there is ultimately no simple cause-effect relationship (71). Thus, comprehensive assessment is needed to obtain a better understanding of the interplay between substance use and mental health symptoms, in order to provide effective treatment. Furthermore, many of these youth receive services across multiple service sectors, and so, they require enhanced planning to support transitions across systems of care.

Transitions

Due to transitions being a lengthy and complex process, it is unsurprising that up to 60% of youth in mental health services lose access to treatment as they transition to adult services (72). Unfortunately, youth who present with a number of complex needs, cultural differences, and/or general distrust of the healthcare system are at greatest risk for ineffective transitions, and therefore, are most likely to experience gaps in their care (73–75).

There are numerous barriers to successful transitions such as the lack of communication between service providers, long wait lists, lack of a common language across sectors, and differing levels of involvement for families in decision-making processes (76, 77). Even small transitions can be difficult for young persons who have difficulty adapting, with particularly challenging transitions across educational placements and service transitions (75). Children and youth who do not have the needed support systems in place often require additional resources to support their care. Because transitions often co-occur with changes in professional relationships, it is quite common for youth to experience feelings of abandonment from their service providers during this time (78, 79). By recognizing these issues and bridging service gaps, positive transitions to support proper care planning can be facilitated, thereby increasing the chances of successful outcomes (75).

Education

A greater focus on mental health functioning in educational settings may promote learning and prevent the adverse outcomes linked to untreated mental health issues (80). Studies have reported that learning problems predict anxiety, depression, and substance use during adolescence (81–83). In addition, children and youth with mental health concerns are at increased risk of academic struggles (84–86). When children have both mental health and academic problems, they are at greater risk of negative distal outcomes, including a higher likelihood of mental health service utilization, poor academic achievement, special education placement, and school disengagement (87). Notably, over 50% of students (14 years of age or above) who have emotional and behavioral difficulties drop out of high school (88). Overall, mental health problems are significant barriers to learning and school success, and positive behavioral and emotional health are related to academic achievement (89, 90). Therefore, early identification of mental health concerns among students is of significant importance to ensure appropriate access to community resources, effectively providing young persons with a continuum of care.

Youth Justice

Youth involved in the juvenile justice system experience high rates of mental health problems and trauma (91–93). Approximately 65% of justice-involved youth meet criteria for a mental health disorder, compared to 10–25% of youth in the general population (92). Furthermore, justice-involved youth experience a high level of comorbidity and are 5-times more likely to have one or more mental health disorders compared to the community sample (94).

There is substantive overlap between the mental health needs of youth receiving mental health services and those involved with the justice system (6). Unfortunately, many young persons with mental health concerns are often directed toward the juvenile justice pathway, particularly those with oppositional defiant disorder (ODD), conduct disorder (CD), and substance use issues (95, 96). Ultimately, many justice-involved youth do not receive the mental health care they need – a problem exacerbated by the incarceration of juveniles in adult prisons, which do not provide mental health services designed for youth.

Traumatic Life Events

Traumatic life events can have debilitating lifelong consequences for children and youth (97, 98). The Adverse Childhood Experiences (ACE) Study examined the impact of family dysfunction and childhood abuse on numerous health outcomes later in life and found that exposure to traumatic events in childhood was strongly associated with mental and physical health problems in adulthood (e.g., depression and heart disease) (99–101).

Traumatic events can be categorized as interpersonal or non-interpersonal in nature (102). Interpersonal traumatic events include those that are directly "human induced [and] involve a malicious perpetrator, one who consciously intends to harm another human being," (e.g., sexual or physical abuse) (p. 2502) (103). In contrast, non-interpersonal traumatic events lack a malicious perpetrator (e.g., car accidents), or the effects of a malicious perpetrator indirectly impact the individual (e.g., being the victim of crime) (103). Children and youth who have experienced interpersonal trauma are more likely to have internalizing and externalizing problems, such as depression and aggression (104), as well as poor self-image, difficulties in self-regulation, and increased risk of self-harm (105, 106). Overall, interpersonal trauma has a negative effect on psychological, social, and emotional well-being.

Extant research has shown that chronic activation of a child's stress response system can have an adverse impact on a wide-range of aspects of typical development, such as the development of secure attachments and higher order cognitive skills (107, 108). Notably, many children who experience traumatic events often have a diagnosable mental health disorder, namely Attention Deficit/Hyperactivity Disorder (ADHD), anxiety disorders, ODD, reactive attachment disorder (RAD), and communication disorders (107). Due to the plethora of adverse consequences of traumatic life events, comprehensive assessment is needed to understand how trauma relates to mental health concerns across the lifespan.

THE interRAI CHILD AND YOUTH SUITE OF MENTAL HEALTH INSTRUMENTS: AN INTEGRATED ASSESSMENT SYSTEM

interRAI is a not-for-profit collaborative of over 100 clinicians, researchers, and policy experts from over 35 countries. Although its initial focus in the early 1990s was on geriatrics, the scope of interRAI's research broadened to include vulnerable persons with complex needs of all ages, including infants, toddlers, and school-aged children.

interRAI's primary aim is to improve quality of life and care through the development and implementation of an integrated suite of comprehensive assessment, screening, and care planning systems that span the continuum of care. The development of the child/youth suite of instruments in the last decade currently comprises 11 comprehensive assessments, screeners, and supplements (6 finalized, 5 in final stages of refinement). The following section provides a brief description of the child/youth suite using interpersonal trauma as a common clinical theme to show how these instruments provide insights into a young person's preferences, strengths, and needs.

Before outlining the assessment and screening instruments within the child and youth suite, the paper will define some important key terms. An "infant" refers to an individual from birth to 12 months of age; a "toddler" refers to an individual over 12 months (12 months and 1 day) to 3 years of age; and a "preschooler" refers to an individual 3 years and 1 day to 3 years and 11 months. Furthermore, a "child" refers to an individual over 4 years (4 years and 1 day) to 12 years of age; and a "youth" refers to an individual 12 years and 1 day to 21 years of age.

Assessment and Screening Instruments for Children and Youth

Published Assessment Tools

interRAI Child and Youth Mental Health Instrument and Adolescent Supplement

The interRAI Child and Youth Mental Health Instrument (ChYMH) is the primary tool in the child and youth suite of instruments (109). It is used in mental health settings at admission, discharge (if more than 7 days after admission), every 90 days (for longer term patient stays), or when there is a clinically significant change in the young person's status that potentially requires care plan modifications. The target audience is children and youth between the ages of 4–18 years. The ChYMH is intended to support quality indicators, outcome measurement, case-mix classification, and comprehensive care planning in 30 domains, including social and peer relationships, education, traumatic life events, sleep disturbance, and life skills.

The ChYMH has 31 summary scales (e.g., externalizing and internalizing) and four algorithms (i.e., assessments of harm to self, harm to others, caregiver distress, and resource intensity) embedded within it to support symptom monitoring and care planning. The tool uses specific look-back periods to provide valid and reliable measures of clinical characteristics that represent the young person's preferences, strengths, and needs. Most items employ a 3-day observation period; however, some items use a 7-day, 30-day, or 90-day window, or lifetime estimates depending on the nature of the issue. Notably, some items address the frequency and/or recency of symptoms prior to and within the last 3 days. The tool also provides the option to indicate that symptoms are present but not exhibited within the last 3 days. An example item from the ChYMH that falls under the 'Mental State Indicators: Mood Disturbance' section is "sad, pained, or worried facial expression." This item can be coded from 0 (not present) to 4 (exhibited daily in last 3 days, 3 or more episodes or continuously). The instrument is typically completed by mental health professionals, such as social workers or nurses, and takes approximately 1 h to complete (dependent on case complexity).

The ChYMH assessment has two versions available, the in-patient and community-based forms (see **Table 1**). The in-patient version is used for young persons residing in a psychiatric unit/facility or residential facility, whereas the community-based version is used for young persons who reside within the community. Importantly, in the event that a child or youth is transferred from an in-patient to community-based setting, the discharge assessment is shared to support continuity of care. Finally, both versions of the ChYMH include an Adolescent Supplement, which is completed for children and youth who are 12 years of age or above. The supplement can be used for children below 12 years of age if they are engaging in mature behaviors such as substance use or sexual activity.

The ChYMH was piloted in Ontario and has been adopted by 90 children's agencies within the province. Additionally, several organizations in other provinces (e.g., British Columbia, Newfoundland and Labrador, Quebec, Prince Edward Island, and Nova Scotia) have now implemented the interRAI children's mental health system. The instrument was published in 2015 and is currently available in both English and Canadian-French. To date, over 20,000 assessments have been completed; notably, this data has been utilized in a number of research studies [e.g., (110–112)].

interRAI Child and Youth Mental Health Instrument for Developmental Disabilities and Adolescent Supplement

The interRAI Child and Youth Mental Health Instrument for Developmental Disabilities (ChYMH-DD) is intended to be used with children and youth 4–21 years-old with intellectual or developmental disabilities [e.g., autism, Down syndrome; (113)]. The ChYMH-DD assessment has two versions available; the in-patient and community-based forms, supporting the same broad range of applications as the ChYMH. The instrument supports care plan development in 23 domains, including accessibility and mobility, injurious behavior, continence, educational support, modified nutrition intake, life skills, and social relations.

The ChYMH-DD inpatient and community-based forms are typically completed by developmental service workers. The tool mirrors the ChYMH with respect to the scales and algorithms embedded within it, its specific observation periods, and approximate time for completion. Further, the ChYMH-DD similarly has an Adolescent Supplement. The ChYMH-DD was piloted within Ontario and Finland and is now standard of care in Newfoundland and Labrador, Prince Edward Island, and Nova Scotia. The instrument was published in 2015 and is currently available in both English and Canadian-French. To date, just over 1,000 assessments have been completed, with several interRAI papers examining this particularly vulnerable population [e.g., (114–116)].

interRAI Child and Youth Mental Health Screener

The interRAI Child and Youth Mental Health Screener (ChYMH-S) is a brief standardized assessment tool that is intended to complement the full ChYMH and ChYMH-DD assessments (117). The ChYMH-S was designed to support decision-making related to triaging, placement, and service urgency for young persons with mental health issues. This basic screening tool has the same target audience as the previously described instruments, namely children and youth between

TABLE 1 | Item counts by domain area and interRAI mental health system for child/youth populations (ages 0–18).

Characteristic	**interRAI Assessment or Screening Instrument***													
	interRAI Early Years	**ChYMH Screener**	**ChYMH Inpatient**	**ChYMH Community**	**ChYMH-DD Inpatient**	**ChYMH-DD Community**	**EDU**	**YJCF**	**ESP-CY**	**PEDS-HC**	**QoL-ChYMH**	**Youth Justice Supplement**	**Adolescent Supplement**	**Adolescent Addictions Supplement**
Setting	Outpatient and developmental programs	School settings, inpatient and outpatient programs	Inpatient psychiatry	Community (case management)	Inpatient psychiatry	Community (case management)	School settings	Youth justice settings	Emergency department, mobile crisis	Home care	Inpatient and outpatient programs	Youth justice settings	Inpatient and outpatient programs	Addictions programs
Age	0–47 months	4–18 years	4–18 years	4–18 years	4–21 years	4–21 years	4–20 years	12–18 years	4–18 years	4–20 years	7–18 years	12–18 years	12–18 years[4]	12–18 years
Item counts														
Administrative and tracking	74	34	49	44	49	46	38	48	43	54	12	20	13	13
Mental status indicators	46	26	46	46	51	51	43	45	37	32	0	3	4	0
Substance use/addictions	3	5	7	7	7	7	6	20	11	5	0	4	11	22
Harm to self/others	0	9	15	15	15	15	14	16	13	5	0	0	0	0
Behavior	30	6	26	24	43	43	32	43	8	17	0	25	6	11
Cognition	31	1	7	7	8	8	8	9	6	11	0	0	0	0
Functional status	112	1	29	29	30	30	11	13	5	68	1	0	13	0
Communication and vision	67	3	6	6	18	18	24	5	0	8	0	0	0	0
Physical health conditions	21	0	26	26	28	28	6	24	1	37	2	0	1	0
Stress and trauma	27	10	32	32	28	28	32	26	3	1	0	0	3	0
Medications	17[1]	1	13[1]	12[1]	13[1]	12[1]	11[1]	11	4	10	0	0	0	0
Service use and treatments	73	0	32	32	40	40	39	31	3	61	4	0	3	7
Control interventions	0	0	6	0	6	1	0	10	0	0	0	0	0	0
Nutritional status	33	0	3	3	4	4	3	7	3	7	0	0	1	0
Social relations	13	2	28	28	28	28	27	21	10	18	13	3	1	2
Employment, education and finances	17	4	26	26	25	25	48	14	2	27	2	0	1	1
Housing, home environment and living arrangements	30	2	20	20	21	20	15	30	6	27	8[3]	5	0	0
Diagnoses	81	2	28[2]	30[2]	29[2]	29[2]	33[2]	32[2]	19[2]	58		0	0	1
Strengths and resilience	0	0	5	5	7	7	5	6	0	0	3	0	1	0
Total	675	106	404	392	450	440	395	411	174	446	45	60	58	57

[1] *An additional detailed list of medications used in the last 3 days is optional.* [2] *Section allows for entry of additional DSM/ICD diagnoses as needed.* [3] *The post-service outpatient/inpatient version has an additional item/two items, respectively.* [4] *Supplement can be utilized if the child is younger than 12 years of age and engaging in mature behaviors. *The full names of each instrument are not included here due to space, but they can be found within the body of the text.*

the ages of 4–18 years. Further, the tool can be used in various settings, such as in-patient and out-patient programs and educational environments.

The ChYMH-S is comprised of items largely selected from the ChYMH instrument, with some additional items specific for screening purposes. The tool has similar look-back periods to that of the ChYMH and ChYMH-DD and takes approximately 15–20 min to complete by trained clinical staff. It is important to note that while the ChYMH-S informs immediate care triaging, it is not an alternative to or a replacement for the full ChYMH or ChYMH-DD; more pointedly, it is intended to identify those young persons who are in need of a more comprehensive mental health assessment. Furthermore, the ChYMH-S does not support care plan development. Lastly, the tool has three clinical scales and three algorithms (i.e., assessments of harm to self, harm to others, and service urgency) embedded within it. The algorithm related to service urgency is called the Children's Algorithm for Mental Health and Psychiatric Services (ChAMhPs). ChAMhPs provides a score ranging from 0–6, with higher scores indicative of more urgent and emergent cases. A score of three or higher indicates a full ChYMH should be completed based on case complexity.

The ChYMH-S was initially piloted within Ontario and China. The tool was published shortly after the comprehensive ChYMH and ChYMH-DD assessments in 2017 and is now used as part of standard of care across most mental health agencies in the Province of Ontario. It is currently available in English, Canadian-French, and Simplified Chinese. Over 80,000 assessments have been completed thus far, with a number of research studies utilizing the ChYMH-S data [e.g., (118–120)].

interRAI Pediatric Home Care

The interRAI Pediatric Home Care Assessment (PEDS-HC) is a clinical tool intended for children and youth between 4–20 years of age who receive home-based medical care due to their complex health needs (121). The instrument is predominantly used to support decision-making with respect to the allocation of funding for children and youth who are medically complex and require home-based services. It supports several wide-ranging applications (e.g., quality indicators and outcome measurement), and employs similar specific observation periods.

The PEDS-HC is comprised of over 400 items with scales, algorithms, and care plans in development. The PEDS-HC was developed in the United States and has been piloted within Ontario. It is currently used in Ontario, Nebraska, Texas, and Maryland. The tool was published in 2014, is currently available in English, and almost 500 assessments have been completed to date.

Self-Reported Quality of Life – Child and Youth Mental Health

The interRAI Self-Reported Quality of Life – Child and Youth Mental Health (QoL-ChYMH) is a self-report survey that assesses the perception of well-being and life satisfaction of young persons 7–18 years of age prior to and after receiving mental health services (122). The tool fosters child and youth engagement and involvement in treatment planning and goal setting, thus providing young persons with an opportunity to impact service delivery. The purpose of the QoL-ChYMH is to identify areas of strengths and needs of young clients, with the ultimate goal of maximizing quality of life.

The QoL-ChYMH is comprised of four major domains, which are then further subdivided into 10 categories based on protective factors and indicators of positive mental health that are well-established in the literature: (1) Basic Needs (living conditions, food, safety, and privacy), (2) Social (friends and activities, respect from others, family), (3) Individual (autonomy, health), and (4) Services (school, treatment). Three harmonized versions of the tool have been developed, including pre-service for in-patient and out-patient programs, post-service for in-patient programs, and post-service for out-patient programs. The QoL-ChYMH can be used in conjunction with the ChYMH and Family Quality of Life tool to gain insight into the young person's perspective and inform treatment planning. The tool takes around 15 min to complete. Approximately 1,000 assessments have been completed to date, and research studies have begun to utilize the QoL-ChYMH data [e.g., (123)]. Similar to the other instruments, the QoL-ChYMH was piloted in Ontario and has been recommended as best practice by Accreditation Canada.

Family Quality of Life – Child and Youth Mental Health

The interRAI Family Quality of Life – Child and Youth Mental Health (FamQoL) is a survey that assesses the perception of the family's well-being and life satisfaction prior to and after their child receives mental health services (122). Similar to the self-report tool, the FamQoL assists with the promotion of family engagement by involving an adult family member (preferably the primary caregiver) in the child or youth's treatment planning. The purpose of the FamQoL is to help service providers identify areas of strengths and difficulties from the family's perspective, in order to maximize treatment outcomes and quality of life of both the child/youth and their family.

Similar to the QoL-ChYMH, the FamQoL was developed in collaboration with expert clinicians well-versed in family dynamics within the context of children's mental health, and in line with well-established protective factors and indicators of positive mental health. The FamQoL tool consists of seven domains, namely Safety, Informal Support, Formal Support, Community Interaction and Leisure, Family Relationships and Interactions, Life Circumstances, and Interpersonal Challenges. Two versions of the tool have been developed, including the pre-service and post-service for in-patient/out-patient programs. Importantly, the FamQoL can be used in combination with the ChYMH and QoL-ChYMH to gain insight into the family's perspective on strengths/needs as well as service satisfaction. This QoL tool takes approximately 10–15 min to complete. The FamQoL was piloted in Ontario and approximately 1,200 assessments have been completed thus far.

Assessments at Pilot Stage

interRAI Youth Justice Custodial Facilities

The interRAI Youth Justice Custodial Facilities (YJCF) is a comprehensive standardized instrument for youth between the ages of 12–18 years who currently reside in custodial facility settings[2]. The YJCF has several wide-ranging applications, including quality indicators, resource allocation, and comprehensive care planning in 26 domains (e.g., criminality prevention, sexual offending, harm to others, self-harm, family functioning). It is available in both English and Canadian-French.

The YJCF utilizes a standard 3-day look back period across several areas. A 3-year Ontario pilot study from 2015–2018 yielded 90 completed assessments and was used to provide descriptive profiles of youth in custody compared to those in mental health settings (6, 69).

interRAI Early Years

The interRAI Early Years is a comprehensive standardized tool that is intended to be used with infants, toddlers, and children between 0–47 months who are demonstrating developmental, emotional, social, or behavioral concerns[3]. The tool has a similar breadth of scope regarding its applications, with a key one being comprehensive care planning. The 17 care planning protocols triggered by the instrument address issues related to attachment, caregiver distress, nutritional intake, traumatic life events, gross/fine motor, and toilet training readiness. Further, the tool currently has three scales and algorithms, with others in development.

The interRAI Early Years assesses five developmental milestones, namely cognition, socio-emotional development, expressive and receptive language, gross motor, and fine motor skills. The tool has similar specific observation periods as the other instruments previously described. The interRAI Early Years is also designed to be directly compatible with other interRAI assessments for young persons such as the ChYMH and ChYMH-DD. The synchronization among the tools within the child/youth suite sets the foundation for a seamless transition between services for infants, toddlers, and school-aged children (4–18 years). Importantly, service providers can monitor a child's progress through consistent outcome measurement from infancy to adulthood. The interRAI Early Years was piloted over a 3-year period, from 2016–2019, within Ontario. Notably, over 1,000 assessments have been completed thus far with publication anticipated by 2022.

interRAI Child and Youth Emergency Screener for Psychiatry

The interRAI Child and Youth Emergency Screener for Psychiatry (ESP-CY) evaluates the needs of young persons with mental health issues who present to crisis or emergency services, such as psychiatric emergency departments, general emergency departments, or mobile crisis teams[4]. Like the ChYMH, the ESP-CY is typically completed by mental health professionals, such as nurses and social workers. Designed to inform decision-making related to patient safety, placement, and service utilization, the ESP-CY can also provide important information and valuable insights at the beginning of an in-patient mental health episode.

The ESP-CY is based on, and complements, the full mental health assessments (i.e., ChYMH and ChYMH-DD). Considering the ESP-CY has a different clinical focus, namely an emphasis on patient safety and acute symptoms, the basic time frame is set to the last 24 h unless otherwise indicated. Consequently, some items address the frequency and recency of symptoms prior to and within the last 24 h.

The target audience of the ESP-CY is young persons between 4–18 years-old. The tool can be used in a variety of settings, including both in-patient and community-based services and programs. The average time for completion is 15–20 min, although it can vary depending on the acute nature of the child or youth's symptoms and availability of other informants, such as family members. The ESP-CY has two care planning protocols and three basic risk appraisal algorithms that assess risk of harm to self, risk of harm to others, and inability to care for self. Importantly, while the instrument informs immediate safety planning, it is not an alternative to or replacement for the full ChYMH or ChYMH-DD assessments. The ESP-CY is now being piloted in Ontario.

interRAI Education

The interRAI Education (EDU) is intended to be used with young persons referred to school-based psychological or mental health services[5]. The tool has the same target audience as the PEDS-HC, which is children and youth between 4–20 years of age. It is designed to support a similar broad range of applications, including case-mix classification, quality indicators, outcome measurement, and comprehensive care planning. Particularly, the tool supports care plan development in 30 domains, such as communication, attention and learning supports, vision and hearing impairment, strengths, classroom management/discipline, and is intended to support school engagement (124–126).

The interRAI EDU essentially provides an assessment of key domains of function, educational needs, mental and physical health, and social support. Certain items on the tool can also identify those students who are at higher risk for specific problems related to well-being, health, and functioning, and may require further evaluation. Importantly, the EDU is compatible with other instruments in the interRAI child/youth suite. The tool also mirrors the ChYMH and ChYMH-DD with respect to specific observation periods (i.e., default set to 3-days), and its Adolescent Supplement. Similar to the interRAI ChYMH and ChYMH-DD, there are several decision-support algorithms within the instrument.

interRAI Adolescent Addictions Supplement

The interRAI Adolescent Addictions Supplement is an ancillary clinical tool that is intended to be used with young persons who struggle with addictive behaviors[6]. The supplement is designed

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[2] Stewart SL, Leschied AW, Hirdes J, Mathias K, Currie M, McKnight M, et al. *interRAI Youth Justice Custodial Facilities (YJCF) Assessment Form and User's Manual.* Washington, DC: interRAI (in pilot).

[3] Stewart SL, Iantosca JM, Klassen JA, Cloutier S, Tucker M, Fisman S, et al. *interRAI Early Years Assessment Form and User's Manual. Version 10.0.* Washington, DC: interRAI (in pilot).

[4] Stewart SL, Hirdes J, Morris JN, Berg K, Björkgren M, Declercq A, et al. *interRAI Emergency Screener in Psychiatry for Child and Youth (ESP-CY) Assessment Form and User's Manual. Version 1.* Washington, DC: interRAI (in pilot).

[5] Stewart SL, McKnight M, Currie M, Gilpin M, Evans B, Richards P, et al. *interRAI Education (EDU) Assessment Form and User's Manual. Version 1.* Washington, DC: interRAI (in pilot).

[6] Stewart SL, Perlman C, Hirdes J, Curtin-Telegdi N, Berger J, Ferris J, et al. *interRAI Adolescent Addictions Supplement to the Child and Youth Mental Health*

for use in conjunction with the ChYMH and ChYMH-DD. Specific scales and care planning protocols for this supplement are in development. Youth can fall into four different addictive behavior streams to support intervention and treatment planning (i.e., video gaming, gambling, tobacco use, and substance use). The supplement employs the same basic time frame (3 days) unless otherwise indicated.

The Adolescent Addictions Supplement should always be completed for young persons who are receiving treatment for addictive behaviors. When triggered, it is strongly advised to complete it shortly after the full mental health assessment (i.e., preferably the same day). When the supplement is not triggered, it can still be completed based on clinician discretion. A number of items are taken into account when deciding whether the supplement should be completed, including "smokes tobacco daily," "number of days in last 30 days consumed alcohol to point of intoxication," "gambled excessively or uncontrollably," "problem video gaming in last 90 days," among others.

Data Holdings Utilized to Demonstrate interRAI Applications

Before outlining the factors that make the child/youth suite an integrated system, it is important to provide an overview of the interRAI data holdings that will be used to illustrate concepts in this and subsequent sections. Analytic data for the results presented are drawn from assessments collected in Ontario mental health settings. The interRAI Early Years assessment is used as part of regular clinical assessment practice in 15 mental health agencies serving very young children from October 2016 to August 2020. The interRAI ChYMH-S, ChYMH, and ChYMH-DD are used by 62, 59, and 13 agencies, respectively, as part of regular clinical assessment practice. The ChYMH and ChYMH-DD are drawn from assessments done between September 2012 and August 2020, while ChYMH-S records were completed between April 2014 and August 2020. The YJCF data is drawn from a pilot implementation in 9 agencies between November 2014 and August 2015. Finally, OMHRS is a mandated implementation of the interRAI-MH in all hospital-based adult in-patient psychiatry units. All residents with stays of 72 h or longer are to receive a comprehensive admission assessment, and these were used if the patient was 21 years of age or younger at the time of the assessment. For these six instruments, an encrypted individual level identifier was available to select the first assessment of individuals if there was more than one. Of note, for the baseline and follow-up treatment used in one set of outcomes, pairs of assessments for individuals were selected between 30 and 365 days apart. Please see the **Appendix** for additional information regarding data holdings.

An Integrated Health Information System

There are a number of key features that make the child/youth suite of instruments an integrated health information system. All these instruments have a primary clinical focus on comprehensive functional assessment of strengths and needs to support care planning and outcome measurement across diverse groups [e.g., (127)]. The intended clinical use is not for diagnosis; rather, the instruments capture existing medical and psychiatric diagnoses. All instruments also have a common conceptual emphasis on care planning protocols. These collaborative action plans (CAPs) use empirically derived triggering algorithms to flag areas of potential need and provide evidence-informed guidelines for engaging youth and their support network in a shared decision-making approach while incorporating individual strengths, preferences, and needs (see text foonote 1, 128).

This integrated system also provides a common language with consistent terminology to define common concepts across all settings (e.g., mental health, youth justice, and education), as well as transitions throughout the lifespan (e.g., from infancy to adulthood), thereby improving the effectiveness of communication. Importantly, items only differ between the child/youth and adult suite when it makes sense to do so from a developmental perspective. Also, some items appear in some, but not all, instruments because they are relevant only in specific developmental stages.

The interRAI system uses standardized data collection methods with a detailed training manual that includes intent, definitions, and coding rules for each item. Assessors typically complete a 2.5-day training for the comprehensive interRAI Child and Youth instruments (e.g., the ChYMH, ChYMH-DD, and interRAI Early Years) and a full day training for the briefer instruments (e.g., ChYMH-S). The trained child/youth mental health professionals include psychologists, nurses, psychiatrists, speech and language therapists, child and youth workers, developmental social service workers, and social workers. All available sources of information are utilized to complete the assessment (i.e., family members, community members, document review, and clinical observations). Utilizing multiple forms of information, the assessments do not use fixed narrative questions, but rather employ a semi-structured interview format, thereby providing assessors flexibility in how data is gathered. The interRAI child/youth suite also has a set of core items shared across tools that allow for population-level analyses of issues that are pertinent to children's mental health.

Psychometric Properties of interRAI Child and Youth Mental Health Instruments

One of the many benefits of adopting research-based mental health instruments for decision-making when providing services to children, youth and their families is the ability to consistently and accurately measure the constructs of interest. Reliability and validity are two psychometric properties that should be considered upon administration of an instrument and interpretation of the collected data (129). The interRAI child and youth mental health instruments and their associated elements, such as scales and algorithms, have gone through extensive reliability and validity testing to ensure their use across multiple service sectors [e.g., (12, 20, 111, 112, 119, 130–139)].

(ChYMH), Child and Youth Mental Health-Developmental Disabilities (ChYMH-DD) and Child and Youth Emergency Screener for Psychiatry (CY-ESP). Version 10. Washington, DC: interRAI (in pilot).

Reliability

Inter-Rater Reliability

It is imperative that assessments conducted by different trained clinicians result in consistent outcomes. Inter-rater reliability or inter-observer agreement is the consistency of results taken from assessments across trained clinicians (129). interRAI assessments have undergone rigorous inter-rater reliability testing with both children and adults (33, 140). One approach to obtain inter-rater reliability strictly utilizes vignettes, which can result in inflated values; however, interRAI takes a more rigorous approach, in that it is conducted as part of typical clinical practice (33). This is exemplified in the obtainment of inter-rater reliability for our newest instrument, the interRAI Early Years. Here, assessors familiar with the tool independently conducted a review of the case file, collateral contacts, and related information while conducting an assessment. Further, they documented their findings with the young child and their family. Results indicated strong precision between raters with values of ICC = 0.98 ([95% CI, 0.97, 0.99], $p < 0.001$) for expressive and receptive language scales and ICC = 0.87 ([95% CI, 0.72, 0.94], $p < 0.001$) for the gross motor scale (140). Similarly, several items within the child and youth instruments are shared across the entire interRAI suite, which have demonstrated strong inter-rater reliability [see (135, 138, 141)].

Item Reliability or Internal Consistency

Another form of reliability is item reliability or internal consistency, which is the extent that items in a single assessment measure the same construct (129). Item reliability is routinely measured by Cronbach's alpha (129, 142). Within the interRAI suite, this form of reliability has been used to evaluate new scales; moreover, it has also been used to help with quality assurance of the data obtained from widespread implementation (33). Numerous studies have been conducted examining the internal consistency of scales and algorithms derived from the interRAI child and youth suite of instruments (132–135, 138, 140). **Table 2** describes several clinical summary scales that are available in the child/youth suite, and **Table 3** summarizes the internal consistency results for symptoms and behaviors of interest across various instruments. Almost all the scales meet or exceed an alpha level of 0.70 or 0.80 indicating fair or good/moderately high reliability, respectively (129).

Validity

Face and Content Validity

A reliable instrument is necessary, but not sufficient, to prompt the adoption of an assessment system for clinical practice. Validity demonstrates that the assessment measures what it intends to capture, with face or content validity referring to the extent to which the assessment's items represent the construct being investigated (129). During the development of each assessment tool, interRAI establishes face or content validity through consultation with clinicians and researchers, as well as a thorough review of the current literature (33, 138). For example, as part of the developmental efforts of the internalizing and externalizing scales for the interRAI ChYMH, a panel of experts in the field were tasked with evaluating the content representativeness. These efforts resulted in scales with excellent content validity [e.g., (111, 131)].

The interRAI ChYMH consists of over 400 clinically relevant items that have shown strong face validity in evaluating a child or youth's strengths, needs, and functioning related to presenting psychiatric, medical, and social issues (109). Strong face and content validity have been demonstrated throughout the test development phase with extensive international feedback. Notably, many items from the ChYMH are shared across other child and youth instruments (i.e., ChYMH-S, ChYMH-DD, YJCF, EDU, PEDS-HC, and Early Years). Additionally, certain items from the child/youth suite are similar to those found in the adult suite to aid with the sharing of information between clinicians in different service sectors and across age groups (33). Such an approach fosters continuity of care across service sectors as well as transitions into adult services. All of the interRAI scales, algorithms, and associated features of the assessment systems are created in a similar, rigorous manner.

Construct Validity

Once the construct has been defined and key items have been selected for inclusion in the assessment tool, it is important to test whether the items are associated in a way that would be expected. There are two forms of construct validity, namely convergent and discriminant validity. Convergent validity examines whether similar factors of a construct are shown to be related to each other, whereas discriminant validity highlights when two dissimilar items are shown to be unrelated (142). Items within the child/youth suite of instruments have demonstrated strong construct validity (111, 130, 132, 133, 135–137).

Lau and colleagues (130) assessed the ability of the Disruptive/Aggressive Behavior Scale (DABS) and Hyperactive/Distraction Scale (HDS) to discriminate between two groups that are known to differ on the elements of interest. This was completed through the comparison of mean scores of DABS and HDS for children and youth with and without disorders of interest based on the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV) criteria. Furthermore, comparisons were made between the values of the area under the curves. Results suggested that DABS could differentiate between disruptive behavior disorders (DBD) and ADHD. Similarly, HDS was able to differentiate between an ADHD diagnosis relative to a DBD diagnosis with area under the curve values of over 0.70, indicating good discrimination for the measures. These results coincide with our previous work that found scores on the Social Disengagement Scale, which measures the frequency of symptoms related to anhedonia, were strongly associated with a mood disorder diagnosis (137). Similarly, the Depressive Severity Index (DSI) has been found to be highly related to a mood disorder diagnosis, while the Anxiety Scale has been found to be related to anxiety disorders in children and youth with and without intellectual disabilities (132, 136).

With respect to Activities of Daily Living (ADLs), Stewart and colleagues (112) developed and validated two ADL summary scales for both children and youth with normative intellect and developmental disabilities; both scales have shown strong psychometric properties. Results from this study highlighted

TABLE 2 | Summary of scales and algorithms in interRAI child/youth mental health instruments.

interRAI scale	Domain	Type of scale	Scale components	Range	Included in
Activities of Daily Living Scale	Basic physical function	Parallel form Sum of items	Bathing; Personal hygiene; Dressing upper body; Dressing lower body	0–8	ChYMH, ChYMH-DD, EDU, YJCF
Anxiety Scale	Frequency and intensity of anxiety symptoms	Parallel form Sum of items	Repetitive anxious concerns; Unrealistic fears; Obsessive thoughts; Intrusive thoughts or flashbacks; Episodes of panic; Hypervigilance; Nightmares	0–28	ChYMH, ChYMH-DD, ChYMH-S, EDU, YJCF
Autism Spectrum Screening Checklist (ASSC)	Frequency and intensity of symptoms related to autism	Parallel form Sum of items	Narrowly restricted range of interest; Excessive preoccupation with activity or routine; Lack of social/emotional conventions when socializing; Excessive or unusual reaction to sensory stimuli; Difficulty adapting to even minor change	0–5	ChYMH, ChYMH-DD, ChYMH-S interRAI Early Years, EDU, YJCF
Caregiver Distress Algorithm (iCCareD)	Degree and diversity of caregiver distress factors	Decision Tree	Proactive aggression; Reactive aggression; Parenting strengths scale; Disruptive/aggressive behavior scale; Aggressive behavior scale; Family functioning composite score	1–5	ChYMH, ChYMH-DD, EDU, YJCF
Children's Algorithm for Mental Health and Psychiatric Services (ChaMhPS)	Level of urgency and need for a full comprehensive assessment	Decision tree	Intent to quit school; Intrusive thoughts; Nightmares; Hyperactivity; Lack of interest in social interaction; Lack of motivation; Negative statements; Guilt or shame; Being socially inappropriate; Risk of family/placement breakdown; Considered self-injury; Others concerned about self-injury; Violence to others; Danger to self; Danger to others; Being a victim of emotional abuse	0–6	ChYMH-S Please note: A score of 3+ on the ChaMhPS indicates a full assessment is required due to case complexity and need for individualized care planning.
Child and Youth Resource Index (ChYRI)	Case-mix classification system to inform resource allocation	Decision tree	Age; Supportive relationship with family; Fine motor skills; Violence to others; Bladder continence; History of foster family placement; Maternal substance use during pregnancy	3-to-1 range	ChYMH-DD, EDU, YJCF
Communication Scale	Level of expressive and receptive communication	Parallel form Sum of items	Making self-understood; Ability to understand others	0–8	ChYMH, ChYMH-DD, EDU, YJCF
Disruptive/Aggressive Behavior Scale	Frequency and severity of aggressive and disruptive behavior	Parallel form Sum of items	Verbal abuse; Physical abuse; Socially inappropriate/disruptive; Destructive behavior toward property; Outbursts of anger	0–20	ChYMH, ChYMH-DD, EDU, YJCF, ESP-CY
Depressive Severity Index	Severity of depressive indicators	Parallel form Sum of items	Sad facial expressions; Negative statements; Self-deprecation; Guilt or shame; Hopelessness	0–15	ChYMH, ChYMH-DD, ChYMH-S, EDU, YJCF, ESP-CY
Externalizing Scale	Frequency of externalizing symptoms (i.e., behavioral disturbance); consists of 2 factors- proactive aggression and reactive aggression	Parallel form Sum of items	*Proactive Aggression Factor:* Stealing; Elopement attempts/threats; Bullying peers; Preoccupation of violence; Violence to others; Intimidation of others or threatened violence; Violent ideation *Reactive Aggression Factor:* Impulsivity; Physical abuse; Outburst of anger; Defiant behavior; Argumentativeness	0–12	ChYMH, ChYMH-DD, EDU, YJCF
Hyperactive/Distraction Scale	Frequency of hyperactivity and distractibility behaviors	Parallel form Sum of items	Impulsivity; Distractibility; Hyperactivity; Disorganization	0–16	ChYMH, ChYMH-DD, ChYMH-S, EDU, YJCF, ESP-CY
Instrumental Activities of Daily Living (Capacity and Performance)	Higher level physical functioning	Parallel form Sum of items	Ordinary housework; Phone use; Use of technology; School tasks; Orientation in familiar environment; Stairs; Meal preparation; Managing finances; Managing medications; Shopping; Transportation	0–66	ChYMH, ChYMH-DD, EDU, YJCF

(Continued)

TABLE 2 | (Continued)

interRAI scale	Domain	Type of scale	Scale components	Range	Included in
Internalizing Scale	Frequency and severity of internalizing symptoms; consists of 3 factors- anhedonia, anxiety, and depression	Parallel form Sum of items	*Anxiety Factor:* Repetitive anxious complaints/concerns; Hypervigilance; Unrealistic fears; Episodes of Panic *Anhedonia Factor:* Lack of motivation; Anhedonia; Withdrawal from activities of interest; Decreased energy *Depression Factor:* Made negative statements; Self-deprecation; Expressions of guilt/shame; Expressions of hopelessness	0–48	ChYMH, ChYMH-DD, EDU, YJCF
Pain Scale	Frequency and intensity of pain	Parallel form Sum of items	Pain frequency; Pain intensity	0–4	ChYMH, ChYMH-DD, EDU, YJCF
Parenting Strengths Scale	Degree of strengths that the parent is demonstrating in parenting activities	Parallel form Sum of items	Communicate effectively with child/youth; Assists child/youth with the regulation of emotions; Uses appropriate disciplinary practices; Demonstrates warmth and support; Appropriate supervision and monitoring; Appropriate limit setting or expectations	0–12	ChYMH, ChYMH-DD, interRAI Early Years, EDU, YJCF
Peer Conflict Scale	Level of conflict with friends	Parallel form Sum of items	Conflict with or repeated criticism of close friends; Friends are persistently hostile or critical of child/youth; Pervasive conflict with peers (exclude close friends)	0–3	ChYMH, ChYMH-DD, EDU, YJCF
Positive Symptoms Scale	Frequency of positive symptoms of psychosis	Parallel form Sum of items	Hallucinations; Command hallucinations; Delusions; Abnormal though process	0–12	ChYMH, ChYMH-DD, ChYMH-S, EDU, YJCF, ESP-CY
Resource Intensity for Children and Youth Algorithm (RIChY)	Intensity and nature of service needs	Decision tree	Intimidation of others or threatened violence; Destructive behavior toward property; Conflict/repeated criticism of close friends; Friends persistently hostile; Bullying peers or conflict with peers; Family Functioning Scale; Victim of crime; Victim of sexual assault; Victim of physical assault; Victim of bullying; Victim of emotional abuse; Witnessed domestic violence; Constipation; Seizures; Dry mouth; Hypersalivation; Dyspnea; Akathisia; Dyskinesia; Tremor; Bradykinesia; Rigidity; Dystonia; Slow shuffling gait; Other emergent conditions; Parenting Strengths Scale; Difficulty falling asleep; Anxiety Scale; Self-Harm CAP; Harm to Others CAP	0–5	ChYMH, ChYMH-DD, EDU, YJCF
Risk of Injury to Others (RIO)	Injury to others	Decision tree	Physical abuse; Violence to others; Threatened violence; Violent ideation; Destructive behavior; Verbal abuse; Socially inappropriate behavior; Impulsivity; Family overwhelmed	0–6	ChYMH, ChYMH-DD, EDU, YJCF
Risk of Suicide and Self Harm in Kids (RiSsK)	Suicide and self-harm	Decision tree	Intent to kill self; Considered self-injury; Attempted self-injury; Others concerned about self-injury; Self-injurious behavior; Family overwhelmed; Depression Symptoms Scale	0–6	ChYMH, ChYMH-DD, EDU, YJCF
School Disengagement Scale	Intensity of school disengagement	Parallel form Sum of items	Increase in lateness or absenteeism; Poor productivity or disruptiveness at school; Expresses intent to quit school; Conflict with school staff; Strong, persistent dissatisfaction with school; Child/youth refuses to attend school; Child/youth removed due to disruptive behavior; Overall academic performance	0–8	ChYMH, ChYMH-DD, EDU, YJCF
Social Disengagement Scale	Frequency of symptoms related to anhedonia	Parallel form Sum of items	Anhedonia; Withdrawal from activities of interest; Lack of motivation; Lack of interest in social interaction	0–16	ChYMH, ChYMH-DD, ChYMH-S, EDU, YJCF, ESP-CY
Sleep Difficulties Scale	Frequency of symptoms related to sleep difficulties	Parallel form Sum of items	Difficulty falling asleep or staying asleep; Wakes multiple times at night; Falls asleep during the day (exclude naptime); Resists bedtime	0–16	ChYMH, ChYMH-DD, EDU, YJCF

TABLE 3 | Internal consistency of clinical scales derived from interRAI child/youth mental health instruments.

	Instrument				
	ChYMH-S	**ChYMH**	**ChYMH-DD**	**YJCF**	**OMHRS < 21**
N	*81,207*	*20,935*	*1,042*	*90*	*36,244*
Depressive Severity Index (0–15; 5 items)	0.800	0.812	0.779	0.790	0.736
Anxiety Scale (0–28; 7 items)	0.732	0.761	0.684	0.848	n/a
Disruptive/Aggressive Behavior Scale (0–20; 5 items)	0.831	0.851	0.779	0.817	n/a
Hyperactive/Distraction Scale (0–16; 4 items)	0.803	0.805	0.671	0.813	n/a
Parenting Strengths Scale (0–12; 6 items)	n/a	0.888	0.877	n/a	n/a
Externalizing Scale (short form) (0–14; 7 items)	0.739	0.781	0.683	0.736	n/a
Internalizing Scale (short form) (0–44; 11 items)	0.822	0.834	0.795	0.846	n/a

that no clear hierarchical structure was observed, particularly when stratified by age. However, children and youth with developmental disabilities exhibited a higher level of dependence in daily tasks. Furthermore, both ADL summary scales had excellent internal consistency. A study conducted by Phillips and colleagues (133) investigated the psychometric properties of two scales measuring the activity limitations of a non-clinical sample of children with chronic illnesses. The results of the study supported discriminant validity with Pearson's $r = -0.0174$ ($p = 0.46$) and -0.025 ($p = 0.28$) for the PEDS-HC Activities of Daily Living Limitations Scale and the Hands-on Needs Scale, respectively.

Criterion-Related Validity

Criterion-related validity compares the scores from an assessment against a particular outcome; two types include concurrent and predictive validity (129). Concurrent validity demonstrates the correlation between the scores under investigation with scores belonging to another assessment that evaluates the same construct (133). In contrast, predictive validity is based on correlations of scores on one assessment with scores on a criterion measure obtained in the future (129, 142).

Concurrent Validity. Numerous studies suggest that the tools in the child/youth suite have strong concurrent validity (111, 131, 132, 135, 136). A common approach to this type of validity is to compare the assessment tool under investigation with a tool that is recognized as a "gold standard" for the construct of interest (33). For example, Lau and colleagues (111, 131) found that the internalizing and externalizing subscales from the interRAI ChYMH had strong concurrent validity by comparing them with relevant criterion measures from other validated assessment instruments: Beck Youth Inventories, Social Skills Improvement System (SSIS), Child and Adolescent Functional Assessment Scale (CAFAS), Child Behavior Checklist (CBCL), and the Brief Child and Family Phone Interview (BCFPI). The strongest correlations were exhibited with the SSIS internalizing and externalizing behaviors and CBCL internalizing and externalizing scales, respectively, as resultant Pearson's Rho Bayesian Correlations were greater than 0.60. Additionally, Stewart and Babcock (135) conducted a similar study examining scales on the ChYMH-S (i.e., anxiety, distractibility/hyperactivity, internalizing, and externalizing). Their findings suggested that the ChYMH-S scales were significantly and positively correlated with relevant criterion scales from The Behavior Assessment System for Children, Third Edition (BASC-3). More recently, Li and colleagues (142) examined the Depressive Severity Index against the CBCL's Internalizing Scale and the BASC-3's Depression Scale and found evidence supporting the DSI's concurrent validity with a resultant Pearson's correlation of $r = 0.450$, $p = < 0.001$ and $r = 0.613$, $p < 0.001$, respectively.

Predictive Validity. One of the most difficult forms of validity to establish is predictive validity (33). A number of studies have shown that various scales within the interRAI child and youth suite have strong predictive validity (132, 133, 137). For example, data from over 5,000 children and youth placed in adult psychiatric settings in Ontario suggested that the Aggressive Behavior Scale was predictive of multiple control intervention use, such as use of restraints. For each unit increase on the Aggressive Behavior Scale, there was a 54%, 62%, and 34% increase in the odds of having received a mechanical restraint, physical restraint, or been held in seclusion, respectively (137). The Severity of Self-Harm (SOS) scale has been useful in predicting admission for risk of self-harm in youth between the ages of 10–17 years, as well as suicide in inpatient settings several years later. Specifically, Hirdes found that individuals who were considered to be high-risk on the SOS were 6.82-times more likely to die by suicide (unpublished data). Similarly, the DSI has been found to significantly predict self-injurious attempts and suicide intent (132). This form of validity is extremely important as one of the main goals of clinical work is to have a positive influence on the child or youth's developmental trajectory (33). The child and youth Caregiver Distress algorithm was recently developed and validated to identify factors associated with, and predictive of, new or ongoing distress among caregivers referred for mental health services (143). Utilizing longitudinal data, it was found to predict new or ongoing caregiver distress in parents of treatment-seeking children and youth, providing valuable clinical information to prevent future family breakdown. Additionally, the Risk of Injury to Others (RIO) is a decision-support tool developed and validated in order to identify children and youth at increased risk for violence (144). Findings indicated that it was a strong predictor of harmful behavior toward others, and it also predicted increased likelihood of future aggressive behaviors. These decision-support algorithms can be utilized to support strategic prevention and early intervention efforts for

TABLE 4 | Odds ratios (95% CL) for provisional psychiatric diagnoses by associated symptoms.

Provisional Diagnosis	*Prevalence*	Explanatory measure/scale	Adjusted[1] OR (95% CI)	c-stat
Attention deficit hyperactivity	*43.3%*	Hyperactive/Distraction Scale: 0	ref	0.780
		1 to 2	2.85 (2.37–3.43)	
		3 to 9	7.72 (6.58–9.06)	
		10 to 16	21.15 (17.83–25.07)	
Anxiety	*43.0%*	Anxiety Scale: 0 to 2	ref	0.716
		3 to 7	2.29 (2.10–2.49)	
		8 to 12	3.33 (2.96–3.75)	
		13 to 28	4.83 (4.10–5.70)	
Mood	*21.2%*	Depressive Severity Index: 0	ref	0.791
		1 to 3	1.45 (1.26–1.67)	
		4 to 7	1.97 (1.70–2.28)	
		8 to 15	2.71 (2.31–3.19)	
		Social Disengagement Scale: 0	Ref	
		1 or 2	1.20 (1.06–1.37)	
		3 to 8	1.57 (1.39–1.77)	
		9 to 16	2.04 (1.70–2.43)	
Learning or communication	*19.9%*	Communication Scale: 0	ref	0.726
		1 to 2	2.41 (2.17–2.68)	
		3 to 4	3.34 (2.86–3.89)	
		5 to 8	4.49 (3.30–6.10)	
		Daily decision making: impaired	2.03 (1.84–2.25)	
Disruptive behavior disorder	*18.8%*	Disruptive/Aggressive Behavior Scale: 0	ref	0.725
		1 to 3	3.16 (2.66–3.76)	
		4 to 9	7.33 (6.21–8.64)	
		10 to 20	14.08 (11.65–17.03)	
Autism spectrum	*9.6%*	Autism Spectrum Screening Checklist: 0	ref	0.827
		1	4.13 (3.36–5.08)	
		2	8.91 (7.19–11.04)	
		3	15.34 (12.30–19.12)	
		4	32.45 (25.78–40.85)	
		5	46.82 (35.25–62.18)	

N = 13,951. [1] *Adjusted for age group and sex.*

these vulnerable youth to circumvent negative sequelae when many of these features present early in life.

Table 4 also highlights the predictive validity of a selected set of scales within the suite. Here, it is evident that an increase in odds ratios for provisional psychiatric diagnoses is related to higher scale values; this means that individuals who scored higher on a particular scale were more likely to have a provisional diagnosis of the associated disorder. For example, those who scored higher on the Hyperactive/Distraction scale were more likely to have a provisional diagnosis of ADHD. Furthermore, goodness of fit ranged from 0.71 to 0.83 after adjusting for age group and sex, suggesting good/moderately high predictive validity.

Use and Utility of the interRAI Child and Youth Suite

Some of the key fundamental measures that are available in all or most of the six instruments previously described in the section outlining our data holdings are summarized in **Table 5**. Considering the different target ages and clinical needs that these instruments are designed for, the ability to measure and report across populations and in a valid and comparable way is a key feature of this family of instruments. For example, about 1 in 10 individuals assessed with the interRAI Early Years instrument report a family member feeling overwhelmed, and this is approximately 2 in 3 among those assessed with the YJCF or ChYMH-DD instrument. This table also highlights that fewer than 10% of those children/youth assessed with the ChYMH, ChYMH-DD, or ChYMH-S had a lifetime suicide attempt, whereas this number jumps to 22% of those assessed in youth justice and 30% of those assessed in inpatient psychiatry. Experiencing abuse is notably higher in the youth justice sample, particularly physical and emotional abuse. Furthermore, younger persons assessed in inpatient psychiatry had the highest prevalence of sexual abuse, at nearly 1 in 5.

Figure 1A shows lifetime interpersonal trauma, which uses three items that record if the child or youth has been a victim of sexual assault or abuse, physical assault or abuse, or emotional abuse at any time. **Figure 1B** shows any interpersonal trauma in the last year, to illustrate the extent to which it is not merely the accumulation of more years of exposure that produces increased prevalence with age. As such, both **Figures 1A,B** show proportions of interpersonal trauma are low among younger ages, and then it generally increases by year. This is evident

TABLE 5 | Summary of fundamental measures available across child/youth instruments.

	Instrument					
	interRAI Early Years	**ChYMH-S**	**ChYMH**	**ChYMH-DD**	**YJCF**	**OMHRS (up to 21)**
N	*1,106*	*81,207*	*20,935*	*1,042*	*90*	*36,244*
Mean age (std. dev)	2.3 (1.0)	12.4 (3.8)	12.4 (3.6)	12.1 (3.6)	17.2 (0.8)	19.3 (1.8)
Male	65.1%	49.1%	54.6%	72.1%	79.2%	52.9%
Lives with parent/guardian	92.6%	92.0%	90.2%	83.1%	63.9%	n/a
History of foster placement	8.7%	n/a	13.4%	18.0%	33.3%	n/a
Custody dispute	5.2%	n/a	5.0%	1.9%	n/a	n/a
Any lifetime residential/inpatient admission	n/a	n/a	18.5%	21.8%	29.2%	33.7%
Children's Aid Society (CAS) is legal guardian	3.8%	1.7%	3.8%	6.7%	0.0%	n/a
Family report feeling overwhelmed	10.6%	35.7%	44.5%	64.8%	57.9%	44.0%
Victim of bullying (ever)	n/a	42.2%	47.7%	24.9%	55.6%	n/a
Witnessed domestic violence	7.6%	23.2%	28.3%	19.9%	44.4%	n/a
Any self-injurious attempt to kill self	n/a	8.6%	9.5%	3.9%	22.2%	30.8%
Violent ideation in last year	n/a	6.5%	11.0%	10.8%	43.1%	15.6%
Sexual abuse	0.4%	8.7%	11.1%	5.6%	16.7%	19.3%
Physical abuse	1.1%	13.5%	18.9%	15.5%	51.4%	28.0%
Emotional abuse	2.5%	22.7%	27.7%	17.1%	55.6%	18.6%
Any of 3 trauma items (physical, sexual, emotional)	3.0%	29.2%	34.9%	22.6%	68.1%	37.1%

regardless of which instrument is used, with the exception of younger adults who are assessed with the interRAI-MH as part of the OMHRS system for inpatient psychiatry beds. Here, it is interesting to note that the proportion with interpersonal trauma declines around 17 years of age. Both figure panels also show that young persons assessed with the ChYMH-DD tend to have lower levels of interpersonal trauma, whereas those assessed with the YJCF have exceptionally high levels. It is possible that, due to low communication or verbal skills, children with intellectual disabilities are less likely to disclose such interpersonal trauma. Furthermore, children in regular inpatient units age 13 and younger show more interpersonal trauma, and this is even more apparent when considering the last year only. Finally, **Figure 1A** highlights that the large number of individuals assessed with the ChYMH-S show lower levels of interpersonal trauma compared to those assessed with the more comprehensive ChYMH; however, this pattern is not similarly seen in **Figure 1B**.

Applications of interRAI Instruments

All instruments within the child/youth suite are intended to be used as part of standard clinical practice and they each serve a number of different functions. Given the high prevalence of interpersonal trauma within children's mental health (i.e., approximately 40% depending on the interRAI instrument used), this construct was utilized to illustrate the differences in applications, specifically across the variety of scales/algorithms, care planning protocols, outcome measurement, and quality indicators.

Care Planning

A unique feature of interRAI assessments is that they integrate a comprehensive evaluation of an individual's areas of strengths and needs within a series of collaborative action plans. Within each instrument, these care planning guidelines have been developed to inform clinical decision-making. Each CAP is comprised of the same five elements: (1) a description of the clinical issue, (2) goals of care, (3) an overview of the various triggering levels, which are based on certain items from the assessment and are associated with different approaches to care, (4) guidelines to assist with care planning based on international best practice, and (5) additional resources related to that particular clinical issue, including references to peer-reviewed publications.

As noted, specific items within each assessment tool serve as "triggers" for certain CAPs, which are subsequently used to help provide evidence-informed care. It is important to emphasize that the purpose of CAPs is to support needs-based care planning; hence, they are not prescriptive in nature. In addition, it is essential that CAPs are utilized within a client-centered approach to care. This means that they are used to help facilitate shared decision-making. More specifically, the child/youth and their family are an integral part of the discussion with regard to how the main areas of need identified by the CAPs will be addressed moving forward. These CAPs have been extensively reviewed by over 150 experts in their respective fields across at least three continents.

Table 6 shows 12 selected CAPs across the ChYMH, ChYMH-DD, and YJCF. The ChYMH cases show the highest triggering rates for medication adherence, whereas the ChYMH-DD cases show the highest triggering rates for communication, medication review, and strengths. Furthermore, YJCF cases show the highest triggering rates for substance use, hazardous fire risk, self-harm, harm to others, interpersonal conflict, transitions, and traumatic life events. Finally, cases across all three instruments show similar triggering rates for sleep disturbance, which is approximately 40% of assessed individuals.

Figure 2A shows the triggering rates for the Suicidality and Purposeful Self-Harm CAP by interpersonal trauma and instrument. It is quite evident that a greater proportion

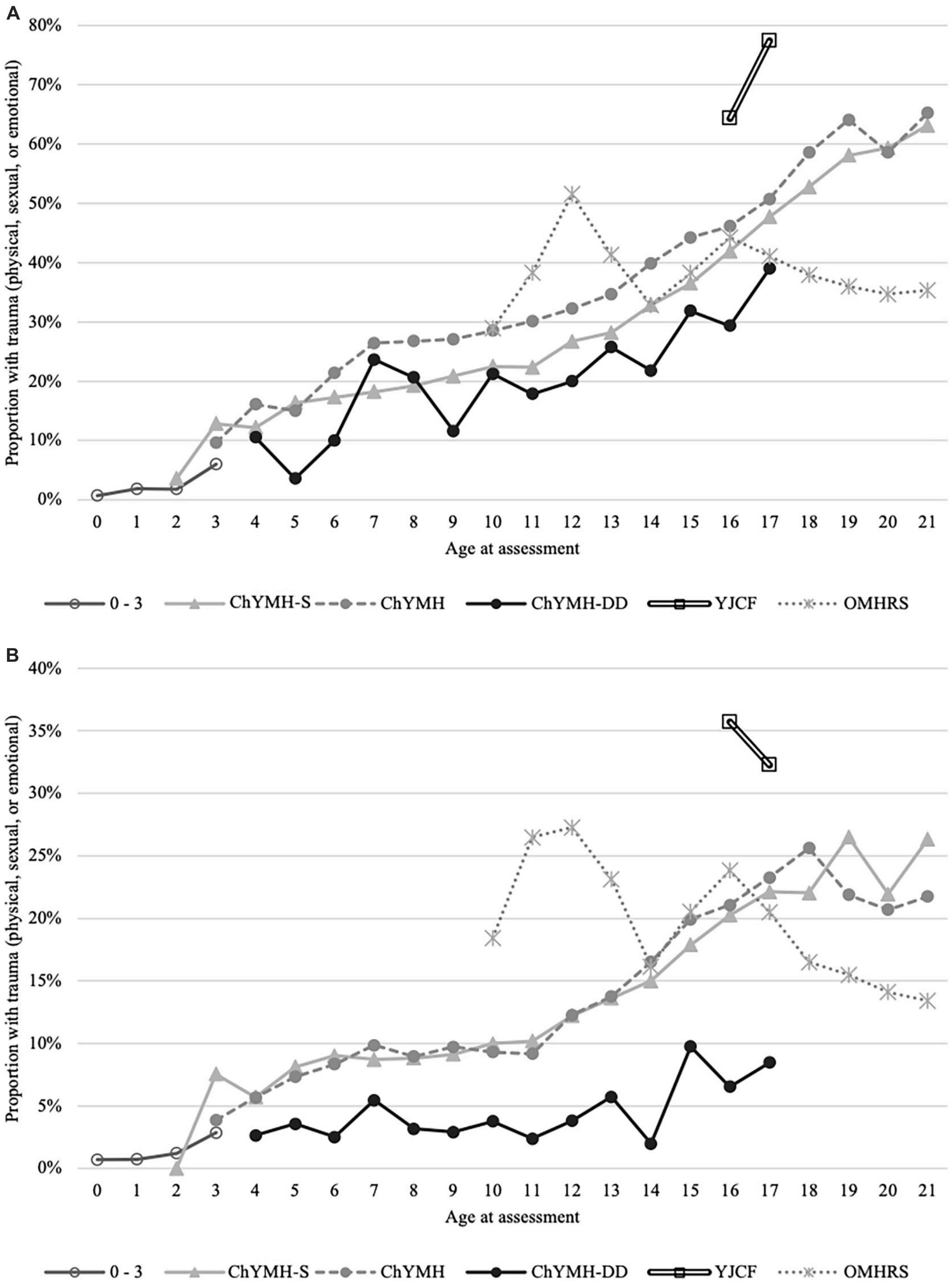

FIGURE 1 | (A) Lifetime trauma: victim of sexual assault or abuse, physical assault or abuse, or emotional abuse at any time. **(B)** Trauma in the last year: victim of sexual assault or abuse, physical assault or abuse, or emotional abuse within the last year.

of those who have experienced interpersonal trauma trigger the Suicidality and Purposeful Self-Harm CAP, regardless of instrument/cohort. This link between interpersonal trauma and increased risk of suicidality and self-harm is well-supported by the literature [e.g., (145–147)]. **Figure 2B** shows the triggering rates for the Harm to Others CAP by interpersonal trauma and

TABLE 6 | List of selected CAPs and their triggering rates across three child/youth mental health instruments.

CAP	Instrument		
	ChYMH (*n* = 20,887)	**ChYMH-DD** (*n* = 1,042)	**YJCF** (*n* = 90)
Self-harm/suicide	24.4%	12.3%	41.7%
Harm to others	12.3%	1.9%	25.0%
Traumatic life events	51.0%	38.1%	61.1%
Interpersonal conflict	54.9%	47.5%	65.3%
Transitions	22.7%	41.8%	72.2%
Substance use	17.9%	1.4%	87.5%
Medication adherence	12.0%	8.9%	6.9%
Medication review	21.7%	40.4%	11.1%
Hazardous fire involvement	4.6%	4.7%	8.7%
Communication	11.8%	65.6%	15.3%
Sleep disturbance	39.9%	42.6%	40.3%
Strengths	16.9%	40.6%	13.9%

instrument. These results show a similar pattern as the Suicidality and Purposeful Self-Harm CAP, whereby a greater proportion of those with a history of interpersonal trauma trigger the Harm to Others CAP across instruments/cohorts. Previous research has also found a relationship between these traumatic experiences and risk of harm to others [e.g., (148–150)].

Outcome Measurement

Scales embedded within interRAI instruments help capture the complexity of the areas of need at a given point in time. These scales provide a clinical summary of an individual's status across key domains (e.g., cognitive functioning, depression) and are automatically calculated upon completion of the assessment. Across all instruments, higher scores indicate greater symptom severity, problems related to functioning, or frequency of occurrences. Overall, interRAI scales are useful in describing the individual's current level of functioning and supporting care planning; furthermore, when examined longitudinally, they provide insights about response to intervention and changes in strengths and needs over time.

Scales can be utilized to highlight differences in mental health severity across in-patient and out-patient services, and to examine outcomes to determine treatment effectiveness (151). An example within the child/youth suite is the Depressive Severity Index, which sums 5 items to produce a scale from 0 to 15, where higher values indicate greater depressive symptoms. In **Figure 3**, the DSI outcome scale is used to show higher depressive symptoms among those with a lifetime history of interpersonal trauma, compared to others without such a history, across 5 instruments used in child/youth mental health populations.

Quality Indicators

Quality indicators (QIs) are summary measures that can provide a comprehensive understanding of quality of care. While outcome scales can be used to track changes in strengths and needs over time at the individual level, longitudinal data can be compiled to track performance at the population level. QIs serve multiple functions; for example, they can be used by agencies to monitor care and facilitate internal quality improvement. Furthermore, QIs can be used to assist the government with accountability and public awareness. These indicators often look at two main outcomes, namely improvement in symptoms or failure to improve/worsening of symptoms between admission and follow-up.

Figure 4 depicts the proportion of children and youth showing improvement at follow-up across five selected scales, by interpersonal trauma status. Based on the findings, the presence of interpersonal trauma history negatively impacts recovery. Specifically, it is less likely for measures of anxiety, depressive symptoms, externalizing symptoms, risk of self-harm and injury to others to improve at follow-up, compared to those without a history of interpersonal trauma. Furthermore, it is important to note that baseline rates are higher in those who have experienced trauma, which means they have a greater opportunity to improve by at least the threshold points, and yet they do not.

The interRAI child/youth suite is currently in the process of further developing QIs to reflect changes in patterns of symptom levels and domains of functioning. A more thorough examination of the relationship between individual characteristics and differential outcomes will help determine which sub-populations respond well to certain interventions, compared to those that do not. As a result, this will help facilitate differential triaging and, in turn, effective resource allocation. Finally, it can also help identify areas that would benefit from the development of innovative approaches to intervention, including novel approaches to trauma-informed care.

Resource Allocation

interRAI assessment systems can also be used to inform decisions with respect to resource allocation at the individual and societal level. For example, within the adult suite of instruments, the interRAI-MH instrument was used to develop a level of care framework to support resource allocation. Notably, such a framework or decision support algorithm had not previously been available for pediatric populations. Specifically, within the children's mental health setting, decisions about resource allocation were often based on unstandardized instruments and subjective interpretations, thereby reducing the likelihood that resources were allocated fairly and effectively. In response to this need, interRAI launched an effort to develop a decision support algorithm for resource allocation among younger populations and created the Resource Intensity for Children and Youth (RIChY) (20).

Resource Intensity for Children and Youth is an empirically based decision-support tool that may be used to inform the nature and intensity of scope of service needs for children and youth needing facility- or community-based services. RIChY is based on item responses on full comprehensive assessments. The RIChY algorithm divides children and youth into three age groups: 7 and under, 8 to 11, and 12 and older. The algorithm provides a score ranging from 0–5 based on levels of need for intensive resources; however, not all ages populate all categories. Specifically, the algorithm ranges from 0–3 for children 7 and under, whereas it ranges from 0–5 for children 8 to 11 years and

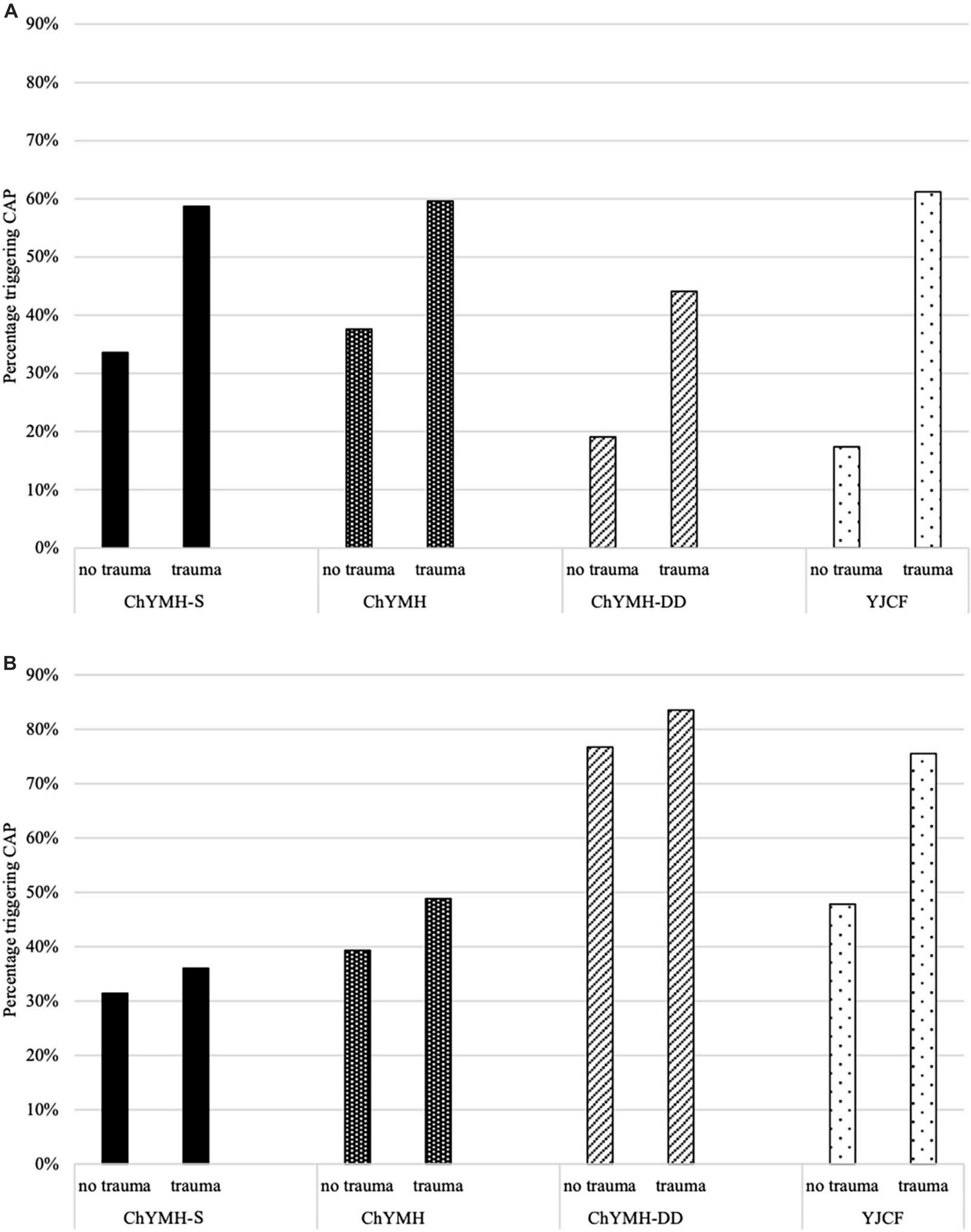

FIGURE 2 | (A) Triggering rates for the Suicidality and Purposeful Self-Harm CAP, by trauma and instrument. **(B)** Triggering rates for the Harm to Others CAP, by trauma and instrument.

those 12 and older. Higher scores on the algorithm indicate a greater priority for intensive services.

The child or youth can fall into a given level via a number of pathways that represent different combinations of risk factors, such as intimidation of others or threatened violence, external circumstances (e.g., traumatic life events, family dysfunction, or lack of close friends), and risk of harm to self or others. While the algorithm is a decision-support tool, it is important to emphasize that it is ultimately the responsibility of the clinical team to use professional judgment to decide if the RIChY score accurately

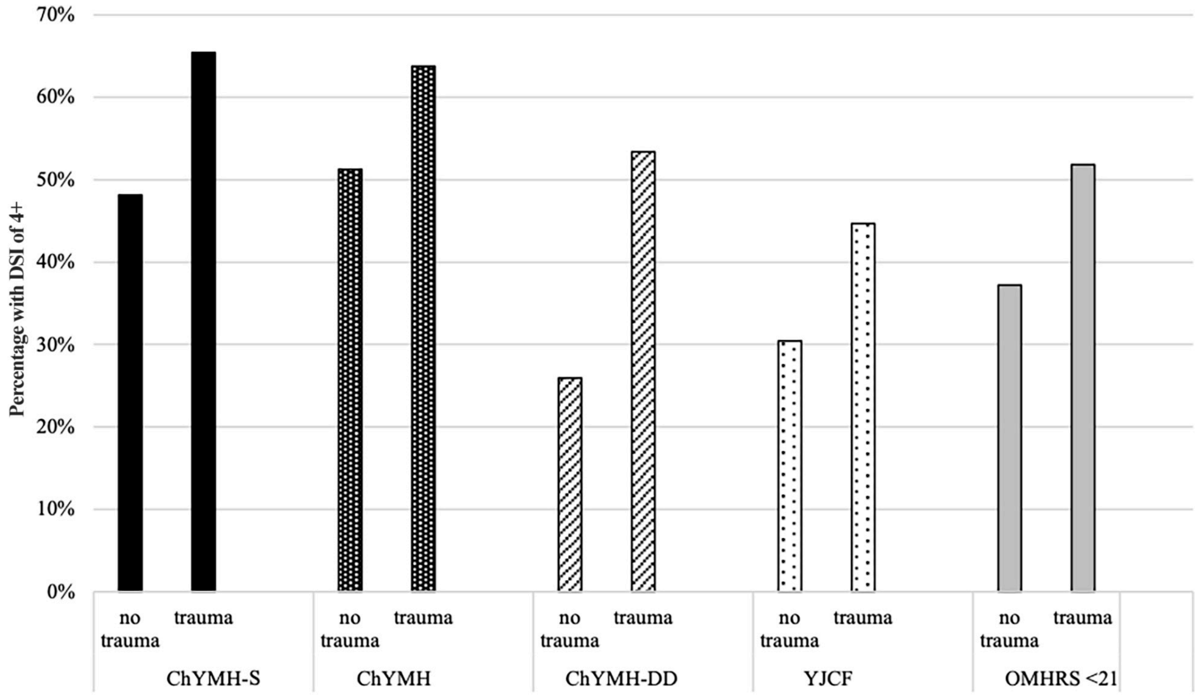

FIGURE 3 | Percentage distributions of Depressive Severity Index score of 4 or greater, by trauma and instrument.

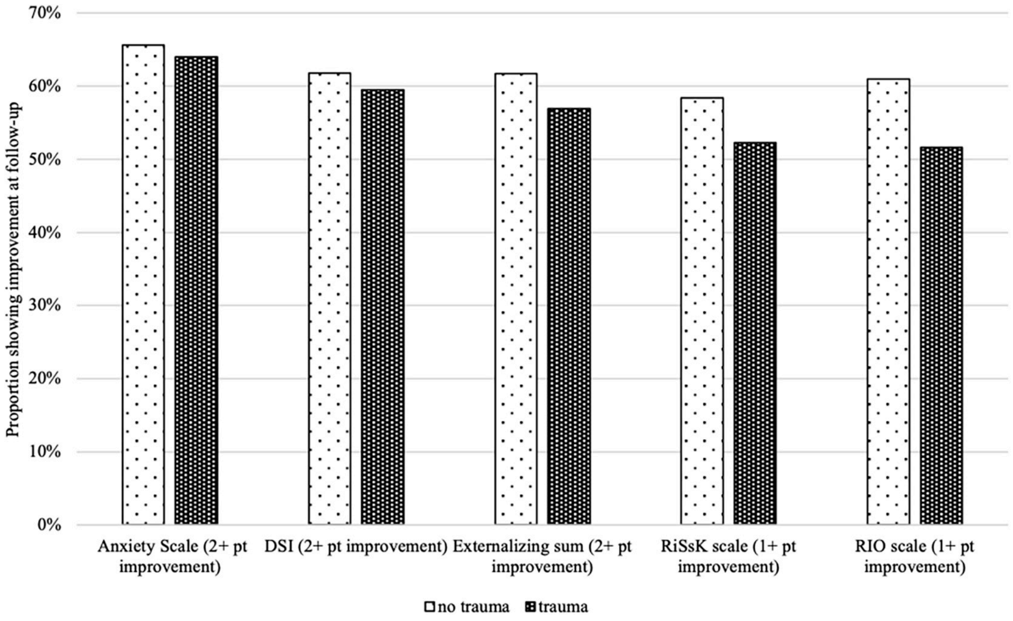

FIGURE 4 | Change from initial to follow-up assessment, by scale and trauma.

reflects the young person's need for intensive services, given all available information.

Figure 5 shows the distribution of the RIChY scale by interpersonal trauma status across the ChYMH and ChYMH-DD. For both ChYMH and ChYMH-DD cases, expected resource intensity is higher in those with a history of interpersonal trauma compared to those without such a history (i.e., there is a greater proportion in high resource groups, and a lower proportion in low resource groups).

Another tool that can be used to inform decisions regarding the allocation of resources within the field of healthcare are case-mix classification systems. Case-mix modeling utilizes

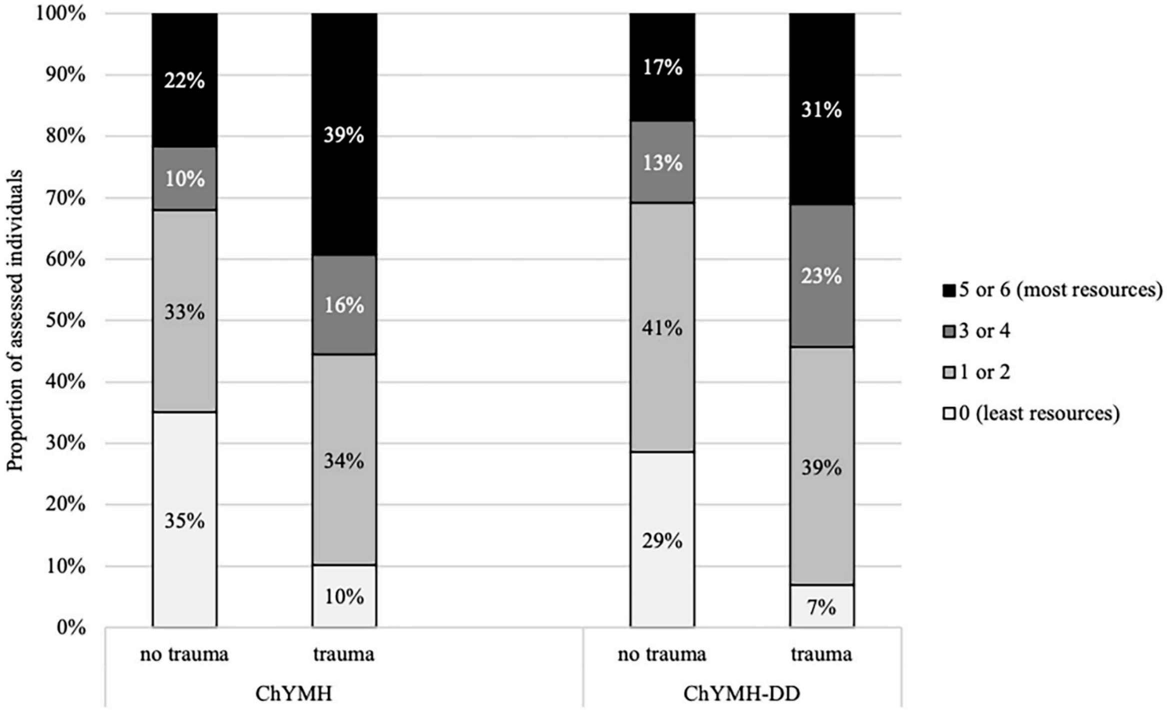

FIGURE 5 | Distribution of the Resource Intensity for Children and Youth (RIChY) scale.

information about individual characteristics in conjunction with resource data to create groupings based on similar resource requirements. Hence, case-mix classification systems typically describe the comparative resource needs of different groups, with payment systems then attaching a dollar value to these various case-mix groups. Within the adult mental health sector, a case-mix system was developed and implemented across the Province of Ontario, namely the System for Classification of In-Patient Psychiatry (SCIPP) (33). Unfortunately, most service sectors typically utilize funding models based on a standard rate per client rather than the complexity of their needs. To address this gap within the children's mental health sector, the Arkansas Division of Developmental Disability Services (ARDDS) collaborated with interRAI to develop a case-mix classification system to inform decisions regarding the allocation of resources for children and youth with intellectual and developmental disabilities (IDD). This effort was part of a system-wide payment reform initiative for Medicaid. As a result of this effort, the interRAI Child and Youth Resource Index (ChYRI) was created (shown in **Figure 6**).

Child and Youth Resource Index is an empirically based decision-support tool that can be used to inform resource allocation among young persons with IDD (152). It serves as a useful guideline to aid in decision-making around allocation of resources and planning for appropriate services. The classification system incorporates 8 distinct groups and explains 30% of the variance in *per diem* costs. A number of variables are included within the system, such as age, motor skills, violence to others, supportive relationship with the family, foster placement, and certain health conditions (e.g., paralysis, bladder continence). There is a 3-to-1 range in case-mix indexes (CMIs) across the groups. Overall, ChYRI can be utilized to improve equitability in the allocation of limited resources within vulnerable populations, centered around stability and fairness.

FUTURE DIRECTIONS

Over the past decade, the child and youth mental health suite of instruments has made significant contributions within both clinical and research domains. Nevertheless, in order to continue to make a meaningful impact, some of the limitations of the suite need to be addressed. For the suite's potential to be fully realized, it is important for the leaders of mental health teams to emphasize the clinical utility of the system rather than the aspects related to data collection. It is also important to emphasize the value of effective communication and collaboration across various service sectors and healthcare providers in order to maximize the utility of this integrated system. Additionally, ensuring there is a strong, well-designed software system to support data collection and uptake of the scales, algorithms, and care plans to ensure proper use and utility of the interRAI suite is key.

Notably, the interRAI instruments exemplify a needs-based approach to care, which supports a more equitable approach to service delivery, and consequently, reduces disparities in the provision of mental health services (153). This approach will only become increasingly vital as the social inequities around the world continue to rise, and we are tasked with

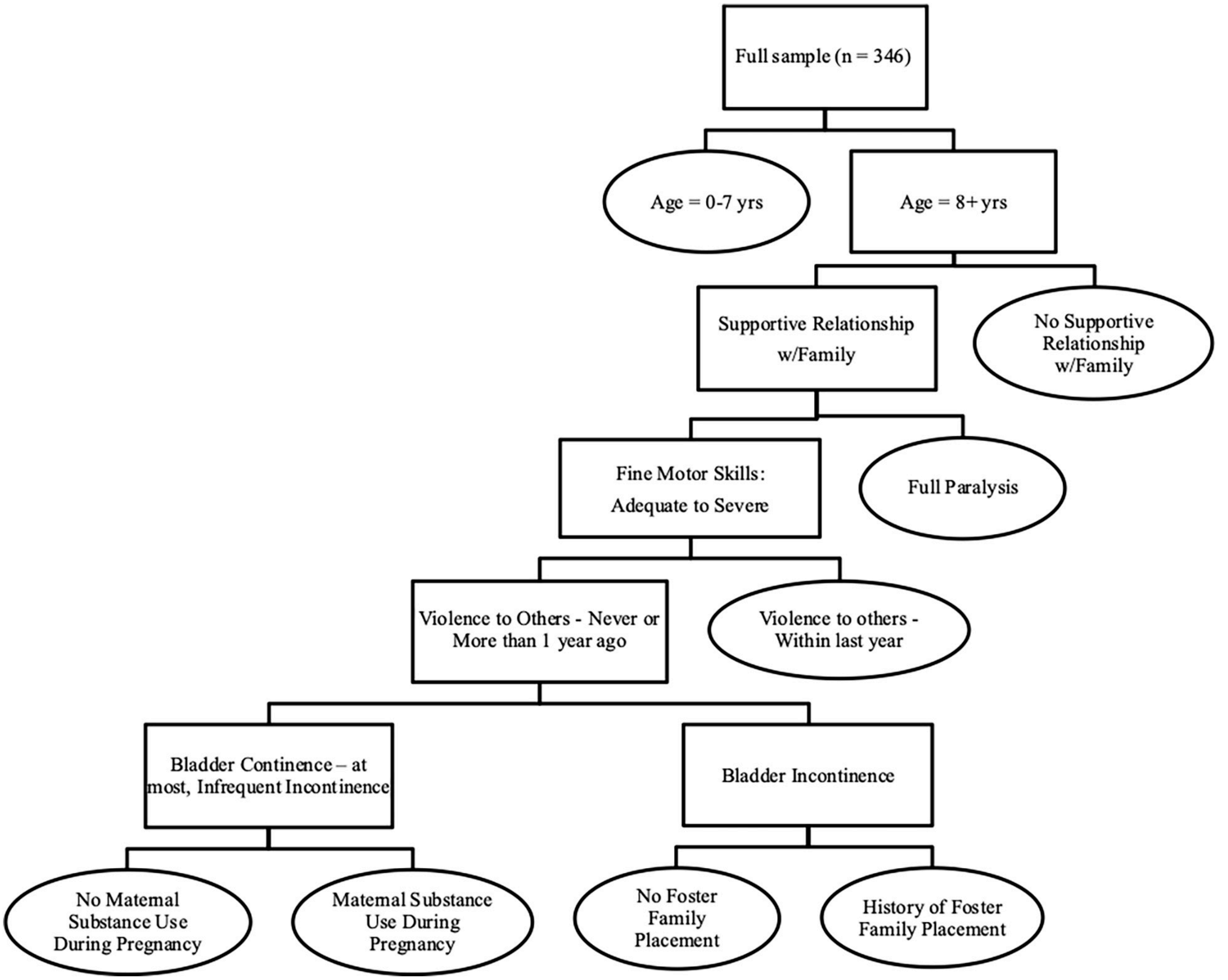

FIGURE 6 | The interRAI Child and Youth Resource Index (ChYRI). Ovals represent terminal ChYRI groups.

navigating new global challenges, as evidenced by the COVID-19 pandemic [see (154–156)]. Therefore, the interRAI integrated assessment system is both well-equipped and well-positioned to help inform equitable service delivery to ensure that those who are most vulnerable and in greatest need have increased access to services and receive the appropriate resources in an efficient, effective manner.

The implementation of the interRAI instruments has been highly effective in Ontario with implementation across other provinces currently underway. Future research is needed across Canada as well at the international level. It will be essential to continue to build partnerships with health leaders from different countries, including those from low-, middle-, and high-income nations. Furthermore, the development of additional self-report tools is presently underway, which will be especially useful in serving parts of the world where there are a lack of mental health professionals and significant barriers to accessing mental health services. These instruments will also support new implementation efforts within primary care.

While many studies have already been published examining the validity and reliability of the child/youth mental health instruments, additional research in this area is needed including international studies investigating the areas of predictive validity, criterion validity, and inter-rater reliability. It will also be important to consider developing case-mix systems for in-patient and community mental health instruments for children and youth in general, as the ChYRI is only intended for those with IDD.

Finally, as the child/youth suite of mental health instruments continues to grow and develop, it will create a plethora of new and exciting opportunities that will be transformative in nature. For example, these longitudinal datasets comprised of rich clinical information will create opportunities for applying artificial intelligence tools, thereby expanding possibilities related to the development of novel applications for personalized health care systems. Most critically, a comprehensive mental health assessment system that spans from infancy to adulthood will provide an extraordinary opportunity to examine the impact of mental health and illness on all ages and stages, and develop innovative solutions to help each individual maximize their quality of life.

AUTHOR CONTRIBUTIONS

SS and JP developed the analytical strategy. JP performed the statistical analysis. All authors contributed to the formulation of the ideas presented in the study and were involved in the writing and reviewing of the final manuscript.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX

Supplemental Data Description

All data used were from extracts of assessments captured by secure software platforms used by the assessing agencies. If an individual was assessed more than once by an agency using the same instrument, the first observation was used.

Data description, by instrument:

Instrument	Start Date	End Date	*N*	Lifetime Trauma		Number of Agencies
				No	Yes	
ChYMH	Oct 2012	Aug 2020	20,887	13,600 (65.1%)	7,287 (34.9%)	59
ChYMH-DD	Oct 2012	Aug 2020	1,042	806 (77.4%)	236 (22.7%)	13
ChYMH-S	Jan 2015	Aug 2020	81,152	57,471 (70.8%)	23,681 (29.2%)	62
Early Years	Feb 2017	Aug 2020	1,106	1,073 (97.0%)	33 (3.0%)	15
OMHRS (up to age 21)	Oct 2005	Mar 2020	35,705	22,468 (62.9%)	13,237 (37.1%)	90
YJCF	Nov 2014	Aug 2015	72	23 (31.9%)	49 (68.1%)	9

For **Figure 4**, individuals with two consecutive assessments (ChYMH or ChYMH-DD or ChYMH-Screener) between 30 and 365 days apart were identified. Assessment setting was required to be the same on both assessments, i.e., inpatient for both or outpatient for both. There were 11,552 pairs: 5,791 ChYMH, 124 ChYMH-DD, and 5,637 ChYMH-Screener. We report the proportion of these pairs that achieved a 2-point improvement (Anxiety, DSI, and Externalizing scales) or a 1-point improvement (RiSsK and RIO scales) among cases that had a baseline scale score of 2 more, or 1 or more, respectively. Note that higher scale values reflect higher acuity, so an improvement is a decline in score value.

These N's were:

Anxiety Scale: 8,176 (3,376 ineligible).

DSI: 8,853 (2,699 ineligible).

Externalizing Scale: 8,661 (2,891 ineligible).

RiSsK Scale: 5,749 (5,803 ineligible).

RIO Scale: 5,992 (5,560 ineligible).

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Risk of Injury to Others: The Development of an Algorithm to Identify Children and Youth at High-Risk of Aggressive Behaviours

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Youth violence is considered one of the most preventable causes of morbidity and premature mortality. Various risk factors have previously been identified, however, there is presently a crucial need to develop effective decision-support tools in order to identify children and youth at increased risk for violence. The current study utilised data collected from the interRAI Child and Youth Mental Health Screener (ChYMH-S), within the province of Ontario, to develop and validate a methodology for the purpose of identifying young persons who were at greater risk of harm to others. Additional data from 59 mental health agencies validated the algorithm, and it was found to be a strong predictor of harmful behaviour toward others. The RIO algorithm provides a valuable decision-support tool with strong psychometric properties that may be used to identify young persons who exhibit signs or symptoms associated with increased likelihood of harm toward others, in order to provide early intervention efforts for these vulnerable youth, thereby reducing the likelihood of future aggressive behaviours.

Keywords: children and youth, mental health, physical aggression, harm to others, interRAI

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INTRODUCTION

Childhood physical aggression is an important public health concern, as it has the potential to lead to more serious, violent behaviours, resulting in a plethora of adverse consequences (1, 2). Violence among youth is considered one of the most preventable causes of morbidity and premature mortality, with homicide continuing to be one of the leading causes of death for young people between the ages of 10–24 (3, 4). Notably, the World Health Organisation has made a dedicated effort to focus on delineating risk factors of youth violence over the recent decades, moving toward a prevention model for violence (5, 6). Through the identification of modifiable risk factors of youth violence, preventative strategies could be implemented to reduce risk of aggression toward others.

Physical Aggression in Youth

While the age of onset for serious injury toward others typically does not occur before the age of 12, studies have found that the majority of children demonstrate physical aggression toward others by 17 months, although it is rare for such young children to cause serious harm (7–9). Most children will learn over time how to regulate their physical aggression; however, those who do not are at highest risk of engaging in serious violent behaviour later in life (2). From a developmental perspective, the precursors of chronic physical aggression are present before the child begins school, suggesting that the spontaneous onset of aggressive behaviours in school-aged children is quite atypical (2, 10, 11). Finally, as these precursors are present at such an early stage of life, it falls in line that a number of the most well-established risk factors can be found within the family context and environment [e.g., (12)].

Potential Risk Factors Regarding Injury Toward Others

A number of family factors have been implicated in the development of physical aggression and subsequent violent behaviour in children and youth. Tremblay and colleagues (12) reported that at 5 months old, the best predictors of a high physical aggression trajectory were coercive parenting and family dysfunction. Moreover, children who have been physically abused within their home are more likely to exhibit aggressive behaviour at school, engage in serious violent acts during their teenage years, and commit violent crimes as adults (13–15). Studies have also found that poor family management practises, such as low parental supervision and monitoring, severe and inconsistent discipline, and unclear expectations predict delinquency later on (16, 17).

Certain individual characteristics and behaviours have also been linked to harm toward others. Poor impulse control and emotion regulation have been associated with violent behaviour from childhood through to early adulthood (18, 19). Research has also found that antisocial behaviour presenting early in life can predict future violence, with disruptive behaviour in childhood being one of the best predictors of violent offending during adolescence and adulthood, particularly for boys (20–22). Further, early-onset conduct problems, such as engaging in destructive behaviours, have repeatedly been identified as important predictors of future violent and criminal acts (23, 24).

Finally, the literature has found that injury toward others is an enduring and robust predictor of future violent acts (25). Children who exhibit chronic physical aggression during their elementary school years are more likely to continue engaging in physical violence during adolescence (2). Importantly, the link between early onset of aggression to more serious and chronic violent behaviour is evidenced in numerous studies; for example, the Denver Youth Study reported that 62% of children who engaged in violent behaviours at 9 years of age or younger became chronic violent offenders during adolescence (26–28). Another study reported that two-thirds of boys who were highly aggressive at 10–13 years of age had criminal records of violent offences by the age of 26. This represented a 6-fold increase compared to those who had low aggression (29). In addition to a history of aggressive behaviour, pro-violence attitudes are also linked to the onset and perpetration of violence among youth (23, 30).

The current study's objective was to develop and validate a methodology for identifying young persons who are at heightened risk of harming others utilising a comprehensive instrument used as standard of care in many mental health agencies within the province of Ontario, Canada. A validated methodological approach to identify adults who are at risk of harm to others (RHO) has previously been developed by interRAI (31). interRAI is an international non-profit collaborative committed to improving the lives of vulnerable persons across the lifespan. In particular, the interRAI child and youth suite of instruments was designed to facilitate a standardised, comprehensive, and coordinated approach to the delivery of mental health services for infants, toddlers, children and youth. An initiative was undertaken to develop a new decision-support algorithm for identifying youth at greatest risk of harm to others by harnessing the power of the existing interRAI assessment system, given that no system for such identification currently exists. A similar methodology utilised in the RHO was applied, creating the Risk of Injury to Others (RIO) algorithm, to assist service providers in determining whether a child or youth was at high risk of harming other individuals. This article describes the development and validation efforts of the RIO algorithm.

METHODS

Sample

The method used in the development and validation of the RIO algorithm parallels that of an algorithm that we have previously developed, the Risk of Suicide and Self-Harm (RiSsK) (32). The following is an abbreviated version of the methodology. For a more detailed and comprehensive account of our Methods, please refer to our previous work (32).

The participants of this study were children and youth who received mental health services from Ontario health agencies. Notably, the study drew from four sample populations for the different stages of the methodology: (1) derivation, (2) validation, (3) descriptive analyses, and (4) longitudinal analyses. Data from the Child and Youth Mental Health Screener (ChYMH-S) (33) were used in both the derivation and validation stages. The RIO algorithm was derived using 60,414 records from 54,280 unique individuals, collected between September 1, 2015 and January 31, 2019. The participants had a mean age of 11.8 years with males comprising 49.8% of the sample (SD 3.74, range 4–18 years). Following the derivation stage, secondary data analyses were completed to validate the algorithm using 2,117 records from 2,098 unique individuals that were completed between February 1, 2019 and March 5, 2019. The participants had a mean age of 11.7 years with males comprising 49.0% of the sample (SD 3.67, range 4–18 years). Fifty-nine mental health organisations were included in the original development efforts of the RIO algorithm. There were no differences in the methods or sources between the derivation and validation samples.

In the post-scale development stage, two additional related sources of data were used to conduct (1) additional descriptive analyses related to diagnoses and (2) longitudinal analyses related to predictive validity. These data sources included the Child and Youth Mental Health (ChYMH) (34) and the Child and Youth Mental Health and Developmental Disability (ChYMH-DD) (35). To conduct the analyses related to diagnoses, a sample of 25,104 ChYMH and ChYMH-DD assessments on 13,899 unique individuals was used, completed between September 1, 2015 and January 31, 2019. The participants had a mean age of 12.1 years and males made up 57.0% of the sample (SD 3.51, range 4–18 years). To conduct the longitudinal analyses, a sample of 6,608 ChYMH-S, ChYMH, and ChYMH-DD assessments on 5,542 unique individuals was used, completed between November 4, 2015 and January 31, 2019. The participants had a mean age of 11.5 years and males made up 58.3% of the sample (SD 3.53, range 4–18 years).

The three aforementioned assessment tools (i.e., ChYMH, ChYMH-DD, and ChYMH-S) are used routinely as the standard of care in Ontarian mental health agencies. Thus, the inclusion criteria for this study consisted of children and adolescents between the ages of 4–18 years who presented at mental health facilities utilising the interRAI child/youth suite of instruments as standard of care.

Measures

The ChYMH-S is a relatively new assessment instrument developed by interRAI, a non-profit collaborative that is composed of researchers and clinicians from over 35 countries. It is a brief assessment tool utilised to assess, triage, and prioritise children and adolescents seeking mental health services.

Nearly 100 items comprise the ChYMH-S. The items are generally selected from the larger comprehensive Child and Youth Mental Health assessment (34), with some additional items specific to screening purposes. The full interRAI ChYMH and ChYMH-DD assess mental health needs more extensively. These comprehensive tools consist of ∼400 items that are used to assess psychiatric, social, environmental, and medical issues for children and youth. The ChYMH, ChYMH-DD, and ChYMH-S are divided into various subsections, such as mental state indicators, education, and behaviour. Further, the tool is supported by a detailed training manual containing coding rules for all items. The result is a reliable and valid assessment that can be used for a number of different purposes (e.g., case documentation and program planning) (36).

Procedure

The ChYMH, ChYMH-S, and ChYMH-DD were routinely administered as part of the standard of care for young persons seeking mental health services in 59 agencies across the Province of Ontario. Assessors gathered information face-to-face or via telephone using a semi-structured interview format, from all available sources (e.g., conversations with parents/guardians, the child, and teachers; medical and education records; and clinical observations).

Secure web-based software was implemented to record assessment information. Before making the data available for analysis, personal identifiers were removed. Ethics approval was obtained from Western University's ethics review board to conduct secondary analyses on data collected in various Ontarian mental health agencies (REB #106415).

Analysis

The intended use of the algorithm is to predict those at highest risk of injury to others based on an ordinal summary score in order to help facilitate early intervention efforts for these vulnerable youth. Assessors were asked to record perceived risk of "danger to others" using a single ordinal item that ranges in value from 0 (minimal) to 4 (very severe or imminent), based on all evidence available to the assessor at that time. We used this estimate as the dependent variable to be predicted by a variety of items from the ChYMH-S. As such, the dependent variable is a subjective professional opinion, as opposed to an objective behavioural measure of aggression. Because this scale is intended to be used with the comprehensive ChYMH assessment, all of the independent variables included in the algorithm must be available on both the ChYMH-S and full ChYMH. Notably, the single item for risk of danger to others is not recorded in the full ChYMH instrument, as it is in the ChYMH Screener. All of the screening records were used for scale development in order to properly represent the population of the sample. For example, if a young person has been screened twice, such as within an inpatient and outpatient setting, both of their records would be included.

While various modelling options were explored, it was ultimately decided to use the simple unweighted mean clinician rating of risk as a starting point in these analyses. Modelling was done using an interactive decision tree tool, which is supported by the SAS Enterprise Miner package (37). The software employs both Chi-Square Automated Interaction Detection (CHAID) and Classification and Regression Trees (CART) to create decision trees for categorical or continuous dependent variables. While it is possible to use a fully automated process to generate decision trees, our approach was iterative in nature using both clinical judgement and statistical criteria to identify potential splitting rules in developing the final decision tree. SAS defaults to propose binary splits for suggested independent variables, but we consistently checked to determine whether trichotomous or more granular splits were warranted. Enterprise Miner identifies candidate variables for splits in decision trees based on statistical criteria such as variance reduction (for continuous variables), Gini Impurity (for nominal variables), or chi-squared tests of significance (for binary variables). The software orders candidate variables based on the strength of their statistical performance for each split, but it also allows the analyst to specify other splits based on substantive reasons. In some cases, the decision related to a specific split in the tree may be based on expected performance across multiple nodes rather than a single node. This allows the user to interactively control which variable is selected and explore alternative trees before proceeding.

A key strength of decision trees, as opposed to conventional regression models, is that it can naturally handle complex interactions that can identify important subgroups that would be difficult to identify with simple two-way multiplicative interaction terms. The end result after the analyst sequentially divides all cases into their respective nodes is a tree with mutually exclusive and exhaustive classifications. Attention was paid to not "overfit" the model with unreasonably small terminal nodes in the decision tree. In addition, in the derivation process, Enterprise Miner provides real time feedback on performance of each split in a virtual hold-back sample, which allows the analyst to avoid specifying splits that will be unstable across samples.

In decision tree modelling, the initial splits are particularly important. Forced splits were considered as initial splits, such as age and sex, in addition to top-ranking variables; however, the forced splits were not selected in our decision tree model because they failed to offer any additional explanatory power. Moreover, they resulted in some fragmentation and small cell sizes in some of the tree's branches. The final tree model was subsequently tested among both age and sex groups.

An important goal within the design of our RIO algorithm was for the final ordinal scale to have a compact range: 7 groups (labels of 0–6). Due to the large sample and numerous explanatory variables, decision trees could have 30 or more terminal nodes. As a result, some of the nodes needed to be combined after modelling, which was achieved using weighted k-means clustering. The end product was a parsimonious tree for which the final nodes could be logically assigned to one of the 7 groups.

Multinomial logistic regression was then employed using the seven groups of the algorithm to test model fit of the dependent variable, as well as provide the c-statistic [area under the receiver operator characteristic (ROC) curve] and odds ratios. This was repeated using the validation sample, which consisted of new screener assessments that had accrued since the derivation data work had begun—approximately a 5-week period. The next steps used a sample of 25,104 ChYMH and ChYMH-DD assessments, in which the RIO scale was calculated, and additional descriptive analyses related to diagnoses were conducted. Further, using a sample of 6,608 ChYMH-S, ChYMH, and ChYMH-DD assessments, the RIO scale was calculated, and longitudinal analyses related to predictive validity were conducted. All available initial screener assessments were included at time point 1. These were linked to the next assessment (either a screener, ChYMH, or ChYMH-DD) at time point 2, which was between 31 and 120 days in the future. The association between the subjective assessor rating of "danger to others" at baseline and five measures of violence at follow-up was examined. Additionally, the association between the RIO score at baseline and five measures of violence at follow-up was examined. Analyses were performed using SAS 9.4 and SAS Enterprise Miner 14.1.

RESULTS

A schematic representation of the final RIO algorithm is presented in **Figure 1**. The RIO algorithm categorises young persons into levels of risk that suggest the need for heightened concern that the individual may be a danger to others, based on criteria as identified from the ChYMH-S. The final tree that was selected comprised of 21 terminal nodes, and used nine items from the ChYMH-S. All of the items included in the end product can be found on both the full ChYMH assessment and screener.

Groups were assigned a score from 0 (lowest) to 6 (highest) with higher scores indicating heightened risk of harm to others, as depicted in **Table 1**. The young person may fall into a given level via a number of different pathways that represent various combinations of the predictors. Highest risk was found in a small minority of young persons (∼0.6% scored 6, the highest value on the RIO), in which 41.3% of these were rated as having a risk of harm to others that was severe, very severe, or imminent. Conversely, over half of those assessed were classified in the lowest risk group, in which only 0.08% were rated at these levels of risk. **Table 1** shows the odds ratios of higher RIO levels, compared to the lowest group. The validation results for the 2,117 screening assessments are shown in **Table 2**. The C-statistic was 0.860 for the derivation sample and 0.853 for the validation sample.

The derivation sample by age group and sex are presented in **Tables 3** and **4**, respectively. As shown in **Table 3**, younger children scored higher on the RIO algorithm than older children, indicating that they were judged to be at higher risk of harm to others. Specifically, for children 12 and older, only 3.2% were classified as a 5 or 6 on the RIO algorithm compared to children aged 8–11 years (8.1%) and those 7 and under (10.5%). As shown in **Table 4**, males scored higher on the RIO algorithm than females, with 8.4% of males classified as a 5 or 6 compared to only 3.2% of females.

Further collapsing the RIO score into dichotomous groups, various cut-points of the scale were tested for their explanatory power of various levels of actual risk of injury toward others. Such cut-points would be employed to identify cases for specific services or referral related to harm to others. These results are summarised in **Table 5**. For flagging mild or moderate risk, a RIO cut-point of 2 or greater may be optimal, while for flagging severe risk, a RIO score of 3 or greater was found to perform best.

Using the ChYMH and ChYMH-DD assessment data, which include the nine items necessary to assign the RIO scale, diagnoses associated with higher RIO scores were investigated. As can be seen from **Table 6**, the most prevalent diagnoses associated with higher risk of harm to others were Disruptive Behaviour, Reactive Attachment, Substance-Related, and Attention Deficit/Hyperactivity disorders. Diagnoses associated with lower RIO scores were Eating, Mood, and Anxiety disorders.

Using the ChYMH, ChYMH-S, and ChYMH-DD assessment data, the predictive validity of the subjective assessor rating of "danger to others" and the RIO score were investigated. As can be seen from **Figure 2**, the "danger to others" rating is predictive of 5 future violent behaviour items (C-statistics of 0.66–0.72). Further, as shown in **Figure 3**, RIO itself is highly predictive of these 5 behaviour items (C-statistics of 0.70–0.83). Of note is that 8 of these 10 C-statistics are 0.7 or greater, suggesting a good model (38).

DISCUSSION

A variety of factors predicted high risk of injury to others. Several of the contributors were related to a prior history of abusive behaviours and violent thoughts/actions, certain individual traits and behaviours, and family factors. Young persons who displayed violent ideation, threatened violence, or engaged in violent actions toward others received higher scores on the RIO algorithm. This strong relationship between prior ideas, threats, and acts of violence, and future risk of injury toward others is well-supported by the literature. In a comprehensive multivariate analysis, one of the most salient predictors of harm toward others was prior violent behaviour, among both boys and girls (39).

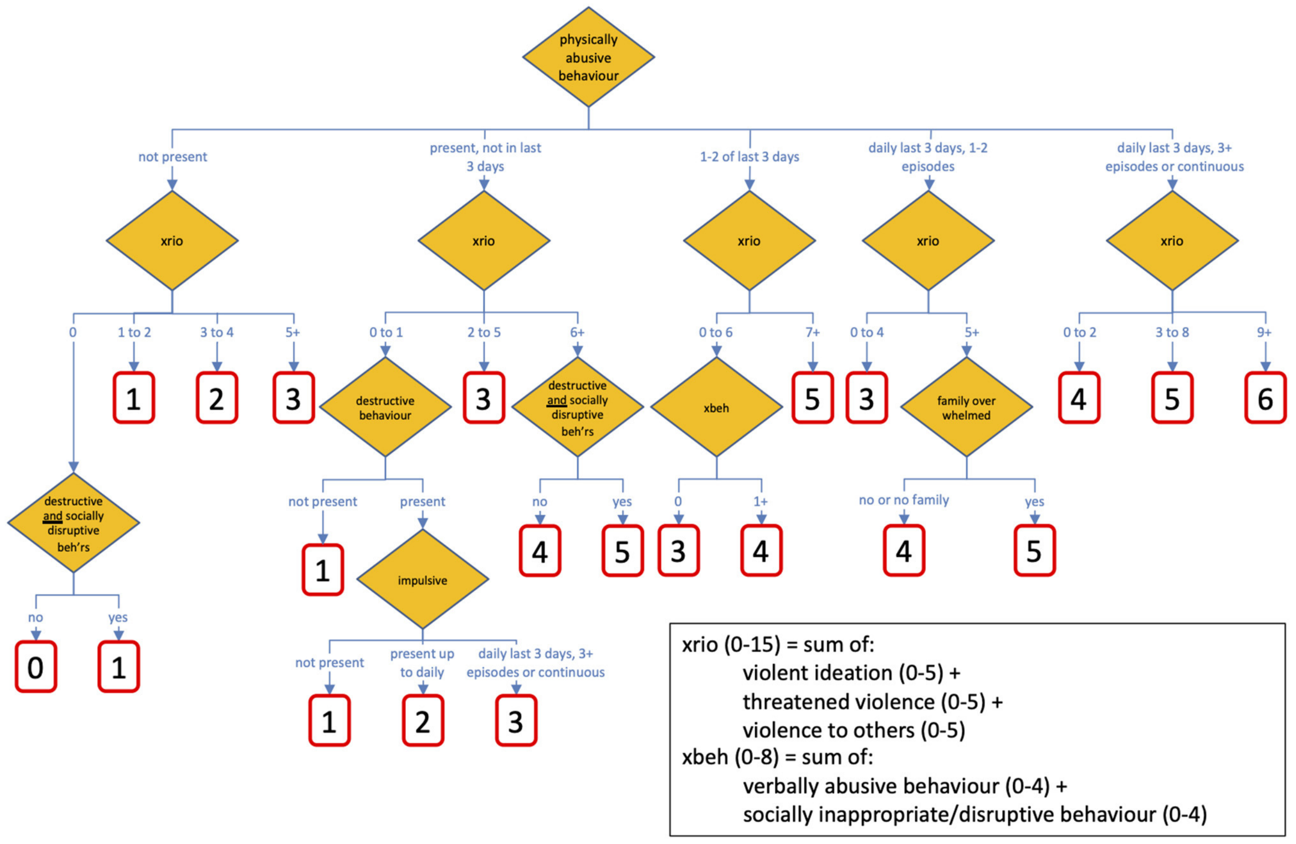

FIGURE 1 | Risk of Injury to Others (RIO) decision tree diagram. *Socially disruptive beh'rs,* socially inappropriate/disruptive behaviours.

TABLE 1 | Derivation results of Risk of Injury to Others (RIO) algorithm ($N = 60,414$ screener assessments).

Scale label	% of sample	Mean risk	% severe, very severe, or imminent risk	Odds ratio	Low 95% confidence interval	High 95% confidence interval
0	54.5%	0.04	0.1%	Reference		
1	12.2%	0.26	0.8%	8.3	7.6	9.0
2	5.7%	0.50	1.6%	18.4	16.8	20.2
3	16.6%	0.80	4.4%	36.4	33.8	39.2
4	5.3%	1.12	8.7%	69.3	63.3	75.9
5	5.1%	1.62	19.2%	171.6	156.2	188.5
6	0.6%	2.18	41.3%	477.4	392.0	581.4
					c-statistic = 0.860	

Research has also shown that the frequency of violent threats is positively associated with engagement in violent acts (40). Finally, in a comprehensive review of the literature, Hawkins and colleagues (41) reported that youth who have favourable attitudes toward violence were more likely to commit violent acts in the future.

We found that children and youth who exhibited physically abusive behaviour were at higher risk of injury toward others, and this was, in fact, the first predictor included within the RIO algorithm. This is in line with prior research that has found physical aggression to be the most consistent predictor of future violent offending (2, 42). In addition to physical abuse, verbally abusive behaviour was also associated with increased risk of harm toward others, in our model. This is consistent with extant literature that reported adolescents in the sixth grade who engaged in bullying, which encompassed both physical and verbal abuse (e.g., picking on another kid, slapping, or hitting), were more likely to be perpetrators of dating violence by the

TABLE 2 | Validation results of Risk of Injury to Others (RIO) algorithm (*N* = 2,117 screener assessments).

Scale label	% of sample	Mean risk	% severe, very severe, or imminent risk	Odds ratio	Low 95% confidence interval	High 95% confidence interval
0	56.5%	0.05	0.0%	Reference		
1	11.9%	0.19	0.0%	5.0	3.2	7.8
2	6.3%	0.48	1.5%	13.4	8.4	21.2
3	12.6%	0.88	3.0%	36.7	25.2	53.5
4	8.3%	0.97	5.7%	43.7	29.0	65.8
5	3.8%	1.45	22.5%	117.0	69.9	195.6
6	0.6%	2.92	66.7%	>999.9	569.9	>999.9
					c-statistic = 0.853	

TABLE 3 | Risk of Injury to Others (RIO) algorithm by age, derivation sample (*N* = 60,414 screener assessments).

Scale label	7 and younger		8–11		12 and older	
	% of sample	Odds ratio (95% CI)	% of sample	Odds ratio (95% CI)	% of sample	Odds ratio (95% CI)
0	27.7%	Ref	42.7%	Ref	67.8%	Ref
1	14.6%	9.0 (7.01–11.50)	15.2%	8.8 (7.39–10.47)	10.1%	7.9 (7.05–8.82)
2	6.8%	20.7 (15.93–26.89)	6.4%	17.2 (14.16–20.81)	5.0%	18.7 (16.55–21.11)
3	30.0%	35.6 (28.44–44.68)	20.8%	38.0 (32.42–44.45)	10.7%	36.3 (32.92–39.98)
4	10.0%	58.9 (46.15–75.23)	6.9%	67.5 (56.33–80.83)	3.3%	84.7 (74.11–96.76)
5	9.5%	145.5 (113.52–186.55)	7.2%	158.2 (131.78–189.80)	2.9%	226.1 (195.72–261.19)
6	1.4%	407.5 (279.81–593.32)	0.9%	454.7 (325.50–635.26)	0.3%	619.5 (423.01–907.20)
c-statistic		0.792		0.841		0.867

eighth grade (43). Children and youth who were more impulsive also received higher scores on the RIO algorithm, which is similar to previous work that has found a strong correlation between impulsivity and aggressive behaviours toward others (41, 44).

Socially inappropriate/disruptive behaviours, as well as destructive behaviours, also significantly contributed to higher scores on the RIO. This finding is in accordance with prior research, which has reported that a range of anti-social behaviours, including under-age smoking, stealing, and destruction of property, are linked to greater risk of violence among males (45, 46). Studies have also found that deficits in social and cognitive ability in childhood are associated with future aggressive behaviour (47, 48). Children who struggle with social and cognitive functioning may not be able to fully comprehend social norms, thereby acting in socially inappropriate and disruptive ways. Interestingly, belief and commitment to a social/moral order is suggested to decrease risk of engaging in violent behaviour (49). Therefore, children and youth who act in ways that would be viewed as contradictory to social norms may be at increased risk of harm toward others, which would support the current study's finding.

The last predictor variable of the RIO algorithm is the family being overwhelmed by the child or youth's condition, which could be due to a number of different reasons, including ineffective coping strategies when dealing with the young person's difficult presentation. Other family stressors may increase the distress level in an expediential manner, further taxing the situation. Research has shown that a number of family factors can increase a child's risk of engaging in injury toward others, such as low parental supervision and monitoring (17). Interestingly, a chaotic family life has been shown to increase risk of youth violence (50). Families may feel stressed because of the chaotic nature of their family environment, thus contributing to the child's increased risk of injuring others, a finding consistent with this study. Research has also found that harsh and inconsistent discipline is associated with aggression in children [e.g., (51)]. It can be postulated that when a family is overwhelmed by the child's situation, caregivers may not feel capable of providing the fair, consistent discipline the child requires for positive development, thereby resulting in a higher likelihood of the young person engaging in harmful behaviours.

Findings also indicated an association between age and scores on the RIO algorithm, whereby younger children were more likely to have a higher RIO score compared to older children. More specifically, younger children were at heightened risk of engaging in behaviours that would injure others compared to their older counterparts, a finding that is consistent with extant literature (52). However, it is important to note that although younger children tend to be more physically aggressive, older children and youth are larger in stature and size; therefore, their aggressive behaviours could lead to more serious injuries in others, despite the fact that it occurs less frequently. This relationship between age and severity of aggressive behaviour is well-documented in the literature, with the period of adolescence

TABLE 4 | Risk of Injury to Others (RIO) algorithm by sex, derivation sample (*N* = 60,414 screener assessments).

Scale label	Males		Females	
	% of sample	Odds ratio (95% CI)	% of sample	Odds ratio (95% CI)
0	41.3%	Ref	67.5%	Ref
1	14.0%	6.7 (6.03–7.55)	10.4%	8.9 (7.81–10.14)
2	7.3%	14.4 (12.77–16.28)	4.1%	20.1 (17.33–23.39)
3	21.9%	29.3 (26.52–32.32)	11.4%	37.3 (33.31–41.75)
4	7.2%	52.4 (46.55–58.92)	3.6%	80.3 (69.48–92.84)
5	7.5%	131.8 (116.92–145.60)	2.8%	183.1 (156.25–214.53)
6	0.9%	342.0 (269.86–433.41)	0.4%	624.6 (433.82–899.31)
c-statistic		0.831		0.872

TABLE 5 | Sensitivity and specificity results for the derivation sample: mild, moderate, and severe.

	RIO	Sensitivity	Specificity	AUC
Predict **mild or greater** risk of harm to others	1+	93.0%	68.9%	0.809
	2+	82.2%	81.5%	0.818
	3+	73.3%	86.2%	0.797
	4+	39.6%	94.4%	0.663
Predict **moderate or greater** risk of harm to others	1+	98.1%	60.6%	0.793
	2+	92.5%	73.5%	0.830
	3+	86.2%	79.1%	0.826
	4+	51.9%	91.0%	0.717
Predict **severe or greater** risk of harm to others	1+	98.4%	55.9%	0.772
	2+	94.7%	68.3%	0.815
	3+	91.4%	74.1%	0.827
	4+	63.4%	87.9%	0.773

AUC, area under the curve.

and young adulthood being known as a time of heightened risk behaviour, such as engaging in more violent acts. It has been reported that the age of onset for serious, violent offending typically does not occur before the age of 12, but this rate increases drastically from 12 to 16 years of age, doubling between 13 and 14 years old (7, 53). Therefore, it is critical to make the distinction that, although younger children are more likely to be physically aggressive, older children are more likely to engage in more serious, violent acts.

The current study also examined DSM-diagnoses related to the RIO algorithm, and identified disruptive behaviour, reactive attachment, substance-related, and attention deficit hyperactivity among the top diagnoses associated with higher RIO scores. The association between these diagnoses and higher risk of harm to others is well-supported by the literature. For example, one study that examined the most common psychiatric disorders among children and adolescents referred to mental health services for serious aggressive behaviour found that the most common diagnoses behind aggression were oppositional defiant disorder (93.02%), attention deficit hyperactivity disorder (88.37%) and conduct disorder (38.75%) (54). It has also been reported that aggression is a frequently co-occurring condition to reactive attachment disorder (RAD) (55). Several other studies have consistently found aggression to be one of the key risk factors associated with substance-use disorder (56, 57); furthermore, aggression has been found to be significantly related to early substance use initiation among youth (58).

Finally, the current study also investigated the predictive validity of the subjective assessor rating of "danger to others" as well as the RIO score itself. First, the findings showed that the assessors' rating of perceived risk of "danger to others," subjective as it is, predicts future violent behaviour. More specifically, higher assessor ratings at time point 1 were associated with increased violent ideation, intimidation/threatened violence, violence to others, physically abusive behaviour, and destructive behaviour toward property at time point 2. This supports the use of this measure in the derivation of RIO. It may not be a "gold standard," but it supports the validity of a measurement that predicts what is intended to be modelled. Second, the findings indicate that the RIO score itself at baseline is associated with increased violence in the future across the same five items previously described. This demonstrates the utility of the RIO algorithm in predicting future aggressive behaviour toward others among children and youth.

TABLE 6 | Risk of Injury to Others (RIO) algorithm by DSM diagnosis.

DSM-IV[a] N=25,104 full ChYMH or ChYMH-DD	RIO 2+		RIO 3+	
	Most important dx	Any importance	Most important dx	Any importance
Disruptive behaviour	73.9%	67.2%	66.2%	58.6%
Reactive attachment	63.0%	65.9%	55.7%	58.1%
Substance related	64.0%	61.5%	55.7%	51.3%
Attention deficit hyperactivity	56.0%	55.6%	47.7%	47.4%
Autism spectrum	56.7%	54.7%	48.4%	46.5%
Learning or communication	50.8%	51.3%	43.8%	44.4%
Adjustment	40.3%	44.4%	33.5%	37.2%
Sleep	44.9%	39.0%	39.1%	31.7%
Schizophrenia/psychotic	41.9%	40.3%	32.3%	33.3%
Anxiety	31.4%	36.6%	26.2%	30.5%
Mood	30.5%	32.9%	24.8%	26.7%
Eating	12.3%	21.9%	11.3%	17.7%

[a] *Among assessments with this diagnosis, this is the proportion reaching this RIO threshold.*

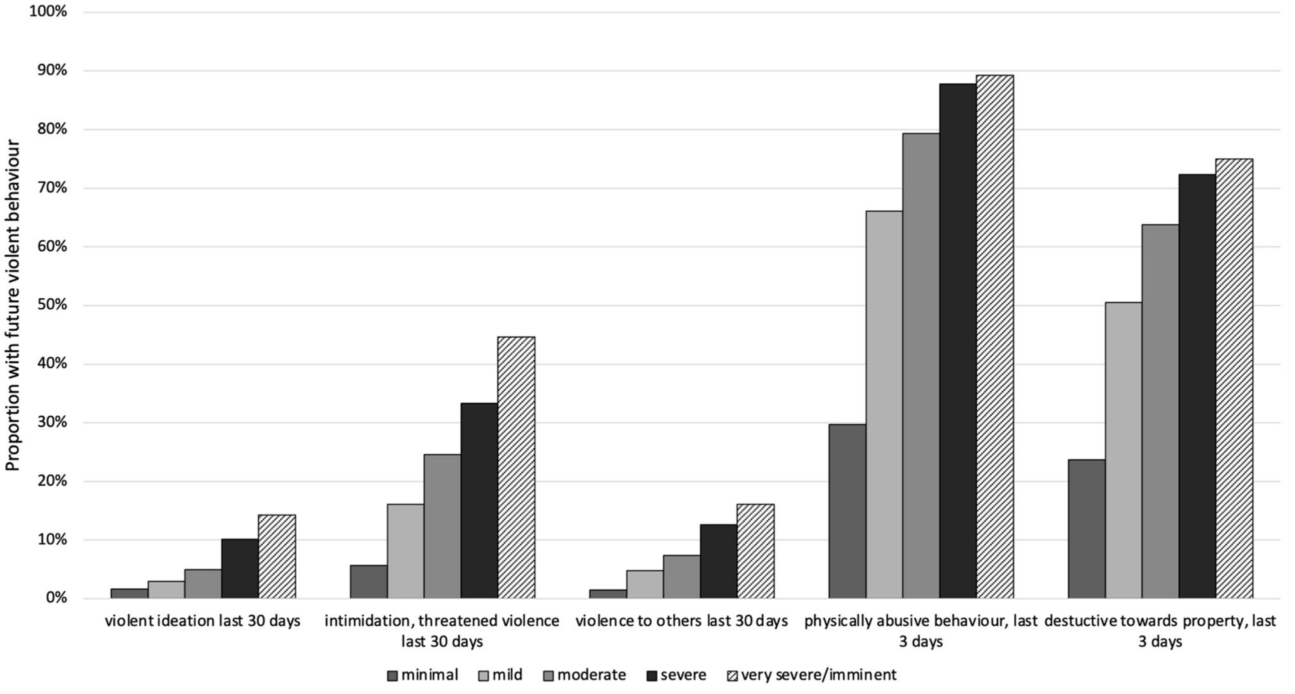

FIGURE 2 | Longitudinal analysis: High risk for future violent behaviour by subjective assessor rating of "danger to others" at baseline ($N = 6,608$).

Use and Utility of RIO

Based on our results, RIO is an empirically based decision-support tool that may be used to identify young persons who have a higher likelihood of engaging in harmful behaviour toward others. Because it can validly and reliably predict high-risk physically aggressive behaviour, mental health professionals will be able to make more systematic evaluations in determining whether an individual is at heightened risk of committing violent or injurious acts. Ultimately, the algorithm was designed to help facilitate early intervention efforts to provide support for these vulnerable youth in order to decrease the likelihood of future aggression.

Importantly, the use and utility of the RIO algorithm falls in line with that of our previously published RiSsK algorithm (32). For example, the RIO score can similarly be obtained automatically when the ChYMH-S assessment is submitted from the assessor's computer, and these results are also intended to be used along with other information obtained during the screening process.

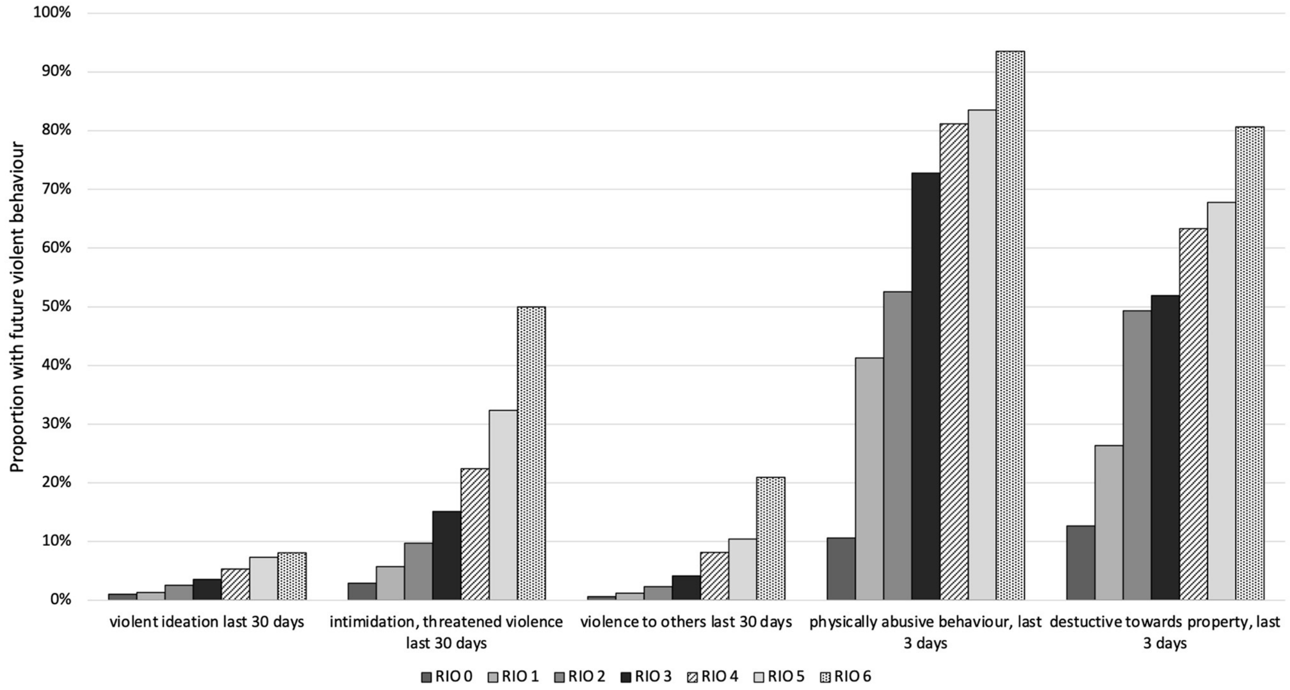

FIGURE 3 | Longitudinal analysis: High risk for future violent behaviour by Risk of Injury to Others (RIO) score at baseline (*N* = 6,608).

Subsequent care planning steps are informed by whether the young person's score falls within the lower or upper range. If a score falls within the lower range, the clinical team should discuss further to decide whether, based on all available information, the RIO level seems appropriate. If a score falls within the upper range, the clinical team should consider the individual to be at high risk of injuring others. Clinicians can use the Harm to Others collaborative action plan (CAP) developed by interRAI to assist with their care planning (59, 60). When the young person is at high risk of injuring others, immediate intervention for acute physical aggression is required, followed by debriefing discussions and assessment of the incident. Regardless of moderate or high risk, it is imperative the clinician performs an assessment of harmful behaviour (e.g., precipitating factors, targets, intensity, frequency, and duration of episodes); this information will be used in the selection of subsequent interventions.

Similar to the RiSsK algorithm, the RIO also has broader applications beyond individualised care planning. For example, it can provide high-quality standardised data across large catchment areas, which would enable the identification of risk of injury to others across the system (e.g., examining different jurisdictional patterns); it can also be used to provide justification for specific services and expenditures, as well as for benchmarking purposes (61, 62). For a more detailed discussion of these broader applications, please refer to our previous work (32).

The major advantage of implementing the RIO algorithm would be that young persons with higher levels of risk should be receiving more emergent services and extensive resources (e.g., inpatient services) than those with lower-level risk. Nevertheless, this does not prohibit the likelihood of receiving appropriate services for young persons scoring at the lowest level of risk. Notably, research has shown that early identification and intervention can lead to reduced likelihood of future aggresssive behaviours [e.g., (63, 64)].

While there are a number of strengths in the current study, including internationally-used comprehensive assessment tools and the relatively large sample size, it also has limitations. For example, because all of the children and adolescents assessed were accessing inpatient or outpatient mental health services (i.e., entering the formal system), the results may not be generalizable to a community-based, non-clinical sample. As such, future research could examine whether the present study's findings are consistent when the sample population is from the community.

Additionally, assessors completed the items used to derive the RIO algorithm at the same time the overall risk score was determined utilising the interRAI ChYMH Screener. The algorithm was modelled on this overall risk score and, as a result, utilised concurrent measurement. Notably, while it may not have the ideal characteristics of an independent gold-standard measure on which to derive the RIO score, the validation efforts also utilised other instruments within the suite (e.g., ChYMH, ChYMH-DD) that did not incorporate the overall risk score, providing additional evidence of its utility. This approach was viewed as reasonable given the goals of the algorithm and its use across numerous instruments within the interRAI suite of child and youth assessments. Further concurrent validity measures were also examined within the ChYMH and ChYMH-DD that were not in the interRAI ChYMH Screener at the time the overall risk index was obtained by assessors; this included the items known to use/carry weapons and serious injury to another in the last 90 days. Furthermore, the present study investigated concurrent validity cross-sectionally among first assessments of individuals as well as predictively (using RIO at baseline and its association with these two items at a follow-up assessment between 31 and 182 days). Findings indicated strong concurrent validity.

CONCLUSION

The adverse consequences of injury toward others are wide-ranging, including psychopathology, substance use, reduced psychosocial functioning, and the most severe and tragic consequence being youth homicide (65–68). In light of the negative sequelae of youth violence, identifying risk factors associated with harmful behaviour is crucial for the development of strategic prevention and intervention programs. This underscores the critical utility of the RIO algorithm, as it provides a psychometrically sound decision-support tool that can assist clinicians in identifying children and adolescents at heightened risk of injuring others, thus facilitating earlier intervention.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because of privacy restrictions and regulations. Requests to access the datasets should be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Western University's Ethics Review Board (REB #106415).

AUTHOR CONTRIBUTIONS

SS contributed to the conceptual basis of the study and its methodology. SS and JP developed the analytical strategy. JP performed the statistical analysis. All authors contributed to the formulation of the ideas presented in the study, provided critical feedback to the manuscript, were involved in the writing, and reviewing of the final manuscript.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX

TABLE A1 | Items used in the RIO algorithm.

Item	Coding
• Physical abuse—e.g., others were hit, shoved, scratched, sexually abused • Verbal abuse—e.g., others were threatened, screamed at, cursed at • Socially inappropriate or disruptive behaviour—e.g., screamed out during class, smeared or threw food or feces • Destructive behaviour toward property—e.g., throwing or breaking objects, turning over beds or tables, vandalism • Impulsive—e.g., running into traffic; takes risky actions without thinking; difficulty taking turns; interrupts	0. Not present 1. Present but not exhibited in last 3 days 2. Exhibited on 1–2 of last 3 days 3. Exhibited daily in last 3 days, 1–2 episodes 4. Exhibited daily in last 3 days, 3 or more episodes or continuously
• Violent ideation—e.g., reports of premeditated thoughts, statements, plans to commit violence • Intimidation of others or threatened violence—intentionally makes threatening gestures, verbalizations or stance with no physical contact (e.g., throwing furniture, explicit threats of violence) • Violence to others—acts with purposeful, malicious, or vicious intent, resulting in physical harm to another (e.g., stabbing, choking, beating)	0. Never 1. More than 1 year ago 2. 31 days - 1 year ago 3. 8–30 days ago 4. 4–7 days ago 5. In last 3 days
• Family members report feeling overwhelmed by child's/youth's condition—e.g., severe behaviour problems	0. No 1. Yes 8. Not applicable

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School Disengagement and Mental Health Service Intensity Need Among Clinically Referred Students Utilizing the interRAI Child and Youth Mental Health Assessment Instrument

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Although mental health challenges are widespread, impacting 1 in 5 children and youth, only 25% of these young people receive the required mental health supports. Unmet mental health needs are strongly associated with functional impairments including poor self-care, interpersonal challenges, and school difficulties among young people. School disengagement, or a student's lack of involvement in education through interest, curiosity, motivation, and active participation, is associated with a wide array of detrimental outcomes including chronic mental health difficulties, conduct and delinquent behaviors, criminal justice involvement, and unemployment in adolescence and adulthood. Disengagement observed within the school setting may be indicative of underlying mental health challenges and reflective of service intensity need. The current study extends the literature by examining the relationship between school disengagement and mental health service intensity need among 14,750 clinically referred students across elementary and secondary school utilizing the interRAI Child and Youth Mental Health instrument. Findings indicated that more than 25% of clinically referred students were at heighted risk for school disengagement and required high-intensity services. Further, mental health service intensity need was positively associated with risk of school disengagement among students, along with the specific reason for referral (i.e., psychiatric symptoms, harm to self, harm to others, or addiction or dependency), after controlling for sex and age. Implications of the findings are explored within the context of the school setting and future directions are suggested.

Keywords: school disengagement, resource intensity need, referral reason, mental health, interRAI

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INTRODUCTION

An estimated 1.2 million Canadian children and youth experience significant mental illness with clinically significant impairments in functioning requiring treatment (1). Despite a significant number of children and youth demonstrating functional limitations across settings, an alarming number of young people and their families continue to have unmet mental health needs (2, 3). Challenges exist in mental health care for young people across Canada with respect to access to timely and effective treatment as well as coordination of services across sectors [i.e., education, social services, medical, and community-based services; (4, 5)]. Identifying those young people in need of support services and making available the necessary treatments is important to promote positive immediate and life-long outcomes for all Canadians. Certainly, determining the intensity and nature of mental health services required to support a young person and his or her family is a difficult and yet critical step in offering timely and effective treatment opportunities. Although it is widely accepted that mental health challenges are associated with negative educational outcomes, service intensity need has yet to be explored in relation to academic outcomes [e.g., (6)]. Early identification of children and youth in need of mental health services and providing timely access to appropriate treatments is important to promote educational success.

Mental Health and School Problems

Mental health concerns exhibited by children and youth such as anxiety, attention deficit/hyperactivity disorder, depression, conduct disorder, eating disorders, and suicidal ideation and attempts, are associated with negative educational outcomes (7). A review of the literature on the impact of mental health on school success revealed that "poor academic functioning and inconsistent school attendance are early signs of emerging or existing mental health problems during childhood and adolescence" [(8), p. 189]. Research has consistently demonstrated that mental health challenges can contribute to poor academic achievement, school disengagement, school refusal, and school dropout [e.g., (9–16)].

School problems during childhood and adolescence have been associated with significant negative outcomes. Indeed, early school refusal behaviors, such as school disengagement, increases the risk for later criminal activity, substance use, and school dropout (17). A substantial number of youth involved in the criminal justice system have experienced academic failure, school refusal, school exclusion, and early termination of secondary education (18). A longitudinal study that followed 585 children from age 5 to 27 years old demonstrated that individuals who drop out of secondary school are four times more likely to experience negative outcomes such as being arrested, fired, reliant on government assistance, using illicit substances, and having poor health by 27 years of age (19). Additionally, secondary school dropouts are 24 times more likely to experience as many as four or more of the stated negative outcomes (19). When considering adult outcomes, individuals who dropped out of secondary school make up disproportionately higher percentages of prison inmates as compared to those who completed secondary school (20). Notably, when young people who dropout of secondary school received treatment for behavioral, emotional, or substance use problems before the age 24 years, a reduction in the number of expected negative outcomes has been observed (19). Early identification and timely provision of treatment for children and youth requiring intervention services may reduce the likelihood for the manifestation of acute distress requiring crisis supports both immediately and later in life [e.g., (5, 21)].

Estimated Value of Services

Significant costs are associated with mental health challenges and delinquency including criminal activity, substance use, and school dropout. Previously, Cohen (22) estimated that typical societal costs for a career criminal, ($1.3–$1.5 million USD), a heavy drug user ($370,000–$970,000 USD), and a high-school dropout ($243,000–$388,000 USD). When taken together, Cohen (22) estimated that the monetary value of saving a high-risk youth was ∼$2.3 million USD. Updated estimates of the monetary value of saving a high-risk 14-year-old from a life of negative outcomes range from $2.6 to $5.3 million USD (23). Ultimately, delinquency, including school refusal and school dropout can be both detrimental for individuals and their families as well as expensive for society [e.g., (2, 20)].

Costs associated with supporting children and youth presenting with various mental health challenges has been examined (24). According to the findings, significant discrepancies in expenditures associated with specific diagnoses exist likely because of inconsistent samples and methods for assessing the monetary costs of treatment and the accumulated consequences of unmet treatment needs. Nonetheless, it is clear that when young people do not receive adequate support and treatment, there is an increased likelihood of experiencing significant negative outcomes (i.e., health, mental health, quality of life, unemployment, and poor income), ultimately increasing long-term societal costs (24).

Service Utilization

Although the first onset of many mental health issues is typically between childhood and early adulthood, children and youth do not always receive the necessary treatment to prevent life-course persistent and chronic mental health problems (2, 25, 26). Research indicates that up to 75% of Canadian children and youth with mental health challenges do not receive required mental health services (2). Early research on patterns of service utilization for addressing mental health challenges among young people indicated that sociodemographic factors, parental attitudes, and the intensity of a child's illness significantly influence service use across settings [i.e., mental health, general health, and school; (27)]. The education system is uniquely situated to identify and support children and youth who are experiencing mental health distress and functional limitations. Not surprisingly, schools were revealed as the main point of entry to mental health services for children and youth (4). The second most common point of entry to mental health services for children up to 13 years old was identified as the specialty mental health sector and for youth 14–16 years old was the juvenile justice system (4). First episode of mental health service utilization among young people tends to "increase in early to middle childhood, stabilize, then increase again in early adolescence" (28). Externalizing behaviors were most predictive of first time service use in middle childhood; however, combined externalizing and internalizing presentation predicted first time service use during adolescence (28).

Parental and adolescent problem recognition are an important step toward service utilization for addressing mental health challenges [for a review see (29)]. Indeed, caregivers play an important role in supporting young people in accessing and participating in mental health interventions (30). Parental beliefs that their child needs help is a critical predictor of service use (27). Parents are more likely to seek services when their child's problems are more severe and persistent, including the presence of comorbidity (29). Additionally, medical issues and school problems were revealed to increase parental help seeking behaviors for young people (29). Consistently, children and youth who acknowledge their experience of psychological distress and related impairments are more likely to seek services (29). Gender differences in help-seeking behaviors were revealed such that males were more likely to access services during childhood and early adolescence, whereas females were more likely to access services in late adolescence (29).

Current Study

School disengagement, that is a student's lack of meaningful involvement in education as represented by low interest, curiosity, motivation for learning, is associated with varying degrees of challenges for students within the school setting (31). The current study presents a first look at the association between service intensity need and school disengagement among clinically referred students. A strong positive relationship between school disengagement and service intensity need was expected such that students who were disengaged in school were expected to require high-intensity services (i.e., requiring three or more of the following mental health services: inpatient admission; formal care provided by a psychiatrist, psychologist, psychometrist, social worker, child protection worker, or case management; or intervention for life skills training, social skills, crisis management, family functioning, anger management, family preservation, behavior management, family support, and medication management) compared to those students who were engaged in school. Consistent with previously noted age and sex-based findings, it was anticipated that the association between school disengagement and service intensity need at the time of intake to clinical services may differ based on age and sex. Further, primary concerns for referral to mental health services (i.e., psychiatric symptoms, harm to self, harm to others, addiction, or dependency) were investigated to offer insights for triaging purposes.

METHODS

Participants

Archival *interRAI Child and Youth Mental Health Assessment* [ChYMH; (32)] data collected at seventy community mental health agencies in the Province of Ontario, Canada between November 2012 and May 2019 were utilized for this study. A convenience sample of 14,750 clinically referred young children (n = 1,700; ages 4–7 years old), school-aged children (n = 4,396; ages 8–11 years old), and youth (n = 8,654; ages 12–18 years old) who accessed mental health services was investigated. Participants in this study accessed services through self-referral and referral by healthcare professionals (e.g., family physician or pediatrician), schools, or mental health professionals (e.g., counselor or social worker). The total sample was comprised of English-speaking male (56.2%) and female (43.8%) children and youth ranging in age from 4 to 18 years old (M_{age}= 12.23, SD_{age}= 3.52) who were formally enrolled in schooling (i.e., part-time or full-time). Students were identified as: (a) attending preschool, homeschool, regular classroom with no extra supports; (b) regular classroom with extra support (e.g., classroom, workload, or testing accommodations or modifications such as additional time to complete assessments, oral testing, frequent breaks, withdrawal from class for extra help completing work, one to one support, assistance with personal needs such as feeding or dressing), or; (c) a specialized classroom program (e.g., intellectual, learning, or behavioral needs; vocational training; education within a treatment facility). Refer to **Table 1** for more detailed participant characteristics.

Procedure and Ethical Considerations

Trained assessors (including nurses, psychologists, psychiatrists, social workers, child and youth workers, case managers, and speech and language pathologists) collected data as part of typical clinical practice using a 60–90-min semi-structured interview with the child or youth, caregivers, and collateral contacts (e.g., teachers and therapists) along with any information available with respect to medical and education records. All participants are assigned a case record number upon completion of the assessment tool and no identifying information (e.g., names, full birthday, and postal code) are stored on the interRAI secure server. Data collection using the ChYMH is ongoing across the Province and has been approved by the university ethics review committee.

Measures

The interRAI Child and Youth Mental Health Assessment [ChYMH]

The interRAI ChYMH (32) is a comprehensive assessment tool designed to identify clinically relevant elements pertaining to the specific needs of school-age children and youth (i.e., medical, psychological, social, behavioral, environmental, strengths, and risk). As part of the Child and Youth suite of interRAI assessment tools, instruments within the Child and Youth suite of instruments are being utilized both nationally and internationally. A variety of scales and algorithms are embedded within the instrument to provide tracking indices for measuring symptom severity and to generate data-driven risk assessments across domains (e.g., self-harm, harm to others, and service intensity need). Further, numerous care planning protocols highlighting areas of imminent concern or risk are produced upon completion of the interRAI ChYMH to support clinicians in tracking client progress and in developing adaptive treatment plans. Additional literature with respect to the interRAI assessment can be found on the interRAI website (www.interrai.org). Scales and algorithms developed specifically for the Child and Youth suite of instruments have demonstrated robust psychometric properties including strong inter-rater reliability, internal consistency, as well as substantial face validity, content validity, criterion validity, and discriminant validity [e.g., (33–42)]. Several items, scales and a recently published algorithm from the interRAI ChYMH suite were included in the current research to investigate factors associated

TABLE 1 | Sample demographic information by age group.

	Young children **(*n* = 1,700)** **(% of subsample)**	**School-age children** **(*n* = 4,396)** **(% of subsample)**	**Youth** **(*n* = 8,654)** **(% of subsample)**
Age	*M* = 6.20 (SD = 0.91)	*M* = 9.56 (SD = 1.10)	*M* = 14.77 (SD = 1.77)
Biological sex			
Male	1,188 (69.9%)	3,039 (69.1%)	4,059 (46.9%)
Female	512 (30.1%)	1,357 (30.9%)	4,595 (53.1%)
Patient type			
Inpatient	29 (1.7%)	201 (4.6%)	654 (7.6%)
Outpatient	1,671 (98.3%)	4,195 (95.4%)	8,000 (92.4%)
Enrollment in school			
Part-time enrolled	93 (5.5%)	169 (3.8%)	655 (7.6%)
Full-time enrolled	1,607 (94.5%)	4,227 (96.2%)	7,999 (92.4%)
Education status			
Pre-school	45 (2.6%)	N/A	N/A
Homeschooled	*	30 (0.7%)	117 (1.4%)
Regular classroom—no extra support	814 (47.9%)	1,621 (36.9%)	4,023 (46.5%)
Regular classroom—extra support	733 (%)	2,103 (%)	2,769 (%)
Specialized school program	101 (%)	642 (%)	1745 (%)
Reason for referral			
Specific psychiatric symptoms	822 (48.4%)	2,315 (52.7%)	5,473 (63.2%)
Harm to self	249 (14.6%)	925 (21.0%)	3,050 (35.2%)
Harm to others	557 (32.8%)	1,436 (32.7%)	1,748 (20.2%)
Addiction or dependency	*	16 (0.4%)	702 (8.1%)

**Ethics approval prohibits reporting on groups smaller than 10 participants.*

with the risk for school disengagement among clinically referred children and youth.

School Disengagement

School disengagement among students was evaluated using an eight-item scale, *School Disengagement Scale* (SDeS), including elements of behavioral, emotional, and cognitive disengagement[1]. The presence (0 = *no*, 1 = *yes*) of the items were recorded by assessors (i.e., increased lateness or absenteeism, poor productivity or disruptiveness at school, conflict with school staff, current removal from school due to disruptive behavior, strong persistent dissatisfaction with school, current refusal to attend school, expresses intent to quit school, and poor overall academic performance). The standardized Cronbach's alpha based on the polychoric correlation matrix for the eight items of the SDeS was 0.86, suggesting good reliability. Items were summed and ranged from zero to eight with higher scores indicating an increased risk of school disengagement. Validation research suggests that optimal sensitivity (56.9–76.2%) and specificity (74.1–86.4%) for predicting poor academic performance in the last 6 months is achieved when the cut-off score on the SDeS is two (43**?**). As such, all students in the present study with SDeS scale scores of two or greater were identified as being at risk for school disengagement. Those students with SDeS scale scores of zero or one were identified as being engaged in school.

Service Intensity Need

Reflecting the intensity and nature of services required to support children and youth seeking mental health services, the *Resource Intensity for Children and Youth* (RIChY) algorithm was used in this present study (42). The RIChY algorithm is an empirically based decision-support tool composed of 25 individual items, three scales (i.e., *Anxiety*, *Parenting Strengths*, *Family Functioning*), and two decision-support algorithms (i.e., *Self-Harm*, *Harm to Others*) from the ChYMH assessment. Based on critical indicators from the interRAI ChYMH assessment tool, an individual's level of risk is determined using the RIChY to suggest priority for intensive service needs. Variability in critical indicators of service need due to the age of a young person led to the development of three independent but related age-based RIChY decision trees (i.e., 4–7 years old, 8–11 years old, and 12–18 years old). The terminal nodes of the RIChY decision tree range from zero to five, where higher nodes are indicative of higher service intensity need. Strong psychometric properties and clinical applicability have been demonstrated for the RIChY algorithm for its use with children and youth accessing mental health services (42). Notably, children and youth accessing outpatient services scored significantly lower on the RIChY algorithm as compared to children and youth accessing inpatient

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[1] Klassen JA, Hamza CA, Stewart SL. *interRAI's Child and Youth School Disengagement Scale (SDeS): Validation of a New Scale to Measure School Disengagement Among Children and Youth* (manuscript in preparation).

services (42). Consistent with the published optimal cut-off score for predicting service intensity need, students with RIChY terminal nodes of three or greater were identified as requiring high-intensity services (42). Those students with RIChY terminal nodes of two or less were identified as requiring low-intensity services. Additional information about the RIChY algorithm is available in the identified publication.

Data Analysis

First descriptive statistics were conducted for all variables using means, standard deviations, and range for the continuous variables and percentage for the categorical variables. Bivariate analyses were conducted to determine the independent associations between school disengagement and service intensity needs with age, gender, and reason for referral. Finally, multivariate binary logistic regression modeling was conducted to examine service intensity need as a function of school disengagement, reason for referral (i.e., psychiatric symptoms, harm to self, harm to others, and addiction), and demographic variables (age and sex) with separate models for each of the investigated age groups (i.e., young children, school-age children, and youth). Notably, addiction as the reason for referral was only computed for youth (age 12–18 years). Variables were considered significant if the *p*-value was <0.05. Odds ratios and 95% CI are reported in **Table 4**. Assumptions testing were conducted for each analysis to control for threats to statistical conclusions.

RESULTS

School Disengagement and Service Intensity Need

Findings indicated that 45.9% of students were identified as at risk for school disengagement (young children: 42.1%; school-age children: 47.6%; youth: 45.9%) and 45.5% of students were identified as requiring high-intensity service needs (young children: 23.6%; school-age children: 41.4%; youth: 51.9%) at the time of intake into clinical care. Within this sample, 26.1% of the students (young children: 16.2%; school-age children: 26.3%; youth: 28.0%) were identified as being disengaged in school and as requiring high-intensity service needs. The relationship between school disengagement and service intensity need was examined using separate chi-square analyses for each of the investigated age groups (i.e., young children, school-age children, and youth).

Findings presented in **Table 2** revealed that service intensity need was significantly related to school disengagement with low to moderate effects for each of the investigated age groups (i.e., young children, school-age children, and youth). Sex differences in the relationship between service intensity need and school disengagement are also presented in **Table 2**. As expected, findings indicated that students who require low-intensity services were more likely to also to be engaged in school; conversely, those students who require high-intensity services were more likely to be disengaged in school. Further, sex differences are present in the relationship between school disengagement and service intensity need; however, this relationship is more stable for male students across development as compared to female students.

Reason for Referral and School Disengagement

As presented in **Table 3**, the relationship between reason for referral and school disengagement was examined for each of the investigated age groups (i.e., young children, school-age children, and youth) revealing low to moderate effects. As expected, findings indicated that the specific reason for referral (i.e., psychiatric symptoms, harm to self, harm to others, and addiction or dependency) was uniquely related to the likelihood that students experienced school disengagement.

Multivariate Analyses

Table 4 presents the results of multivariate binary logistic regression modeling. Each model examined service intensity need as a function of school disengagement, the reason for referral, and demographic variables (age and sex). Separate models examined these relationships for each of the investigated age groups (i.e., young children, school-age children, and youth) and reason for referral (psychiatric symptoms, harm to self, harm to others, and addiction). The model with addiction was computed only for youth (age 12–18 years).

As seen in **Table 4**, in multivariate models, among young children aged 4–7 years, those with high (vs. low) school disengagement and any reason for referral were more likely in odds to require high-intensity services. In particular, young children referred for harm to self were more than three times likely in odds, and those referred for harm to others were more than six times more likely in odds, to require high-intensity services compared to young children with no such referral concerns. In addition, among young children, younger males (compared to females) were more likely in odds to require high-intensity services.

Next, in children aged 8–11 years, those with high (vs. low) school disengagement and any reason for referral were more likely in odds to require high-intensity services. Specifically, school-aged children referred for harm to self were more than two times likely in odds, and those referred for harm to others were more than three times more likely in odds to require high-intensity services compared to school-aged children with no such referral concerns. In this group, females and males had the same likelihood in odds to require high-intensity services. Older children were more likely in odds to require high-intensity services than their younger counterparts within this age range.

Finally, among youth, those with high (vs. low) school disengagement and any reason for referral were more likely in odds to require high-intensity services. In this group, youth referred for harm to self were more than five times more likely in odds, youth referred for harm to others were more than four times more likely in odds, and youth referred for addiction were more than two times more likely in odds to require high-intensity services, compared to youth with no such referral concerns. Notably, in this group, females were more likely in odds to require high-intensity services than males. Older children were more likely in odds to require high-intensity services than younger youth.

TABLE 2 | Chi-square comparison of service intensity need and risk for school disengagement by sex and age.

	School disengagement				**χ^2 (df)**	***p***	**Cramer's V**	**OR**
	Engaged		**Disengaged**					**(95% OR CI)**
	N	**(%)**	***N***	**(%)**				
Young children								
Male (*n* = 1,188)								
Low service need	521	(84.3)	348	(61.1)	81.62 (1)	<0.001	0.262	3.43
High service need	97	(15.7)	222	(38.9)				(2.60, 4.51)
Female (*n* = 512)								
Low service need	338	(92.1)	92	(63.4)	63.43 (1)	<0.001	0.352	6.71
High service need	29	(7.9)	53	(36.6)				(4.04, 11.16)
Total (*n* = 1,700)								
Low service need	859	(87.2)	440	(61.5)	151.45 (1)	<0.001	0.298	4.26
High service need	126	(12.8)	275	(38.5)				(3.35, 5.42)
School-age children								
Male (*n* = 3,039)								
Low service need	1,045	(71.3)	708	(45.0)	215.83 (1)	<0.001	0.266	3.04
High service need	420	(28.7)	866	(55.0)				(2.12, 3.54)
Female (*n* = 1,357)								
Low service need	593	(70.6)	228	(44.1)	94.01 (1)	<0.001	0.263	3.04
High service need	247	(29.4)	289	(55.9)				(2.42, 3.82)
Total (*n* = 4,396)								
Low service need	1,638	(71.1)	936	(44.8)	312.48 (1)	<0.001	0.267	3.03
High service need	667	(28.9)	1,155	(55.2)				(2.68, 3.43)
Youth								
Male (*n* = 4,059)								
Low service need	1,227	(64.3)	943	(43.9)	169.37 (1)	<0.001	0.204	2.30
High service need	682	(35.7)	1,207	(56.1)				(2.03, 2.61)
Female (*n* = 4,595)								
Low service need	1,383	(49.8)	606	(33.3)	122.50 (1)	<0.001	0.163	1.99
High service need	1,392	(50.2)	1,214	(66.7)				(1.76, 2.25)
Total (*n* = 8,654)								
Low service need	2,610	(55.7)	1,549	(39.0)	240.19 (1)	<0.001	0.167	1.97
High service need	2,074	(44.3)	2,421	(61.0)				(1.80, 2.14)

DISCUSSION

Although it is widely accepted that mental health challenges are associated with negative educational outcomes, service intensity need has yet to be explored in relation to school engagement problems among clinical samples of students. The current study contributes to the literature by presenting a first look at the association between school disengagement and service intensity need among clinically referred young children, school-age children, and youth. As predicted, school disengagement was found to be associated with high-intensity service needs. Indeed, students who were at highest risk for school disengagement were ∼2–4 times more likely in odds to require high-intensity services. The strength of this relationship differed by age [i.e., young children (4–7 years), school-age children (8–11 years), and youth (12–18 years)] such that young children who were at high risk for school disengagement were more likely to require high-intensity services as compared to their youth counterparts. Further, sex differences indicated that male students who were at high risk for school disengagement were two to three times more likely in odds to require high-intensity services while female students who were at risk for school disengagement were two to seven times more likely in odds to require high-intensity services. The relationship between school disengagement and service intensity need was more stable for male students as compared to female students. Results indicated that young female children who were at heighted risk for school disengagement were found to be almost seven times more likely in odds to require high-intensity services as compared their matched male peers who were only three times more likely in odds to require high-intensity services. Young girls who require high-intensity services is rare, but when this occurs, it is quite significant and highly associated with school disengagement. Interestingly, among school-age children and youth, the likelihood for male and female students to be disengaged in school and require high-intensity services was similar. When investigating service

TABLE 3 | Chi-square comparison for school disengagement and reason for referral.

	School disengagement				**χ^2 (df)**	***p***	**Cramer's V**	**OR**
	Engaged		**Disengaged**					**(95% OR CI)**
	N	**(%)**	***N***	**(%)**				
Young children								
Psychiatric symptoms					28.48 (1)	<0.001	0.129	1.69
No	563	(57.2)	315	(44.1)				(1.40, 2.06)
Yes	422	(42.8)	400	(55.9)				
Harm to self					87.38 (1)	<0.001	0.227	3.74
No	908	(92.2)	543	(75.9)				(2.80, 4.99)
Yes	77	(7.8)	172	(24.1)				
Harm to others					144.24 (1)	<.001	.291	3.56
No	777	(78.9)	366	(51.2)				(2.88, 4.40)
Yes	208	(21.1)	349	(48.8)				
School-age children								
Psychiatric symptoms					167.32 (1)	<0.001	0.195	2.21
No	1,305	(56.6)	776	(37.1)				(1.96, 2.50)
Yes	1,000	(43.4)	1,315	(62.9)				
Harm to self					128.53 (1)	<0.001	0.171	2.35
No	1,973	(85.6)	1,498	(71.6)				(2.02, 2.73)
Yes	332	(14.4)	593	(28.4)				
Harm to others					299.95 (1)	<0.001	0.261	3.14
No	1,821	(79.0)	1,139	(54.5)				(2.76, 3.59)
Yes	484	(21.0)	952	(45.5)				
Youth								
Psychiatric symptoms					134.58 (1)	<0.001	0.125	1.69
No	1,981	(42.3)	1,200	(30.2)				(1.55, 1.85)
Yes	2,703	(57.7)	2,770	(69.8)				
Harm to self					92.36 (1)	<0.001	0.103	1.54
No	3,246	(69.3)	2,358	(59.4)				(1.41, 1.69)
Yes	1,438	(30.7)	1,612	(40.6)				
Harm to others					333.97 (1)	<0.001	0.196	2.72
No	4,078	(87.1)	2,828	(71.2)				(2.44, 3.03)
Yes	606	(12.9)	1,142	(28.8)				
Addiction or dependency					176.13 (1)	<0.001	0.143	2.97 (2.51, 3.51)
No	4,472	(95.5)	3,480	(87.7)				
Yes	212	(4.5)	490	(12.3)				

intensity need as a function of school disengagement, reason for referral (i.e., psychiatric symptoms, harm to self, harm to others, and addiction or dependency), and demographic variables (age and sex), similar findings were revealed. Indeed, students of all ages who were identified as being disengaged in school (i.e., as compared to engaged) were more likely in odds to require high-intensity services. Specifically, referral for psychiatric symptoms was associated with two times increased odds for requiring high-intensity services among all students. Further, referral for harm to self was associated with two to five times increased odds for requiring high-intensity services, while referral for harm to others was associated with three to six times increased odds for requiring high-intensity services. Finally, referral for addiction or dependency was associated with two times increased odds for requiring high-intensity services among youth. Findings are considered within the context of the school setting and future directions are suggested.

Research suggests that the severity of presenting concerns is typically associated with the intensity of individualized treatment approaches such that young people who are experiencing more severe distress are more likely to be involved with psychiatric or multidisciplinary supports (3). In this study, students who were at heightened risk for school disengagement, thus experiencing significant challenges within the school setting, were found to be more likely to require high-intensity services. The proportion of students identified as being disengaged in school and requiring high-intensity services increased with age. That is, among clinically referred students, 26% of school-age children and 28%

TABLE 4 | Multivariate binary logistic regression models for service intensity need as a function of school disengagement, reason for referral, sex and age.

	Model 1 Psychiatric symptoms OR (95% OR CI)	Model 2 Harm to self OR (95% OR CI)	Model 3 Harm to others OR (95% OR CI)	Model 4 Addiction or dependency OR (95% OR CI)
Age 4–7 years				
Sex (female vs. male)	0.67 (0.50, 0.89)	0.71 (0.53, 0.94)	0.81 (0.60, 1.09)	
Age	0.89 (0.78, 1.02)	0.89 (0.77, 1.02)	0.88 (0.76, 1.02)	
School disengagement (High vs. Low)	3.99 (3.10, 5.14)	3.61 (2.79, 4.67)	2.99 (2.28, 3.92)	
Reason for referral	1.76 (1.38, 2.23)	3.24 (2.41, 4.36)	6.39 (4.93, 8.28)	
Age 8–11 years				
Sex (female vs. male)	1.01 (0.88, 1.16)	1.05 (0.91, 1.20)	1.17 (1.01, 1.35)	
Age	1.09 (1.03, 1.15)	1.07 (1.01, 1.14)	1.11 (1.05, 1.18)	
School disengagement (High vs. Low)	2.78 (2.45, 3.16)	2.79 (2.45, 3.17)	2.43 (2.13, 2.77)	
Reason for referral	1.76 (1.55, 2.00)	2.36 (2.02, 2.76)	3.62 (3.15, 4.16)	
Age 12–18 years				
Sex (female vs. male)	1.60 (1.46, 1.75)	1.34 (1.22, 1.47)	2.14 (1.94, 2.35)	1.68 (1.54, 1.84)
Age	1.06 (1.03, 1.08)	1.06 (1.03, 1.08)	1.11 (1.08, 1.14)	1.04 (1.02, 1.07)
School disengagement (High vs. Low)	2.02 (1.85, 2.21)	1.93 (1.75, 2.12)	1.84 (1.68, 2.02)	2.04 (1.87, 2.23)
Reason for referral	1.66 (1.52, 1.82)	5.13 (4.63, 5.68)	4.66 (4.09, 5.31)	2.03 (1.70, 2.41)

of youth were identified as being disengaged in school and requiring high-intensity services as compared to only 16% of young children. Understandably, young people often rely heavily on their parents for accessing mental health treatment and research suggests that service utilization by children and youth is associated with the health-seeking behaviors of the adults in their household (44). An early study investigating unmet mental health service needs in community samples of children and adolescents revealed that economic disadvantage, parental psychopathology, poor school grades, and parent-reported barriers were key problems for accessing services (45).

It has also been found that parental psychopathology is associated with increased service utilization and expenditures for children and youth, even after controlling for parental service utilization (44, 46). For example, parental depression is associated with increased emergency department use and consultations with general practitioners as well as outpatient and inpatient services by children and youth (44). An investigation of predictors for mental health service utilization among a sample of adolescent males revealed that diagnoses of attention deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD) among adolescent males, as well as parental substance use disorders (i.e., paternal alcohol disorder and maternal amphetamine use disorder) predicted increased mental health service utilization (47). Previous research suggests that young people who acknowledge their distress and related functional impairments are more likely to seek services (29, 45).

Help seeking behaviors associated with mental health services among adolescents and young adults were revealed to be hindered by "perceived stigma and embarrassment, difficulties recognizing symptoms, and a preference for self-reliance" (48). Research consistently indicates that stigma associated with mental illness and mental health treatments can significantly impact an individual's willingness to access and fully participate in treatment services (49). Among 1,092 young Canadians ages 15–24 years old presenting with a mood, anxiety, or substance-related disorders, it was demonstrated that individuals most likely to access mental health services were female, living alone, experiencing challenges in social situations, and presenting with mood disorders or chronic illness (50). Harm to self and others as well as substance use represent forms of maladaptive coping. In the current study, referral for each form of maladaptive coping (i.e., harm to self, harm to others, and addiction or dependency) was found to increase the likelihood for school disengagement for all students.

The education system has been identified as the main point of entry to mental health services for children and youth (4). School staff are uniquely positioned to support students through referrals to more intensive school and community based services. Exploration of the effectiveness of universal screeners as completed by school staff vs. traditional classroom-referral methods for identifying at-risk students revealed that many students requiring mental health support are overlooked when universal screeners are not utilized (51). As indicated in the present study, psychiatric symptoms as well as harm to self and others were related to school engagement problems for all students. Interestingly, although findings revealed that general referrals for psychiatric symptoms increased the likelihood for school disengagement by two to four times across age groups, the likelihood for high service need only increased by about 1.5 times. Consistently, in an investigation of educators' ability to recognize students with mental health concerns within the classroom, teachers were found to be significantly less likely to accurately identify students exhibiting moderate or subclinical mental health symptoms (52). Within the school setting, teachers can consistently detect students exhibiting severe externalizing and internalizing problems (52).

Given the nature of behavioral problems across settings, referral for harm to others was therefore expected to be associated with school engagement problems as well as higher intensity service needs for all students. Findings from the present study revealed strong associations between referral for harm to others, school disengagement, and service intensity need such that students referred for harm to others were between two to three times more likely in odds to be disengaged in school and between four to six times more likely in odds to require high-intensity services compared to students with no such referral concerns. Notably, younger children (ages 4–7 years) who were referred for harm to others were revealed to be at the greatest risk, followed by youth (ages 12–18 years) and finally school-aged children (ages 8–11 years). This is consistent with previous research which indicates that young children are most often referred for externalizing problems such as aggressive and disruptive behaviors whereas youth are referred more for both internalizing and externalizing disorders (28). Further, young children are highly dependent on their caregivers which necessitates significant caregiver involvement in accessing and participating in intervention services. Although the education system is the first most common point of entry to mental health services for children and youth, the second most common point of entry to mental health services for children up to 13 years old is the specialty mental health sector and for youth 14–16 years old was the juvenile justice system (4). In the present study, it may be that older students are just as likely to require high-intensity service needs for harm to others behaviors, however, these students may be involved in services from other sectors (e.g., youth justice) and thus not included in our clinically referred sample.

Results indicated that referral for harm to self was associated with risk of school disengagement and service intensity need. Specifically, students referred for harm to self were between two to three times more likely in odds to be disengaged in school and between two to five times more likely in odds to require high-intensity services compared to students with no such referral concerns. Notably, younger children (ages 4–7 years) who were referred for harm to self were more likely to experience school disengagement meanwhile youth (ages 12–18 years) who were referred for harm to self were more likely to require high-intensity services. Students who are engaging in self-harm require intensive services and support across settings. Within the classroom, self-harm among young students may be more obvious or disruptive in nature as compared to youth who may use adaptive strategies to conceal their self-harming behaviors. As such, school disengagement and self-harm among young students might be more easily detected. Indeed, youth who engage in self-harming behaviors may in fact be high-achieving students with perfectionistic tendencies who are engaged in school, but are struggling with mental health functioning outside of the classroom setting (53, 54). Relatedly, Splett et al. (52) found that teachers rated externalizing behaviors to be more severe and detrimental for the student than internalizing symptoms which may help to explain why self-harm behaviors go unnoticed until the student reaches a point of requiring significant support and intervention.

Of concern particularly among youth, referral for addiction or dependency was found to be associated with an increased likelihood in odds by two times for school disengagement as well as an increased likelihood in odds by two times for requiring high-intensity services as compared to their non-substance addicted counterparts. Although experimentation with risky behaviors such as substance use is common among adolescents, regular substance use can jeopardize an adolescent's physical and mental health and well-being especially given that adolescent substance use is a significant predictor of substance abuse in adulthood (6, 12). Further, substance using teens are at a greater risk for both immediate and long-term consequences such as psychopathology, emotional distress, cognitive impairments, and substance-induced psychosis [e.g., (55, 56)]. Youth who are dependent on substances tend to have significant challenges with managing their drug related behaviors which can interfere with their education. Indeed, directly as related to school outcomes, substance using youth are not able to fully participate in their learning if they are under the influence during school or homework hours. Present findings highlight that drug and addiction education is important among school-age children and youth to reduce the likelihood of addiction and dependency problems which can impact adaptive functioning later in life.

Summary

Taken together, findings from the current study extend previous research to highlight the relationship between risk of school disengagement and mental health service intensity need among clinically referred students across elementary and secondary school. Indeed, one in four clinically referred students were found to be at risk for school disengagement and requiring high-intensity service needs. School engagement problems within the school setting may be an indicator of underlying mental health problems. School staff are uniquely positioned to support students through early identification and referrals to school and community level supports and services. Significant age and sex differences in the relationship between school disengagement and high-intensity service need suggest the requirement of focused triaging protocols to support students at various stages in development.

Limitations

Despite the large sample size and use of the interRAI ChYMH, known to be a highly reliable and valid multisource clinician-rated comprehensive assessment tool, the present study should be considered together with its limitations. All participants in the present study were accessing services at a community or inpatient mental health agency, and consequently, generalization of these findings to school-based populations is limited. The examination of school disengagement longitudinally, and prior to referrals to community agencies, would be beneficial to enhance prevention measures to reduce discontinued pursuits to educational attainment. Additionally, racial and cultural information was not obtained and, as a result, examination of these variables in relation to service utilization could not be conducted. Such data will be important to examine to improve social justice, equity as well as the importance of multi-culturally attentive processes and procedures when delivering mental health services.

Clinical Implications and Future Directions

This research highlights the necessity for early identification and providing timely access to intervention as a method to improve the lives of those at risk for mental health and school problems. Early identification and timely provision of treatment for children and youth requiring mental health services may reduce the likelihood for the manifestation of acute distress requiring crisis supports as well as life-long consequences [e.g., (5, 21)]. Many mental health supports and treatments are provided within the education system; however, the education system is not an appropriate venue to provide all types of treatments required to address psychopathology (e.g., psychiatric intervention, family support, and trauma-focused intervention). Thus, it is critical that sectors involved in supporting children and youth work together in their approach to mental health screening and assessment to foster improved mental health and well-being and to maximize reductions in the negative outcomes that may otherwise be experienced (57). Continuity of care across sectors, namely education, mental health, and medical health services, is essential for ensuring that children and youth demonstrating mental health challenges are provided with appropriate services in a timely manner (4, 24). Implementation of a standardized assessment-to-intervention system within the educational system, the most common point of entry into mental health services, could ultimately improve our mental health delivery system. Such an approach supports early intervention while also facilitating service integration through the use of a common language across service providers, improved triaging and prioritization, and enhanced use of quality data for decision making at a system level[2]. Through the identification of risk and resilience factors, early identification of at-risk students could reduce the likelihood of long-lasting detrimental impacts of school disengagement, resulting in improved outcomes and reducing negative sequalae throughout the lifespan.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available to protect the privacy of participants. Requests to access the datasets should be directed to the corresponding author.

ETHICS STATEMENT

Western University's ethics board granted approval for the secondary analysis of data collected in various agencies throughout the Province of Ontario (REB #106415).

AUTHOR CONTRIBUTIONS

JA and SS devised the main conceptual ideas for this study, carried out analyses and interpretation of findings, and prepared the manuscript. NL provided data analytical support during revisions for publication. All authors agree to its submission for publication.

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Autism Spectrum Screening Checklist (ASSC): The Development of a Scale to Identify High-Risk Individuals Within the Children's Mental Health System

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Autism Spectrum Disorder (ASD) is a complex childhood onset neurodevelopmental disorder that has become the fastest growing developmental disability. Due to the increased demand for diagnostic assessments and subsequent increased wait times, standardized screening as part of regular clinical practice is needed. More specifically, there is an important need for the development of a more streamlined screening tool within an existing assessment system to identify those at greatest risk of having ASD. The current study utilized data from ∼17,000 assessments obtained within the province of Ontario, based on the interRAI Child and Youth Mental Health (ChYMH) and Child and Youth Mental Health and Developmental Disability (ChYMH-DD), to develop a scale to identify children who have a higher likelihood of having autism. The scale was then tested on a trial population with data from the interRAI Early Years instrument. Further analyses examined the predictive validity of the scale. The Autism Spectrum Screening Checklist (ASSC) was found to be a good predictor of ASD with a sensitivity of 0.73 and specificity of 0.62, at the recommended cut-point of 2+. The results were consistent across several age ranges, specifically from 2 to 21 years of age. The ASSC scale provides an initial screen to help identify children and youth at heightened risk for autism within larger populations being assessed as part of routine practice. The main goal for the development and implementation of the ASSC scale is to harness the power of the existing interRAI assessment system to provide a more efficient, effective screening and referral process. This will ultimately help improve patient outcomes through needs-based care.

Keywords: interRAI, children and youth, mental health, autism spectrum disorder, screening

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INTRODUCTION

Autism spectrum disorder (ASD) is a complex, lifelong, neurodevelopmental disorder that is characterized by impairment in social communication and the presence of restricted repetitive behaviors (1, 2). ASD has a variety of causes, such as those at the genetic, biological, and environmental level (3). Some of the earliest signs reported by parents include lower levels of social communication and attention, increased repetitive behavior, and temperament dysregulation (4). However, there is also substantial heterogeneity in its presentation and overlap with other developmental disorders, especially in the first few years of life, thereby adding to the complexity of the diagnostic process (5, 6). Autism is also highly co-morbid with intellectual disability, with estimates around 50–70% being reported in the literature (7). Notably, ASD is associated with substantial disability across the lifespan, which is only exacerbated when interventions are not provided early on (8, 9).

Autism is one of the most common childhood onset neurodevelopmental disorders. It is estimated that the current prevalence rate is ∼1–1.5% of the world's population (10). With respect to the pediatric population in particular, recent estimates indicate that 1 in 68 school-aged children has been identified with ASD in the United States (11). Autism has also been deemed the fastest growing developmental disability, with a steady increase in reported prevalence over the past decade (12). Increased prevalence rates have led to increased demand for diagnostic assessments, which typically exceeds available resources and results in increased wait times. Importantly, this waiting time occurs during a critical period of brain development, and so lengthy wait times may delay intervention and decrease its effectiveness (8, 13). Indeed, there is substantive research showing that early intervention is key to achieving better prognostic outcomes (14, 15). This waiting period also represents a highly stressful time for families (16, 17). As such, studies have found that many parents are frustrated and dissatisfied with the diagnostic process and experience it as slow, stressful, and poorly managed (18, 19). Three recent ASD guidelines have recommended a maximal wait time of 3 to 6 months, yet the average wait time between parents' first concerns around their child's developmental progress and diagnosis is 2 to 4 years (20). This discrepancy can help explain the consistent finding that the average age of diagnosis is 4–5 years-old despite the fact that ASD can be reliably detected within the second year of life (20).

Various factors account for the more than 2 year difference between parents noticing the early signs of autism to receiving a diagnosis. Some of these barriers include time-consuming evaluations as well as a lack of providers who are able to administer the diagnostic assessments (21, 22). Other important barriers include inappropriate referrals (or more specifically, over-referrals), and a lack of effective screening tools (23–25). In a comprehensive review of early autism screening, the authors concluded that their findings emphasize the need for "a more efficient, intelligent, and innovative ASD screening tool" (p. 24) (25). Some instruments: (1) are time-consuming to administer, (2) have an unacceptable level of sensitivity (e.g., 40%), and (3) are not comprehensive in terms of the population served; for example, some of the screening tools were only intended to be used on infants from 16 to 36 months, whereas others were strictly meant for adolescents/adults.

Finally, an overarching barrier to early identification and diagnosis is ineffective care pathways (23). Improved care pathways are needed to reduce waiting times for an ASD diagnostic assessment and direct each child to more appropriate services. More explicitly, there is a critical need for the development of a more streamlined, easily implemented, resource-effective screening method to identify those at greatest risk of having ASD and require a more comprehensive follow-up. This will help facilitate earlier diagnosis and, as a result, earlier intervention and better patient outcomes.

The aim of the present study was to develop a methodology for identifying children who are at greatest risk of having autism within the children's mental health system in the province of Ontario, Canada. Since no effective, easily implemented screening method exists, an effort was launched to develop a new scale for identifying individuals who have an increased likelihood of autism. The Autism Spectrum Screening Checklist (ASSC) was created to assist service providers in determining whether a toddler, child or adolescent is at higher risk of having ASD. This scale is embedded in an assessment-to-intervention system that is already used as standard practice across Ontario in most child and youth mental health agencies to foster effective, evidence-informed care pathways. The aim of this study is to describe the development of the ASSC scale.

METHODS

Sample

Data came from assessments of children and youth receiving mental health services in Ontario, Canada. The derivation sample came from individuals aged 4–21 years assessed with the Child and Youth Mental Health (ChYMH) (26) or the Child and Youth Mental Health and Developmental Disability (ChYMH-DD) (27) instruments, as part of regular clinical practice from 54 agencies from 2012 to 2020. An additional sample of 2 and 3 year-old children assessed with the interRAI Early Years instrument (28) was used for a trial application, and collected from 15 agencies from 2017 to 2020. These assessment instruments are described below. Assessed individuals were referred to these agencies through a variety of sources including family and specialty physicians, school personnel, other allied health professionals, or parents/primary caregivers. Assessment information is used for a variety of purposes, including standardized care planning, as well as the use of items and calculated outcome measures to inform decision making and to track individual change.

There were 16,955 individuals in the derivation dataset, using the first assessment if an individual had more than one. The mean age was 11.95 years (SD 3.50) and 55.9% were male. There were 724 individuals in the trial application dataset of 2 and 3 year-old children, where the mean age was 2.48 (SD 0.52) and 68.8% were male. To examine predictive validity, a sub-sample of 318 individuals was used from the original derivation sample. The mean age was 11.02 years (SD 4.00) and 64.5% were male.

Assessors completed a 2.5 day training of each of the three interRAI Child and Youth instruments: ChYMH, ChYMH-DD, and the interRAI Early Years. The trained child/youth mental health professionals included psychologists, nurses, psychiatrists, speech and language therapists, child and youth workers, developmental social service workers, and social workers. All available sources of information are utilized to complete the assessment (i.e., family members, community members, document review, and clinical observations).

Secure web-based software was utilized to record assessment information, requiring responses of the proper form for all essential items before the record can be authorized as complete. Before making the data available for analysis, personal identifiers were removed. Western University's ethics board granted approval for the secondary analysis of data collected in various agencies throughout the province of Ontario (REB #106415).

Measures

The *interRAI Early Years* is a new instrument within the interRAI child/youth suite and has been designed for young children under the age of 4 years who are referred for assessment due to mental health, relational and/or developmental concerns (28). It provides unique information tailored to early identification and intervention (e.g., prenatal complications; family and social relations; temperamental characteristics; risks related to development and mental health). It also provides a comprehensive assessment of individual needs with applications that can be used to support decisions related to care planning and outcome measurement. There are compatible items in use across care domains that share design features such as a specified observation period or time frame, a focus on observable behaviors, the use of a few, powerful questions to assess areas of need, and the use of professional judgment to integrate multiple sources of information. The interRAI Early Years is compatible with other interRAI instruments across services and sectors (e.g., mental health, education, adult sectors), relevant for all age groups across the lifespan.

The *interRAI ChYMH* and *ChYMH-DD* are comprehensive, clinician-rated, standardized, and multi-sectoral mental health instruments for children and youth (26, 27). These instruments include over 400 items and build a comprehensive picture of the child's strengths, needs, functioning, and areas of risk to inform care-planning for clients with mental health needs. The clinician creates a clinical profile of children based on a collection of reports, observations, and judgments made from interactions with the family, the children themselves, and service providers with appropriate consent. Each instrument contains evidence-based items, scales, and domains relevant to the population used in this study. While the ChYMH was designed for children 4–18 years of age with potential mental health issues, the ChYMH-DD covers a range of common issues in children with global developmental delays or intellectual disabilities from 4–21 years of age. The items are tailored to the needs of children and youth with intellectual and developmental disabilities and mental health concerns in inpatient and outpatient settings as part of standard of care. Assessors rate a child/youth on a number of demographic variables, family, mental health, and physical health indicators.

For all three instruments, clinicians receive an item-by-item interpretation guide to the interRAI instruments with information regarding intent, definition, process, and proper coding method of each item to ensure accurate and uniform assessment of children/youth across multiple mental healthcare settings. The ChYMH, ChYMH-DD and interRAI Early Years include a subsection called "*Diagnostic and other health information,*" which collects diagnostic information on 12 provisional categories, including ASD, as determined by a psychiatrist, psychologist, or attending physician.

These instruments were designed to provide a comprehensive assessment to support enhanced individualized care planning (29–32), while providing clinical decision-support algorithms (33–36) to foster evidence-based prioritization/triaging. Notably, the relatively new interRAI Early Years provides 17 care planning protocols pertinent to specific areas of need (37); for example, attachment, sleep, caregiver distress, gross and fine motor skills, and sensory issues.

Strong reliability and validity for the scales and algorithms on the interRAI ChYMH and ChYMH-DD have been found (38–42). These instruments have several applications including outcome measurement, resource allocation, and case-mix systems (34, 35, 43–46).

Analysis

We sought to create a calculated scale that would explain a diagnosis of autism. The dependent variable was "Autism Spectrum Disorder" as a provisional diagnosis, for which the assessor records if a psychiatrist, psychologist, or attending physician has made this diagnosis. It is important to note that the assessor is not acting in any diagnostic capacity and is merely consulting all available sources of information to determine if such a diagnosis has been made. The recorded item requires the assessor to rank any of a number of provisional diagnoses by importance (most, second most, etc.); for our dependent variable, we collapsed a diagnosis of autism of any importance to be one, otherwise zero.

A list of potential explanatory variables was generated. All items in the ChYMH or ChYMH-DD instruments were considered by a clinical expert for their potential association with autism, and seven candidate items were selected (e.g., narrowly restricted range of interest and excessive preoccupation with activity or routine). Furthermore, bivariate associations between an autism diagnosis and other items in the derivation dataset were used to identify a small number of additional items that offered statistical strength. However, these additional items were not pursued, either because they were not available in the interRAI Early Years assessment instrument, or they were considered problematic for use with very young children (e.g., positive symptoms or having at least one friend). The seven candidate items were all binary. The last 3 days was the reference timeframe.

Using multivariable logistic regression, these seven items were tested together to assess their ability to independently predict an autism diagnosis and to remove non-contributing items. A series of tests using the count of retained items was then applied, with logistic regression of the count of the items to assess goodness of fit, and correlation analysis to provide a Cronbach alpha value for the individual items to inform internal consistency of the contributing items. Sensitivity and specificity for different summed scale cut-points were considered. The selected scale was tested in a trial population using the interRAI Early Years cases where it could be calculated. Furthermore, using a sample of 318 ChYMH or ChYMH-DD assessments, the ASSC scale was calculated, and longitudinal analyses related to predictive validity were conducted. Specifically, the sample included individuals for whom provisional diagnostic assignment (for all DSM-IV diagnoses, including ASD) had not been completed at the time of initial assessment, and a follow-up assessment within 365 days where it had been subsequently done. This allowed the scale to operate more like a predictive measure where a child or youth not yet subjected to diagnostic assignment at the time the scale is assigned is subsequently diagnosed, either positively or negatively, for autism.

RESULTS

The seven candidate items and their distribution by autism diagnosis are summarized in **Table 1**, along with sample characteristics. One item, "lack of interest in social interaction", was dropped because of a weaker association and also because it was not available in this form in the interRAI Early Years instrument. Progression of the analysis is summarized in **Table 2**. Step 1 used the six items, giving a Cronbach alpha of 0.702 that would be increased to 0.723 if the item "self-injurious behavior" was removed. When this was done (step 2), the model fit did not decrease, making the five-item construction superior to the six-item one. As one additional variation, the weakest item of these five, "difficulty adapting to even minor change", was dropped, resulting in a four-item sum (step 3) with a small drop in internal consistency but no change in model fit. Distribution of the summed items, odds ratios of each sum total, as well as sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for sum cut-points are also provided in **Table 2**. Receiver-Operator Characteristics (ROC) curve plot of the five-item sum is shown in **Figure 1**.

The five-item version was ultimately selected based on it having more parsimony than the six-item version, and the best internal consistency of the three options. However, all three versions are quite similar in performance with strong goodness of fit; c-statistics are >0.82, which is considered to be a strong result (47).

The five-item summative scale was applied to the interRAI Early Years assessments, where 9.5% of the cases had a diagnosis of autism; the results are summarized in **Table 3**. Distribution of the summed items and sensitivity, specificity, PPV, and NPV

TABLE 1 | Sample characteristics.

***N* (%)**	**Prevalence**		
	All	**Autism Dx**	**No autism Dx**
N (percent of sample)	*16,955 (100%)*	*2,111 (12.5%)*	*14,844 (87.5%)*
Mean age (std)	11.9 (3.50)	11.7 (3.36)[‡]	12.0 (3.52)
Males	9,478 (55.9%)	1,595 (75.6%)[‡]	7,883 (53.1%)
Assessed as inpatient	1,145 (6.8%)	167 (7.9%)[‡]	978 (6.6%)
Assessed in person	11,472 (68.2%)	1,072 (51.5%)[‡]	10,400 (70.5%)
Walked independently by 18 months	13,308 (78.8%)	1,602 (76.7%)[‡]	11,706 (79.1%)
Talked** by 24 months	11,899 (70.5%)	1,075 (51.5%)[‡]	10,824 (73.1%)
Toilet trained, daytime by 4 years	12,860 (76.2%)	1,326 (63.5%)[‡]	11,534 (77.9%)
Cognitive skills independent, makes safe decisions	9,160 (54.0%)	529 (25.1%)[‡]	8,631 (58.1%)
Communication: expresses ideas without difficulty	12,291 (72.5%)	997 (47.2%)[‡]	11,294 (76.1%)
Referral reason: threat or danger to self	5,057 (29.9%)	810 (38.8%)[‡]	4,247 (28.7%)
Referral reason: threat or danger to others	4,592 (27.2%)	955 (45.8%)[‡]	3,637 (24.6%)
Candidate scale items			
Self-injurious behavior	4,908 (29.0%)	937 (44.4%)[‡]	3,971 (26.8%)
Narrowly restricted range of interest	2,977 (17.6%)	1,217 (57.7%)[‡]	1,760 (11.9%)
Excessive preoccupation with activity or routine	3,330 (19.6%)	1,184 (56.1%)[‡]	2,146 (14.5%)
Lack of social/emotional conventions when socializing	3,919 (23.1%)	1,298 (61.5%)[‡]	2,621 (17.7%)
Lack of interest in social interaction*	5,494 (32.4%)	923 (43.7%)[‡]	4,571 (30.8%)
Excessive or unusual reaction to sensory stimuli	4,026 (23.8%)	1,139 (54.0%)[‡]	2,887 (19.5%)
Difficulty adapting to even minor change	3,770 (22.2%)	934 (44.2%)[‡]	2,836 (19.1%)

**Item not in the interRAI 0–3 instrument.*

***Combined 2–4 words into short sentences AND had vocabulary from 50 to 200 words.*

[‡] *Autism significantly different from no-autism stratum.*

TABLE 2 | Sequential steps and results: Derivation sample.

***N* = 16,955; 2,111 with autism diagnosis (12.45%)**	**Step 1: 6 items**		**Step 2: 5 items**		**Step 3: 4 items**	
Odds ratios (95% CI), adjusted for other items used in this list of 6:						
1. Self-injurious behavior	1.26 (1.13–1.40)		Not included		Not included	
2. Narrowly restricted range of interest	3.24 (2.84–3.69)		3.28 (2.88–3.74)		3.33 (2.92–3.79)	
3. Excessive preoccupation with activity or routine	1.86 (1.63–2.13)		1.88 (1.64–2.14)		1.97 (1.73–2.24)	
4. Lack of social/emotional conventions when socializing	2.87 (2.56–3.22)		2.90 (2.59–3.26)		2.97 (2.65–2.33)	
5. Excessive or unusual reaction to sensory stimuli	2.31 (2.07–2.57)		2.36 (2.12–2.64)		2.44 (2.19–2.71)	
6. Difficulty adapting to even minor change	1.22 (1.08–1.37)		1.25 (1.11–1.40)		Not included	
Sum of item *N* (%): 0	6,920 (40.8%)		8,636 (50.9%)		9,644 (56.9%)	
1	4,140 (24.4%)		3,529 (20.8%)		3,397 (20.0%)	
2	2,316 (13.7%)		1,936 (11.4%)		1,719 (10.1%)	
3	1,483 (8.8%)		1,324 (7.8%)		1,363 (8.0%)	
4	1,079 (6.4%)		1,001 (5.9%)		832 (4.9%)	
5	709 (4.18%)		529 (3.1%)		n/a	
6	308 (1.8%)		n/a		n/a	
Odds ratios (95% CI), sum of items: 0	Ref		Ref		Ref	
1	3.15 (2.57–3.68)		3.61 (3.02–4.31)		3.97 (3.38–4.67)	
2	7.47 (6.12–9.13)		9.19 (7.72–10.95)		11.18 (9.51–13.15)	
3	15.93 (13.05–19.45)		18.40 (15.42–21.95)		25.29 (21.54–29.71)	
4	33.01 (26.96–40.41)		35.53 (29.60–42.64)		44.28 (36.91–53.12)	
5	44.81 (35.99–55.78)		50.11 (40.30–62.31)		n/a	
6	60.58 (45.88–79.99)		n/a		n/a	
c-statistic	0.824		0.825		0.825	
Cronbach alpha	0.702		0.723		0.712	
Sum of items predicting autism diagnosis, sensitivity and specificity with 95% confidence intervals	**Sens**	**Spec**	**Sens**	**Spec**	**Sens**	**Spec**
1+	0.929 (0.919–0.940)	0.456 (0.448–0.464)	0.896 (0.883–0.909)	0.567 (0.559–0.575)	0.869 (0855–0.884)	0.631 (0.623–0.639)
2+	0.803 (0.786–0.819)	0.717 (0.710–0.724)	0.752 (0.733–0.770)	0.784 (0.778–0.791	0.701 (0.681–0.720)	0.836 (0.830–0.842)
3+	0.648 (0.627–0.668)	0.851 (0.845–0.857)	0.574 (0.553–0.595)	0.889 (0.884–0.894)	0.499 (0.478–0.520)	0.923 (0.919–0.927)
4+	0.465 (0.444–0.487)	0.925 (0.921–0.929)	0.370 (0.350–0.391)	0.950 (0.946–0.953)	0.223 (0.205–0.241)	0.976 (0.973–0.978)
5+	0.250 (0.232–0.269)	0.967 (0.964–0.970)	0.142 (0.127–0.157)	0.985 (0.983–0.987)	n/a	n/a
6+	0.083 (0.072–0.095)	0.991 (0.990–0.993)	n/a	n/a	n/a	n/a
Sum of items predicting autism diagnosis, PPV and NPV with 95% confidence intervals	**PPV**	**NPV**	**PPV**	**NPV**	**PPV**	**NPV**
1+	0.196 (0.188–0.203)	0.979 (0.975–0982)	0.227 (0.218–0.236)	0.975 (0.971–0.978)	0.251 (0.241–0.261)	0.971 (0.968–0.975)
2+	0.287 (0.276–0.299)	0.962 (0.959–0.966)	0.331 (0.318–0.345)	0.957 (0.953–0.961)	0.378 (0.363–0.393)	0.952 (0.958–0.955)
3+	0.382 (0.366–0.398)	0.944 (0.941–0.948)	0.425 (0.407–0.443)	0.936 (0.932–0.940)	0.480 (0.459–0.501)	0.928 (0.924–0.933)
4+	0.469 (0.447–0.490)	0.924 (0.920–0.928)	0.511 (0.486–0.536)	0.914 (0.909–0.918)	0.566 (0.532–0.600)	0.898 (0.894–0.903)
5+	0.519 (0.489–0.50)	0.901 (0.896–0.905)	0.567 (0.525–0.609)	0.890 (0.885–0.895)	n/a	n/a
6+	0.571 (0.516–0.627)	0.884 (0.879–0.889)	n/a	n/a	n/a	n/a

for sum cut-points are also provided in **Table 3**. The c-statistic is slightly higher than that in the derivation cases, and the Cronbach alpha value is slightly lower. Regarding the distribution, the interRAI Early Years cases tended to be in the lower risk categories, consistent with this group having a lower likelihood of an autism diagnosis.

Using a sub-sample from the derivation dataset, the predictive validity of the ASSC score was investigated. Distribution of the summed items and percentage with autism diagnosis at follow-up are provided in **Table 4**, along with sensitivity, specificity, PPV, and NPV for sum cut-points. In utilizing this approach, cut-points of 1+ and 2+ would provide PPVs of 29.5 and 36.7%, respectively. However, it should be noted that these higher achieved PPVs relate directly to the higher prevalence of a future autism diagnosis at 23.3%, compared to a 12.5 and 9.5% prevalence rate in the derivation sample and trial population, respectively.

DISCUSSION

High risk for ASD was predicted by five contributing items, namely narrowly restricted range of interest, excessive preoccupation with activity or routine, lack of social/emotional conventions when socializing, excessive or unusual reaction to sensory stimuli, and difficulty adapting to even minor change. The contributing items are all well-known signs and symptoms of autism (1). Moreover, several of these items represent some of the earliest behavioral symptoms in ASD. For example, studies have found that some of the signs that are often noticed and reported first by parents include repetitive interests and behaviors, atypical social emotional responses, and extremes of behavioral activity (4, 48, 49). Furthermore, several studies that examined and coded family home videos found differences in repetitive behaviors, social behaviors, and sensory oriented behaviors between those with ASD and typically developing children; these differences were detectable as early as 12 months-old (50, 51). Therefore, in addition to the contributing items of the ASSC scale representing many of the typical symptoms of ASD, research has found that they are also some of the most commonly reported initial concerns.

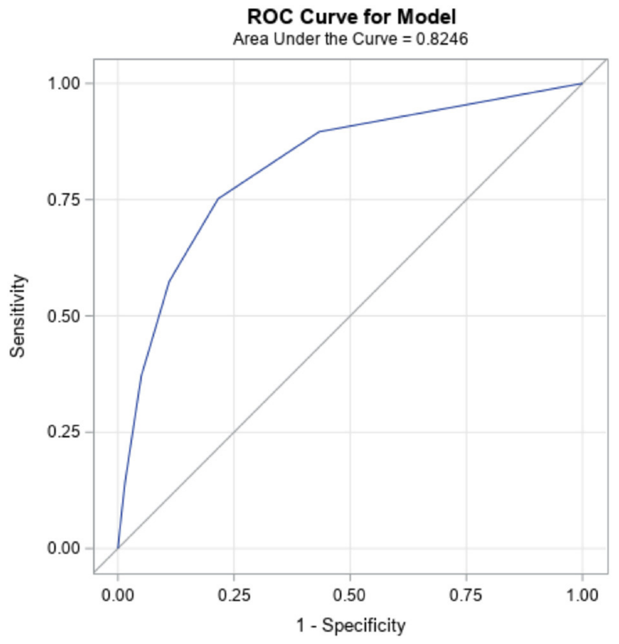

FIGURE 1 | Receiver Operator Characteristics (ROC) Curve: Five-item scale.

Use and Utility of ASSC

Based on the findings, ASSC provides an empirically based score that may be used to identify toddlers, children, and youth who present with signs and symptoms that are known to increase one's likelihood of being diagnosed with ASD. Findings indicate that the ASSC is a good predictor of autism and has reasonable sensitivity and specificity at the designated cut-point of 2+. As a result, it will allow service providers to make more systematic evaluations in determining whether an individual is at greater risk of having ASD, which ultimately helps facilitate prioritization and triaging.

While the ASSC scale has reasonable sensitivity (0.73) and specificity (0.62) at the recommended cut-point of 2+, its PPV at this level is 0.367. This means that ∼37% of children and adolescents above the designated cut-point will likely be diagnosed with autism. Although this percentage seems somewhat low, there are a couple of important considerations to take into account. First, both PPV and NPV depend on prevalence, with PPV being directly proportional to the

TABLE 3 | Five-item scale in trial population (age 3 and younger).

***N* = 724; 69 with autism diagnosis (9.53%)**	**5 item scale**
Sum of item *N* (%): 0	454 (62.7%)
1	138 (19.1%)
2	67 (9.3%)
3	46 (6.4%)
4	14 (1.9%)
5	5 (0.7%)
c-statistic	0.842
Cronbach alpha	0.646

Sum of items predicting autism diagnosis (95% confidence intervals)	**Sens**	**Spec**	**PPV**	**NPV**
1+	0.884 (0.809–0.960)	0.681 (0.645–0.717)	0.226 (0.176–0.276)	0.982 (0.970–0.995)
2+	0.681 (0.571–0.791)	0.870 (0.845–0.896)	0.356 (0.274–0.438)	0.963 (0.948–0.978)
3+	0.391 (0.276–0.507)	0.942 (0.924–0.960)	0.415 (0.296–0.535)	0.936 (0.918–0.955)
4+	0.159 (0.073–0.246)	0.988 (0.979–0.996)	0.579 (0.357–0.801)	0.918 (0.897–0.938)
5+	0.044 (0.000–0.092)	0.997 (0.993–1.000)	0.600 (0.171–1.000)	0.908 (0.887–0.929)

TABLE 4 | Longitudinal analysis: High risk for future autism diagnosis by Autism Spectrum Screening Checklist (ASSC) score at baseline.

***N* = 318; 74 with autism diagnosis at follow-up (23.3%)**	**5 item scale**	**% with autism diagnosis at follow-up**
Sum of item *N* (%): 0	81 (25.5%)	4.9%
1	90 (28.3%)	17.8%
2	68 (21.4%)	25.0%
3	35 (11.0%)	45.7%
4	35 (11.0%)	42.9%
5	9 (2.8%)	66.7%
c-statistic	0.738	
Cronbach alpha	0.559	

Sum of items predicting autism diagnosis	**Sens**	**Spec**	**PPV**	**NPV**
1+	0.946 (0.894–0.998)	0.316 (0.257–0.374)	0.295 (0.237–0.353)	0.951 (0.903–0.998)
2+	0.730 (0.629–0.831)	0.619 (0.558–0.680)	0.367 (0.289–0.445)	0.883 (0.835–0.931)
3+	0.500 (0.386–0.614)	0.828 (0.781–0.875)	0.468 (0.358–0.578)	0.845 (0.799–0.891)
4+	0.284 (0.181–0.387)	0.906 (0.869–0.942)	0.477 (0.330–0.625)	0.807 (0.760–0.853)
5+	0.081 (0.019–0.143)	0.988 (0.974–1.000)	0.667 (0.359–0.975)	0.780 (0.734–0.826)

prevalence of autism. This is exemplified in the current study whereby as prevalence of autism increased, for example, from within the trial population dataset to the longitudinal dataset (i.e., 9.5 to 23.3%), the PPV also increased (i.e., from 0.226 to 0.295 for 1+ and to 0.367 for the designated cut-point of 2+). Therefore, utilizing NPV and PPV when prevalence is low should be done with caution, given that one would expect a low PPV. Second, other studies utilizing administrative datasets from real world settings to screen for autism have also reported low PPV (e.g., 0.11) on previously validated instruments (52–55).

Service providers who have completed the interRAI ChYMH, ChYMH-DD, or interRAI Early Years assessment can obtain the ASSC results automatically from the software in which the scale is embedded. It is important to emphasize that the results are meant to assist healthcare providers in identifying how to best support each child's care planning needs based on the ASSC score. Thus, the scale is not meant to be used as an automated decision-making system, without any clinical judgment, but in conjunction with all of the other information collected during the assessment process. Lastly, it is important to always consult with the individual child and the family to ensure that their strengths and needs are considered throughout the process.

Subsequent assessment and care planning steps will be determined, in part, by whether the child's ASSC score falls within the upper or lower range. For example, if the child's score falls within the lower range, it is advised that the healthcare clinicians discuss whether the ASSC score is fitting in light of all of the information that has been gathered. However, if the child's score falls within the upper range, it is advised that the healthcare clinicians consider the individual to be at higher risk for having autism and conduct an in-depth evaluation specifically designed for this sub-population. Ultimately, the key advantage of implementing the ASSC scale would be that toddlers, children, and youth with higher levels of risk should be receiving a timelier comprehensive follow-up evaluation compared to those with lower-level risk. Notably, future research will be conducted to assign ASSC scores to ascending risk categories to determine what labels are best utilized for specific scores on the scale (e.g., highly probable), as well as how they relate to clinical referrals and specific actions that are recommended.

It is important to note that diagnosing autism is a complex process and requires multiple steps, such as: (a) reviewing records; (b) interviewing parents, family members, and other caregivers; (c) assessing for core features through interactions with the child to examine social interaction and communication abilities; (d) utilizing ASD-specific diagnostic tools; and (e) conducting a physical examination and additional investigations (20). Given that the ASSC scale is a brief 5-item measure of key signs and symptoms of autism, it should only be used as an initial screening tool as part of routine practice within a population-based sample. In jurisdictions where the ChYMH or ChYMH-DD is done routinely, the ASSC scale is available at no added cost to provide an additional point of evidence that the team can weigh in the decision-making process. Best practice for a diagnosis of autism is often conducted within a team-based approach utilizing a multi-modal assessment process. In many Canadian jurisdictions, an inter-disciplinary or multidisciplinary specialized team comprised of various health care practitioners work collaboratively in an integrated and coordinated fashion to establish an ASD diagnosis (56), as well as consider differential diagnoses and co-occurring conditions (20).

While the ASSC scale provides an initial screening as opposed to a diagnostic tool, it still has significant utility for individuals, families, clinicians, and the system as a whole. For example, this effective screening method could reduce wait times, allowing for more efficient referrals, and thus quicker access to health, social support, and education services. Notably, earlier access to intervention can foster appropriate development in social interactions, communication, and behavior (57). Therefore, improving access to early diagnosis for young children will capitalize on key developmental windows, increasing the effectiveness of interventions, thereby enhancing prognostic outcomes (8).

Families will also benefit from implementation of the ASSC; more specifically, utilizing an existing instrument that is already in use across most mental health agencies can facilitate expedited triaging resulting in a reduction in the waiting period for families. Such an approach would not only reduce the stress level of the family when navigating the service system, but also foster an increased likelihood of more appropriate referrals to specialized autism services. Research has shown that most families experience the "diagnostic odyssey" as overwhelmingly negative due to long waiting periods. For example, Lappé et al. (58) found that these lengthy wait times caused parents to experience feelings of frustration and a profound sense of uncertainty. Each obstacle and delay within the diagnostic journey has the potential to erode the trust the family has in the healthcare system and their willingness to interact with it (59). Furthermore, as parents continue to wait for an assessment and their stress levels increase, they may be more likely to seek alternative non-evidence-based treatments for their child (60).

With respect to clinical utility, the ASSC provides an opportunity for initial screening for children and youth who are referred for mental health services. Consequently, children who are at greater risk of having autism can be identified through this initial screening approach, resulting in reduced cost and time on behalf of the clinician, agency, as well as the client and their family. Additionally, if a child is determined to be at high risk of having autism and is eventually referred for a more comprehensive diagnostic assessment, a substantial amount of background information will already be available from the interRAI assessment, thereby reducing assessor burden. Interestingly, one study examined factors influencing wait times for an ASD diagnosis and found that the most important predictor of assessment duration was the amount of information available in relation to the child prior to the assessment (61), exemplifying positive downstream effects of the interRAI assessment-to-intervention approach. Thus, increased efficiency will improve early identification, prioritization, and triaging, which will improve the referral-assessment-diagnostic and care pathway as a whole.

At the systems level, comprehensive assessment of ASD is associated with more healthcare costs and resources. Proper screening and triaging utilizing the ASSC can aid in more expedient and efficient use of resources. Having said that, use and utility may differ depending on the resources available as well as the challenges of operationalizing services that are more or less precious. For example, trading off wait times for follow-up diagnosis may look different if a child is seeking services in an urban center in comparison to a remote area or developing nation.

In addition to individualized care planning, the ASSC scale can also provide comprehensive, standardized data across large catchment areas, which: (1) enhances early identification of children with possible autism across the system and (2) provides the ability to examine the prevalence of these symptoms across jurisdictions. Furthermore, this streamlined screening method may help decrease disparities in access to diagnostic services, providing more equitable care at the population-level (62). In addition to the potential impact the ASSC scale can have on patient outcomes, it can also be more cost-effective to the healthcare system as a whole (8, 63, 64). Therefore, our initial screening tool has the potential to make a meaningful impact at both the individual and societal level.

While the current study has many notable strengths, it also has some limitations. For example, given that the present study was not conducted within the controlled setting of a rigorous research study, reliance on broad signals related to associations between items and an autism diagnosis is required, thereby limiting psychometric precision. As such, these results suggest that augmented assessment approaches are needed to reduce disparities to enhance early detection (53). To improve screening and diagnostic precision, new and innovative approaches could be developed that integrate the ASSC with video models (65), new technological advancements, as well as machine learning (52, 66, 67).

Another limitation is that the results of the study may not be generalizable to a community-based sample. This is due to the fact that the young persons assessed were receiving services from inpatient and outpatient mental health agencies. Therefore, future research will explore whether the results of the current study are similar when the young persons assessed are comprised of a community sample. Furthermore, future research will also examine the scale's utility at different cut points once further implementation of the instruments are done both nationally and internationally.

CONCLUSION AND IMPLICATIONS

There is an overwhelming call for an evolution of the systems of care built to identify those with ASD, as the current wait time to receive a diagnosis is unacceptable to the individuals and families we serve (20, 22, 68). This critical need necessitates the development of an easily accessible and effective screening method. The ASSC scale provides an initial screen for larger populations being assessed as part of routine practice to help identify children and youth at heightened risk for autism. Overall, the main goal for the development and implementation of the ASSC scale is to harness the power of the existing interRAI assessment system to provide a more streamlined screening and referral process. This approach to screening can contribute to earlier identification and intervention, ultimately leading to better patient outcomes at the individual level, and more effective care pathways at the systems level.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Western University's ethics review board (REB #106415). Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

SS and JP developed the analytical strategy. JP performed the statistical analysis. All authors contributed to the formulation of the ideas presented in the study, provided critical feedback to the manuscript, and were involved in the writing and reviewing of the final manuscript.

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Evaluation of the InterRAI Early Years for Degree of Preterm Birth and Gross Motor Delay

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Background: The interRAI 0–3 Early Years was recently developed to support intervention efforts based on the needs of young children and their families. One aspect of child development assessed by the Early Years instrument are motor skills, which are integral for the maturity of cognition, language, social-emotional and other developmental outcomes. Gross motor development, however, is negatively impacted by pre-term birth and low birth weight. For the purpose of known-groups validation, an at-risk sample of preterm children using the interRAI 0–3 Early Years was included to examine correlates of preterm risk and the degree of gross motor delay.

Methods: Participant data included children and families (*n* = 591) from 17 health agencies in Ontario, Canada. Data were collected as part of a pilot study using the full interRAI 0–3 Early Years assessment. Correlational analyses were used to determine relationships between prenatal risk and preterm birth and bivariate analyses examined successful and failed performance of at-risk children on gross motor items. A Kruskal-Wallis test was used to determine the mean difference in gross motor scores for children born at various weeks gestation.

Results: Correlational analysis indicated that prenatal and perinatal factors such as maternal nicotine use during pregnancy did not have significant influence over gross motor achievement for the full sample, however, gross motor scores were lower for children born pre-term or low birth weight based on bivariate analysis. Gross motor scores decreased from 40 weeks' gestation (mean rank = 310.77), to moderate to late preterm (mean rank = 258.96), and to very preterm (mean rank = 234.54), however extremely preterm (mean rank = 236.28) performed comparably to very preterm.

Interpretation: The interRAI 0–3 was evaluated to determine its efficacy and report findings which confirm the literature regarding delay in gross motor performance for preterm children. Findings confirm that pre-term and low birth weight children are at greater risk for motor delay *via* the interRAI 0–3 Early Years gross motor domain.

Keywords: preterm, low birth weight, interRAI, early years, validation

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INTRODUCTION

Children who are born preterm (PT), or low birth weight (LBW) face additional barriers as compared to normal birth weight and full-term children, including risk of chronic developmental (i.e., motor, cognitive, communicative), behavioral, socio-emotional, and psychological difficulties. These children are also more likely to have a diagnosed neurodevelopmental or learning disability as compared to full-term children (Cheadle and Goosby, 2010; Shah et al., 2013; Månsson and Stjernqvist, 2014; Gladstone et al., 2015; Fevang et al., 2016; Johnson et al., 2016). When born LBW or PT, the neonate can be impacted by immediate medical complications such as respiratory distress or intraventricular hemorrhage, and future conditions of diabetes, heart disease and other health conditions (OECD, 2013). In concert, families undergo significant stress due to the additional challenges in financially, physically, and emotionally supporting their child (Cheadle and Goosby, 2010; Hodek et al., 2011; Gerstein and Poehlmann-Tynan, 2015). Preterm birth and low birthweight also impact the longitudinal health and well-being of children and their families, making this an expansive population serviced by hospitals and other treatment facilities in Canada (Lim et al., 2009; Treyvaud et al., 2014).

Children born prior to 37 weeks' gestation are considered PT, and infants with a birthweight of under 5.5 pounds are identified as LBW regardless of gestational age (World Health Organization et al., 2012; OECD, 2013). Although infant mortality has decreased in many developed countries, the incidence of children born with low birth weight is increasing, with estimates in Canada at 6.3 percent, and late preterm births rising 20% from 1990 to 2006 in the United States (National Center for Health Statistics, 2009; OECD, 2013). Increasingly, more attention has been given to children born late preterm, between the gestational age of 34–36 weeks of pregnancy, due to recently observed disparities in health and developmental outcomes (Raju, 2006; National Center for Health Statistics, 2009; Woythaler et al., 2011; Johnson et al., 2015), however, extremely low birthweight (ELBW, < 1,000 g) or very preterm (VPT, 28–32 weeks) children are still at greatest risk (Mikkola et al., 2005; Cheadle and Goosby, 2010; Gladstone et al., 2015; Fevang et al., 2016). Internationally, the prevalence of preterm births falls around 10–11 percent, with LBW and PT more common in developing countries (Beck et al., 2010; Blencowe et al., 2012).

Preventable conditions such as poor maternal mental and physical health, maternal smoking or use of toxic substances, mothers' age at birth, and inadequate prenatal care provide some explanation for the cause of this condition (Bandstra et al., 2010; World Health Organization et al., 2012; Finnegan, 2013; Bouras et al., 2015). A common maternal health complication is gestational diabetes during pregnancy. Type 2 diabetes as diagnosed at or before 26 weeks' gestation was found to be a leading risk for the later diagnosis of Autism Spectrum Disorder (ASD), while controlling for several other common predictors such as maternal smoking, body mass index and socio-economic status (Xiang et al., 2015). Maternal age during pregnancy has also been found to predict low birth weight and preterm birth, in addition to elective caesarian surgery, and post-health outcomes for the mother (Oakley et al., 2016). Prenatal exposure to substances such as illicit drugs and alcohol, are responsible for health and developmental problems in childhood and adolescence and can lead to increased likelihood of preterm birth (Bandstra et al., 2010; Finnegan, 2013; O'Keeffe et al., 2014). Finally, maternal stress *in utero* is linked to low birth weight or preterm birth, however this evidence has not been conclusive when examining stress hormones (Nkansah-Amankra et al., 2010; Kramer et al., 2013; Romero-Gonzalez et al., 2018).

Non-maternal characteristics of preterm birth include being a product of multiple birth, and time spent in a neonatal intensive care unit (NICU). Many preterm or low birth weight children are likely to have spent time in a NICU, impacting the development of sensory systems and ultimately affecting later outcomes in language, cognition and motor areas (Subedi et al., 2017; Vandormael et al., 2019). In one study, preterm children were assessed at multiple time points from 9 months of age into kindergarten, and authors found that the extent of preterm birth as measured by gestational age no longer predicted child outcomes, but rather, the increased length of stay in NICU predicted milestone achievement more substantially (Subedi et al., 2017). Due to any number of maternal and non-maternal issues, children born preterm or low birth weight have broad deficits impacting their development.

Researchers have been examining the continued effects of PT and LBW, including a number of health and developmental issues that are present prior to and beyond kindergarten. Major areas of research revolve around the social competence and behavioral presentation of children born PT or LBW, as well as their cognitive development and academic performance in later life.

Children born PT and LBW display greater dysfunctional behavior, reduced social competence, and a wide range of psychosocial concerns as compared to their full term and normal-birth-weight peers (Jones et al., 2013; Fevang et al., 2016). In a meta-analysis of recent literature, authors found that young children born with severe levels of PT or LBW struggled with poor emotional regulation, social skills, and had more attentional problems as compared to full term children, which predicted future dysfunctional behavior into school age, regardless of cognitive performance (Arpi and Ferrari, 2013). LBW and preterm birth also lead to high levels of maternal stress and burdens in child-parent interactions, potentially impacting the behavioral outcomes of these children (Yates et al., 2010; Woythaler et al., 2011; Poulsen et al., 2013; Ritter et al., 2013; Gerstein and Poehlmann-Tynan, 2015; Fevang et al., 2016; Gerstein et al., 2017). Executive functioning is significantly correlated with childhood social competence, with impairments in executive function prevalent amongst PT and LBW children, particularly childhood inhibitory control (Jones et al., 2013; Ritter et al., 2013; Alduncin et al., 2014).

Children with severe low birth weight and very preterm birth who demonstrate an early delay in executive functioning, may also display cognitive impairment beyond adolescence and into adulthood (Ritter et al., 2013; Eryigit Madzwamuse et al., 2015). It has also been observed that late and moderately preterm children demonstrate significant delays in cognitive function as well (Johnson et al., 2015). In the early years, low birth weight and preterm children demonstrate significantly lower motor, communication and cognitive skills as compared to full-term children (Månsson and Stjernqvist, 2014; Peyton et al., 2018). Even the early abilities of infants to use gestures and other forms of receptive language is affected by these vulnerabilities, which tends to create conditions for future identification of learning disabilities in the school setting (Barre et al., 2011; Johnson et al., 2016; Stolt et al., 2016). Likewise, childhood motor development, often seen as partly responsible for early cognitive function, is negatively impacted by pre-term birth or low birth weight, regardless of diagnosis of physical disability (Van Hus et al., 2013; Sansavini et al., 2014). It is this coordinated process of tuning the gross and fine motor systems that prepares children for more complex tasks in later childhood. Motor skills are crucial in determining independence of children on such tasks as dressing, feeding, hygiene-related activities, as well as on oral and written academic tasks in school settings (Houwen et al., 2016; MacDonald et al., 2016). Children across all levels of severity are at risk for achieving lower IQ scores, more likely to receive placement in special education, as well as decreased academic scores across reading, writing and mathematics as compared to normal-birthweight children (Poulsen et al., 2013; Basten et al., 2015). Even while controlling for the effects of family socio-economic status, for instance, the poor educational performance of preterm children can lead to future decreases in educational attainment later in life, and similarly, less well-paying positions of employment (Basten et al., 2015).

The early intervention literature pertaining to preterm and low birth weight children is scarce and often immaterial (see Johnson (2009), Evans et al. (2017)), however, the early effects of LBW and PT birth on infant and toddler development should be explored in order to enhance early intervention efforts.

With early intervention, it is also crucial to use strong measures of infant and toddler development that pertain to the unique needs of low birthweight and preterm children across specific developmental domains. Few recent studies have evaluated currently used infant and toddler assessments of developmental milestones (see Greene et al. (2012), Sansavini et al. (2014), Lefebvre et al. (2016), Agarwal et al. (2017)). Commonly administered instruments have also been criticized for inaccurate cut offs amongst very preterm or low birth weight children (such as by overestimating motor impairment), as well as unexplained variance in predicting future motor function and classification instability over time (see Luttikhuizen dos Santos et al. (2013), Lobo et al. (2014), Duncan et al. (2015)). In a recent meta-analysis investigating the predictive capacity of future cognitive outcomes for preterm and low birth weight children, common early childhood assessments such as the Bayley Scales of Infant Development, had greater specificity overall, but sensitivity was typically lower when examining future outcomes (Wong et al., 2016). Wong et al. (2016) recommended that test developers examine more closely the predictive accuracy of their screens, and link to consistent follow up assessment in order to increase the odds of detecting later delay. However, others have discovered findings that are strongly predictive of determining developmental delay amongst preterm and low birth weight infants (Agarwal et al., 2017). The accuracy of tests is also important to help determine resource allocation. The resources needed to service this population in Canada ranges based on birthweight and preterm birth, with the cost growing substantially higher than for children born full term and normal birthweight (Lim et al., 2009). For instance, those who are born in the range of 1,000–1,499 grams, cost an average of $50,000 as newborns, and for those born preterm at any gestational age, costing $9,233 and up to $84,235 when extremely preterm (Lim et al., 2009). Thus, for the purposes of early intervention, it is crucial to determine the immediate consequences of preterm and low birth weight newborns by evaluating commonly administered screening and assessment tools for this population.

interRAI is a non-profit conglomerate of researchers from around the world, who develop assessment systems to target the needs of individuals across the lifespan. The child and youth suite of assessments includes the interRAI 0–3 Early Years (Stewart et al., 2017), which has been developed to identify the overall developmental needs of young children between 0 and 47 months of age, as well as their family. The interRAI 0–3 captures more than 650 items that seek insight on ecological risk factors, family dynamics, medical and mental health information, as well as all areas of early development. It provides information specific to early identification and intervention (e.g., preterm birth, low birthweight, caregiver distress, emotion dysregulation). Items include multilevel assessment of frequency and intensity (e.g., *Present recently but not exhibited in last 3 nights/days*), performance and capacity of tasks (e.g., *Extensive assistance- help throughout task, but performs 50% or more of task on own*), and age-related items indicating presence or non-presence of developmental achievement (e.g., *Grasping- picks up tiny objects with fingertips (e.g., food crumbs, peas)*). Items are carried forward from the child and youth suite of instruments as applicable, and new items undergo a rigorous approval process by an Instrument and Systems Development (ISD) committee before pilot and publication. The interRAI 0–3 Early Years is currently in pilot testing, evaluating the efficacy of its items and scales before final approval for submission to publication can be given.

This newly established instrument, however, has yet to explore the development of preterm children under the age of four in the motor domain. In the present study, data from the interRAI 0–3 Early Years was used to explore the motor findings of children at risk due to issues such as preterm birth, or low birthweight, seeking to understand how children between 6 and 47 months perform on gross motor outcomes based on extent of prematurity and other risk factors.

MATERIALS AND METHODS

Sample

Participants completed the interRAI 0–3 Early Years as a part of a pilot study across 17 sites which provide developmental or mental health services in Ontario, Canada. This convenience sample included 591 children between the ages of 6–47 months of age ($M = 31.6$, $SD = 12.71$), with a majority of male participants

TABLE 1 | Characteristics of interRAI 0–3 participants 6–47 months (*n* = 591).

Variables	Frequency (%)	Mean	*SD*
Age at assessment		31.6	12.7
Sex			
Male	369 (62.4)		
Female	222 (37.5)		
Preterm birth			
Yes	120 (20.3)		
No	471 (79.7)		
Levels of prematurity			
Extremely preterm (≤ 28 weeks)	16 (2.7)		
Very preterm (≤ 32 weeks)	37 (6.3)		
Moderate/late preterm (≤ 39 weeks)	91 (15.4)		
40 Weeks' gestation (≥ 40 weeks)	447 (75.6)		
Low birth weight*			
Yes	61 (10.3)		
No	482 (81.5)		
Neonatal intensive care*			
Yes	222 (37.5)		
No	293 (49.6)		
Maternal health problems during pregnancy or delivery*			
Yes	142 (24.0)		
No	360 (60.9)		
Maternal nicotine use during pregnancy*			
Yes	83 (14.0)		
No	437 (73.9)		
Maternal alcohol use during pregnancy*			
Yes	26 (4.3)		
No	531 (89.8)		

**Missing data was unreported by assessors or not inputted into beta software.*

(62.4%; see **Table 1**). As many as 20.3% (*n* = 120) identified as preterm (< 37 weeks) by the assessor during intake. This item utilized a binary response item to record for preterm birth based on caregiver response or an examination of medical documentation. More children were identified as preterm based on a separate item on the 0–3 Early Years, indicated by the number of weeks premature. This item indicated that 24.3% of children had a gestational age under 39 weeks. The majority were considered moderate to late preterm (16.4%), and only 11.2% of the sample was considered low birthweight. Much of the sample had been placed in some level of neonatal care after birth (43.1%), and 28.3% of mothers had health complications during the pregnancy or delivery. The most common health complications included gestational diabetes, hypertensive disorders, and fetal distress.

Measure

The interRAI 0–3 Early Years is a needs-based integrated assessment-to-intervention system that amalgamates social, psychiatric, medical, functional, psychological, and environmental constructs to evaluate and intervene based on the needs of young children and their families. Upon intake within child and family agencies across Ontario, assessors who received training on the interRAI 0–3 began to collect data with the child and family using the above measures. The interRAI 0–3 training included an overview of the form, manual, coding procedures, and practice using case studies. Pediatricians, psychiatrists, psychologists, infant therapists, early childhood educators, child and youth workers, child life specialists, and early intervention teams administered the interRAI 0–3. Assessors were required to have a diploma or degree in early child development, at least 2 years of work experience with young children, and have received the comprehensive *interRAI 0–3* 2-day assessor training program. The *interRAI 0–3* uses a clinician-rated semi-structured interview format and requires approximately 45–90 min to complete depending on case complexity, age of the child and assessor experience. Initial assessments may require additional time due to the novelty of the case. Clinicians were given explicit instruction to use information from multiple sources such as medical documentation where approved, as well as information from the caregivers, extended family, childcare providers or other individuals relevant to the context of the family. If clinicians felt that there was incongruent information based on the report from multiple sources, clinicians were asked to make observational judgments to validate their decisions where possible. The focus of the interRAI 0–3 Early Years measure was the Gross Motor domain, which is a multi-item scale that assesses the developmental milestones achieved in multiple age intervals including early mobility in infancy and the progression of climbing and running as the child matures in age. The presence of these milestones is determined using a 2-point coding structure (*0 = No* to *1 = Yes*), which is summed to provide a composite score based on the age range completed.

To test for gross motor performance, corrected age was used for children above 24 months by subtracting weeks premature by chronological age, indicating the child's corrected age at assessment. For children under 24 months, gross motor outcomes were not adjusted based on corrected age.

Statistical Analysis

The current study initially sought to examine the correlations between risk items (i.e., premature birth, low birthweight, neonatal intensive care, maternal nicotine and alcohol use, and maternal health problems) and performance on gross motor milestones as a means to discover convergence between risk items and associations with gross motor performance. Next, bivariate associations were used to discover the successful and failed performance of *at risk* and *no risk* children on the interRAI 0–3 gross motor domain. Initially, contingency tables and chi square were calculated for predictors of developmental outcomes for premature children based on the literature. Proposed variables that contribute to poor developmental outcomes included maternal age, premature birth, birthweight, maternal health problems, stay in NICU, as well as maternal nicotine and alcohol use. Though important to this research, variables not included in the analysis were *assistive reproductive technology used to achieve pregnancy*, and *child is a product of multiple birth*, as this subsample of participants was not substantive. This

TABLE 2 | Correlation matrix between gross motor performance and risk factors for development.

Items		Low birthweight	Stay in neonatal intensive care unit	Maternal health problems during pregnancy	Maternal nicotine use during pregnancy	Maternal alcohol use during pregnancy	Gross motor performance (pass/fail)
Preterm birth	Pearson correlation	0.389**	0.496**	0.283**	0.013	–0.025	–0.154**
	Significance (2-tailed)	0.000	0.000	0.000	0.766	0.562	0.000
	N	591	561	545	564	558	591
Low birthweight	Pearson correlation		0.300**	0.096*	–0.042	0.060	–0.110*
	Significance (2-tailed)		0.000	0.029	0.339	0.169	0.000
	N		528	516	533	528	543
Stay in neonatal intensive care unit	Pearson correlation			0.235**	0.031	0.032	–0.200**
	Significance (2-tailed)			0.000	0.483	0.466	0.000
	N			510	525	521	515
Maternal health problems during pregnancy or delivery	Pearson correlation				–0.021	0.004	–0.108*
	Significance (2-tailed)				0.635	0.935	0.000
	N				521	521	502
Maternal nicotine use during pregnancy	Pearson correlation					0.296**	0.043
	Significance (2-tailed)					0.000	0.331
	N					548	520
Maternal alcohol use during pregnancy	Pearson correlation						0.135**
	Significance (2-tailed)						0.002
	N						514

**Denotes statistical significance at the 0.05 level.*
***Denotes statistical significance at the 0.01 level.*

dataset includes some missing data, which was unreported or not inputted into beta software by assessors.

Finally, an independent-samples Kruskal-Wallis test was conducted to examine the gross motor outcomes of children born extremely preterm (at or below 28 weeks' gestation), very preterm (at or below 32 weeks' gestation), moderate to late preterm (33–39 weeks' gestation) and at 40 weeks' gestation or having no reported preterm birth. A non-parametric test was chosen as a test of normality revealed that homogeneity of variances could not be assumed. Box-plots were used to determine differences in scores across levels of prematurity, a means test was carried out and *post hoc* tests were used to determine levels of significance among gross motor scores between categories.

RESULTS

Initially, Pearson-product moment correlations were run to seek evidence between performance on gross motor items and variables that place children at risk of poor performance (see **Table 2**). Items from the interRAI 0–3 that were used included preterm birth and low birthweight, stay in a NICU, maternal health problems during pregnancy and maternal nicotine use during pregnancy. Interestingly, the findings showed significant negative correlations between performance on gross motor and all risk-oriented items except for nicotine use during pregnancy, however, the strength of relationship between other items was weak. While the direction of the relationship is not clear, either an improvement in performance on gross motor leads to decreased risk, or an increase in risk leads to poor performance on gross motor items. Correlations between risk-items were also sought, indicating convergence between constructs that are commonly known to load together. Children with any known risk, such as preterm birth, was found to relate to other risk factors such as receipt of neonatal intensive care.

Using items from the interRAI 0–3, common predictive risk factors were chosen to explore associations with developmental outcomes on the gross motor domain as a stronger measure of relationships between variables (see **Table 3**). The findings suggest that children with no identified risks were more likely to achieve gross motor milestones at a higher rate than those with identified risk factors. The gross motor findings indicated that within the at-risk group, most children identified as being preterm, low birthweight or having other risks for developmental delay were found to succeed or fail milestones nearly equally. The

TABLE 3 | Bivariate association between achievement of gross motor milestones and predictors for children 6–47 months ($n = 591$).

Variables	Achievement of gross motor milestones		Chi-square (sig.)
	Yes	No	
Preterm (<37 weeks)			0.000 (0.001)
Yes	55 (45.8)	65 (54.2)	
No	304 (64.5)	167 (35.5)	
Low birth weight (<1,500 g)*			
Yes	28 (45.9)	33 (54.1)	0.011 (0.001)
No	303 (62.9)	179 (37.1)	
Neonatal intensive care*			0.000 (0.001)
Yes	110 (49.5)	112 (50.5)	
No	203 (69.3)	90 (30.7)	
Maternal health problems during pregnancy or delivery*			0.015 (0.001)
Yes	72 (50.7)	70 (49.3)	
No	225 (62.5)	135 (37.5)	
Maternal nicotine use during pregnancy*			0.330
Yes	53 (63.9)	30 (36.1)	
No	254 (58.1)	183 (41.9)	
Maternal alcohol use during pregnancy*			0.002 (0.001)
Yes	23 (88.5)	3 (11.6)	
No	284 (58.2)	204 (41.8)	

**Missing data was unreported by assessors or not inputted into beta software.*

risk estimates for each variable, however, show that passing as compared to failing gross motor milestones for preterm birth, low birthweight, maternal health issues during pregnancy, or being in neonatal intensive care does not increase the risk estimate to above 1. Conversely, maternal nicotine use (1.27), and alcohol use during pregnancy (5.51) did lead to an increased risk estimate, with the group that failed gross motor milestones (1.16; 3.62), respectively, showing a risk estimate above 1.

Initially, the number of weeks a child was born prematurely was converted into categories of extremely premature, very premature, moderate to late premature and 40 weeks' gestation. Children who were at least 2 years of age and were born prematurely, would be asked to perform a set of items within their corrected age range. For children under 24 months, gross motor items were not adjusted based on corrected age. These variables were then examined for normal distribution according to the Shapiro-Wilk's test of normality. The results indicate that although the very preterm category was considered normally distributed, all other levels of prematurity did not meet the normality assumption.

Given the low and unequal sample sizes within each category, a non-parametric test was selected in order to reduce type I error (Kruskal and Wallis, 1952). An independent-samples Kuskal-Wallis Test was used, and initial examination of the boxplot indicated that distributions of gross motor scores were different for each level of premature birth. The distributions of gross motor scores were significantly different across categories of prematurity [$H(3) = 15.520$, $p = 0.001$], thus the null hypothesis was rejected. Gross motor scores decreased from 40 weeks' gestation (mean rank = 310.77), to moderate to late preterm (mean rank = 258.96), and to very preterm (mean rank = 234.54), however extremely preterm (mean rank = 236.28) performed comparably to very preterm.

Given the level of significance, pairwise comparisons using Bonferroni correction were executed. Accepting statistical significance based on adjusted p-values at the $p < 0.05$ level revealed differences between gross motor scores for two categories. *Post hoc* analysis showed statistical significance between gross motor scores for very preterm birth and 40 weeks' gestation ($p = 0.04$), and between moderate to late preterm and 40 weeks' gestation ($p = 0.04$), but not between other groups.

DISCUSSION AND CONCLUSION

The present study examined relationships between perinatal and prenatal risk for gross motor delay, including preterm birth and low birthweight, stay in NICU, maternal health problems as well as nicotine and alcohol use during pregnancy. Next, the mean gross motor scores of children were compared based on levels of preterm birth.

Initially, a correlation matrix was generated to examine the relationship between risk-items on the interRAI 0–3 and their association with pass/fail performance of gross motor milestones. The results indicated that items such as preterm birth and low birthweight, time in a NICU, and maternal health problems during pregnancy or delivery are all positively and significantly correlated with one another, however, maternal nicotine and alcohol use were not correlated with these other risk factors, rather correlated with one another. An increase in any one of the correlated risk factors indicate that the others will also linearly increase. This is an important finding, as it shows that multiple interRAI 0–3 items that link to preterm birth show convergence, however, this also increases the likelihood of multicollinearity in any logistic model. Additionally, these items all show a negative relationship with pass/fail outcomes from the gross motor domain, which is a common finding in the literature for preterm children. Conversely, alcohol use during pregnancy showed a positive statistically significant relationship, which is likely due to limited sample size ($n = 26$). Moreover, nicotine use was also scarcely reported amongst maternal participants ($n = 83$), finding no association to PT, or LBW. Additionally, the relationship between poor performance on gross motor outcomes was expected to be stronger for the at-risk population given the literature which shows that prenatal and perinatal factors have significant influence over gross motor achievement (Ghassabian et al., 2016a,b; Yaari et al., 2018). The present study found that the strength of correlations with gross motor outcomes ranged between –0.108 for maternal health problems during pregnancy and –0.200 for stay in a NICU. Finally, the risk estimate seemed to be highest for variables pertaining to alcohol and nicotine use, more than other perinatal and prenatal factors.

Of the risk factors discussed in this study, of particular interest was the necessity of neonatal intensive care. Much of the current literature shows that children born preterm require care by specialists in a NICU, and that a longer period of time spent in this type of care forecasts poorer developmental outcomes (Subedi et al., 2017). Staying in a NICU is also hypothesized to impact the infant beyond the effects of their prematurity or low birthweight by having increased medical interventions and reducing holding behavior (Pineda et al., 2018). An increase in holding the child leads to stronger tuning of the reflexes based on parent interventions (Pineda et al., 2018). There is evidence to suggest that neuromuscular development can be delayed due to length of stay in a NICU (Zuccarini et al., 2016), thus future research should further investigate this relationship using data from the interRAI 0–3 Early Years instrument.

The interRAI 0–3 adjusts for prematurity within all developmental domains for children under 24 months, which also may be responsible for the weak correlation with gross motor performance. Several assessments that measure child development correct for age by subtracting the number of weeks premature, by the child's chronological age (see Bayley (2006), Bricker and Squires (2009)). We employed the same process to ensure that we capture accurately, the gross motor development of preterm children, as they are still biologically maturing. However, this has been criticized for underserving populations of children still considered at-risk for delay, noting that intervention services may be offered to less children who could still benefit from access (Yaari et al., 2018). Thus, it has been recommended that chronological and corrected age be considered for intervention purposes (Yaari et al., 2018). Future research using the interRAI 0–3 should examine participants scores within their age range without correcting for prematurity to find any measurable differences.

Bivariate associations with risk factors including preterm birth, low birthweight, time spent in a NICU and maternal health problems during pregnancy. These risk factors were found to be associated with higher risk of failure on gross motor domain items from the interRAI 0–3 by comparing at-risk children to the rest of the study population. For instance, 45.8% of children born preterm (< 37 weeks' gestation), achieved motor outcomes as compared to 64.5% of children who were not born preterm. Similarly, children born with low birthweight achieved gross motor outcomes 45.9% of the time, with 62.9% of full-term children achieving milestones for their corrected age. This further reflects findings in the literature that suggest children who are considered preterm or low birthweight function below full term peers on motor outcomes (Sansavini et al., 2014; Lean et al., 2018; Yaari et al., 2018).

Within the group of preterm children in this study, more participants were likely to fail motor milestones. Specifically, of the children born preterm, 45.8% were able to achieve gross motor milestones, and 54.2% did not, and nearly identical findings for were discovered for the passing (45.9%) and failing (54.1%) low birthweight group. Yet, amongst the full-term cohort 64.5% of children achieved gross motor milestones for their age, and only 35.5% failed such milestones. Studies have found poorer results in very preterm and low birthweight children across all developmental domains (Lean et al., 2018; Yaari et al., 2018), thus future research should investigate associations between prenatal and perinatal risk factors using the extent of preterm birth. It may be that for children born pre-term, more immediate intervention services were given, leading to an indiscriminate difference between the participants who achieved or did not achieve particular milestones. Another important consideration pertains to the male predominance in this study (62.4%). Some authors suggest that evaluation of motor outcomes should include age and sex-specific assessment of motor skills during the early years given differences in fundamental motor skills (Kokštejn et al., 2017).

Lastly, the Kruskal-Wallis test was used to determine the mean difference in gross motor scores for children considered 40 weeks' gestation, moderate to late preterm, very preterm and extremely preterm. Distributions amongst the groups varied at a statistically significant level, [$H(3) = 15.520, p = 0.001$], indicating that level of preterm birth effects the gross motor abilities of children, based on corrected age. The mean rank of 40 weeks' gestation was highest, then moderate to late preterm, and very preterm, however, extremely preterm children performed slightly better, but not statistically superior to the very preterm category. Research suggests that the most at-risk groups (i.e., very preterm) tend to do most poorly on functional assessments, finding a reduced effect with children who are less severe (Schonhaut et al., 2013). It is posited that the small number of participants in the extremely preterm group (n = 16) were not sufficient to capture changes in the distribution. The only groups that were statistically significantly different in their achievement of gross motor milestones were the moderate to late preterm and the very preterm groups as compared to children considered 40 week's gestation.

It must also be considered a limitation that the moderate to late preterm week's gestation included cases of children between 33 and 39 weeks as opposed to 32–37 weeks in order to reduce case overlap and capture all children born before 40 weeks. In future, the moderate to late preterm group could be parsed out into early term and late preterm as sample size increases. The sample size of each group should be considered a limitation to interpretation of these findings. With an increased sample size, it would be interesting to examine preterm gross motor scores in infants as compared to older children in our sample, as there are early neuromuscular differences which lead to poor object manipulation at 6 months, and later motor difficulties in children at the age of 2 years (Zuccarini et al., 2016; Allotey et al., 2018).

The present study findings confirm that very preterm children perform poorly on gross motor outcomes as compared to full-term children, however, that late and moderate preterm birth are still suggestive of concern. Recent studies have been done to explore late preterm children, noticing significant differences in achievement across a broad range of milestones both early in childhood and later into school-age (Raju, 2006; National Center for Health Statistics, 2009; Woythaler et al., 2011; Johnson et al., 2015). The findings from this study reflect much of what is found in the literature and confirm the presence of concern for this population using data collected from interRAI 0–3. This helps to substantiate the use of the interRAI 0–3 as an instrument that accounts for levels of prematurity and prenatal and perinatal risk. Further research should explore predictive models based on maternal and post-term risk in order to replicate past studies and confirm the use of the interRAI 0–3 as predicting poorer developmental outcomes for this population. Future work should also consist of measuring the impact of preterm birth on different age cohorts in order to explore the longitudinal effects on gross motor development. Preterm birth and skill development in domains such as language, executive function and social-emotional areas should also be explored in order to replicate findings on preterm performance.

Following this, it would be interesting to explore different age groupings to see what is predictive for individual age ranges. This has been done in other research to counter the issue of developmental change, and more closely examine psychometric properties that appear to improve with the age at assessment (Schonhaut et al., 2013). The study population used for analysis also amalgamated new intake cases and those that may have been in a clinical program receiving early intervention. These cases could not be separated because this pilot study was the first of its kind to evaluate the interRAI 0–3, thus all cases in the database were considered an initial assessment. Future work will have the capability to separate first assessment from routine or discharge assessments. Finally, children who were considered preterm or low birthweight may have experienced other medical comorbidities or multiple diagnoses that impacted the association with these items. With increased data collection efforts, supplementary research into the role that comorbid diagnoses have on the preterm or low birthweight population could expand the impact of the interRAI 0–3.

Children who are preterm and low birthweight have been found to exhibit more delayed developmental trajectories than child who are born full-term and normal birthweight. With the incidence of low birth weight and late preterm birth rising, increased emphasis should be placed on investigating this vulnerable population. The interRAI 0–3 was examined for associations between risk factors for delay and levels of preterm birth on gross motor outcomes, which was an integral part of test development efforts.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This study involved human participants and was approved by the University of Western Ontario Research Ethics Board (REB # 108024). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JI composed the literature review, developed the analytical strategy, and performed the statistical analysis. SS provided intellectual direction, provided critical feedback to the manuscript, and was involved in the writing and reviewing of the final manuscript. Both authors contributed to the article and approved the submitted version.

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An Examination of Correlates of Quality of Life in Children and Youth With Mental Health Issues

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Quality of life (QoL) is significantly lower in children with mental health issues compared to those who are typically developing or have physical health problems. However, little research has examined factors associated with QoL in this particularly vulnerable population. To address this limitation, 347 clinically referred children and adolescents were assessed using the interRAI Child and Youth Mental Health (ChYMH) Assessment and Self-reported Quality of Life- Child and Youth Mental Health (QoL-ChYMH). Hierarchical multiple linear regression analyses were conducted to examine QoL at the domain-specific level. Children and adolescents who experienced heightened anhedonia and depressive symptoms reported lower social QoL (e.g., family, friends and activities; $p = 0.024$, 0.046, respectively). Additionally, children and youth who experienced heightened depressive symptoms reported lower QoL at the individual level (e.g., autonomy, health; $p = 0.000$), and level of basic needs (e.g., food, safety; $p = 0.013$). In contrast, no mental state indicators were associated with QoL related to services (e.g., school, treatment). Due to the paucity of research examining predictors of QoL in children and youth with mental health challenges, this study contributes to the field in assisting service providers with care planning and further providing implications for practice.

Keywords: children and youth, mental health, quality of life, mental state indicators, interRAI

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INTRODUCTION

Untreated mental health issues can have an adverse impact on both individuals and society. Notably, individuals with mental health issues have a significantly lower quality of life (QoL) compared to the general population, as well as those with physical health problems (1–4). While a vast amount of research has investigated determinants of QoL in adults with mental illness, including sociodemographic data, symptom severity, functionality, personality factors, and social interactions [e.g., (5–7)], the same is unfortunately not true for the pediatric population. To address this gap in the literature, the present study examined whether certain factors (i.e., mental state indicators) were associated with QoL in children and youth receiving mental health services.

Quality of Life

Although there is no general consensus on the definition of quality of life, it is agreed that QoL represents a multi-dimensional construct that integrates a number of different domains, such as psychological, physical, and social well-being. There has been an increase in the development and use of QoL tools in recent decades, which has coincided with a shift within the healthcare system towards recognizing the importance of the client's preferences and life experiences in addition to their symptomology [e.g., (8–14)]. These tools are being used for a variety of purposes, such as to evaluate treatment outcomes, to help predict physical and mental health problems, and to facilitate shared clinical decision-making between clinicians and patients (15–18). There is also increased awareness around the value in obtaining self-reports of QoL from children and adolescents in particular, due in large part to the parent-proxy problem. Specifically, extensive research has shown poor agreement between parent-proxy and child reports of QoL (19–21). Therefore, it is strongly advised for children to report on their own QoL whenever possible.

Quality of Life Measurement

QoL has been conceptualized in a number of different ways in the literature because it is a latent construct. For example, researchers have proposed four main approaches to QoL, including objective measures, subjective measures, health-related quality of life (HR-QOL), and health-economic measures (22). Subjective and HR-QOL measures represent two of the most common approaches to QoL measurement in child and adolescent mental health research. Subjective measures are largely focused on the individual's perceptions, such as a sense of well-being and happiness (23). HR-QOL measures have been developed as a result of the healthcare field realizing that traditional measures of disease do not fully capture the effects of illness (24). While the broad domains among most QoL tools are fairly consistent, the specific sub-domains vary depending on the particular measure. This variability in structure can make it quite difficult to compare QoL measures (25).

While there has been an increase in the development of QoL instruments for children and youth, the majority of these instruments are intended for pediatric chronic care [e.g., (26)]. However, in response to the need for more diverse QoL tools, interRAI has developed several self-report QoL measures (11), including those specifically for children and youth receiving mental health services (13). While there is some overlap among these surveys, it was critical to develop a tool specifically for young persons because there are different considerations when assessing QoL in a pediatric population, such as the influence of family relationships and the school environment. A common approach to assessing QoL across the lifespan fosters engagement and self-determination in the treatment process, providing opportunities for improved outcomes while enhancing service system integration.

The Self-reported Quality of Life- Child and Youth Mental Health (QoL-ChYMH) is one of the newest additions to the interRAI Child and Youth suite of instruments (13). The tool assesses the perception of well-being and life satisfaction of children and youth with mental health issues. Importantly, the QoL-ChYMH provides these young persons with a voice, promoting engagement in their own mental healthcare. The purpose of this self-report tool has been to assist healthcare professionals in identifying a young person's strengths and needs in order to maximize treatment gains while improving QoL.

Quality of Life and Mental Health

The relationship between mental health issues and lower QoL is well-supported in the adult literature. For example, research has shown that QoL is reduced in those who have been diagnosed with various psychiatric disorders, such as depression, anxiety, bipolar disorder, schizophrenia, and others [e.g., (27–30)]. With respect to schizophrenia, studies have found that negative symptoms have a significant inverse correlation to QoL; however, the relationship between positive symptoms and QoL is less clear [e.g., (31, 32)]. One study compared QoL among different mental health disorders, including mood, anxiety, somatoform, alcohol, and eating disorders, and found that mood disorders accounted for significantly more impairment across all HR-QOL domains, whereas other disorders only affected certain domains (33). Importantly, researchers have found that even subthreshold symptom levels are associated with lower QoL. This suggests that an individual does not need to receive a psychiatric diagnosis in order for their QoL to be diminished.

QoL in childhood mental health disorders is much less established compared to other fields, including various childhood somatic diseases as well as adult mental health (34). However, Jonsson et al. (35) conducted a recent review examining the impact of childhood mental health disorders on QoL. Overall, they found that clinical populations reported lower QoL compared to healthy control groups. Further, the authors noted that studies for large diagnostic groups, such as anxiety disorders, depressive disorders, and (early onset) schizophrenia are largely lacking. Within the child and youth literature, research has primarily focused on the relationship between QoL and a particular mental health condition as opposed to comparisons between conditions. For example, lower QoL has been reported in young persons with depressive symptoms (36), anxiety symptoms (37), and ADHD (particularly when measured via proxy-report as opposed to self-report) (20).

CURRENT STUDY

While there is a growing awareness of the importance of QoL within the healthcare field, the literature examining the association between mental health and QoL in children and youth is in its infancy. The purpose of this study was to address the current gaps in the literature, given that there is a paucity of research: (1) examining the relationship between the level of impairment/symptom severity and QoL, (2) comparing mental health indicators rather than disorders, and (3) examining QoL at the domain-specific as opposed to overall level. To address these gaps, the present study examined the association between the severity level of various mental state indicators (i.e., depressive symptoms, anxiety, hyperactivity/distractibility, positive symptoms, and anhedonia) and domain-specific QoL, among a sample of children and youth referred for mental health care. On the basis of previous literature, it was predicted that depressive symptoms would be significantly associated with the greatest number of QoL sub-domains. However, analyses examining the predictive effect of the remaining mental state indicators were exploratory by nature since this is the first study,

TABLE 1 | Selected characteristics of sample population.

Characteristic	% of Sample
Marital status of parents	
Never married	18.8%
Married	49.7%
Partner or significant other	3.2%
Separated	9.8%
Divorced	12.1%
Marital status unknown	6.1%
Guardianship	
Both parents	59.7%
Mother only	24.8%
Father only	2.9%
Neither parent, but other relative(s) or non-relative(s)	8.6%
Child protection agency	3.7%
History of foster family placement	
None	80.6%
One foster family	10.4%
Multiple foster families	9.0%
Top diagnoses	
Attention deficit hyperactivity disorder	58.8%
Anxiety disorders	38.6%
Disruptive behavior disorder	29.4%
Learning or communication disorder	25.6%
Autism spectrum disorder	15.3%

to our knowledge, to include such a breadth of clinical factors in the same multivariate model.

METHOD

Sample

A convenience sample of 347 clinically referred English-speaking children and youth who have accessed services from a tertiary center for young persons with complex needs (including autism, developmental disabilities, and mental health) in the province of Ontario over a 3-year period participated in this study. All children and youth were referred for services through their family physicians, pediatricians, school personnel, or other allied health care professionals.

The interRAI Child and Youth Mental Health Assessment (ChYMH) (38) and QoL-ChYMH (13) were administered as part of typical clinical practice to each child or youth upon accessing mental health services at the supporting agency. Both males (72.3%) and females (27.7%) ranging in age from 7 to 18 years old ($M = 10.89$, $SD = 2.76$) were included in this study. Inpatient (25.9%) and outpatient (74.1%) children and youth were included in the current study. Additional selected characteristics of the sample population are included in **Table 1**.

Procedure

Trained child and youth mental health care service providers (e.g., social workers, child and youth workers, psychologists, psychiatrists, occupational therapists) who completed ChYMH assessments had a diploma or degree in the mental health field, at least 2 years of experience with children and youth, and completed a 2.5-day training program with respect to the administration of the interRAI ChYMH. Completion of the ChYMH assessment took ∼60–90 min depending on case complexity. All possible sources were utilized to complete the assessment including information from child/youth and family, medical records, school records, and other collateral documents.

The child or youth accessing mental health services completed the QoL-ChYMH at the same time the assessor completed the ChYMH assessment. The survey takes about 15 min to complete and is suitable for children and youth with a literacy level of grade 2. While there are three versions of the QoL-ChYMH available (i.e., Pre-Service, Post-Service Outpatient, and Post-Service Inpatient), this study only used the Pre-Service version.

All data was gathered over a three-year period. Items from the interRAI ChYMH and QoL-ChYMH were included in the current study to investigate the relationship between mental state indicators and QoL in children and adolescents. Assessment information was recorded utilizing a secure online software system that required the entered responses to conform to acceptable values, and subsequently signed as complete.

The present study was approved by Western University's Ethics Board. The data obtained from participants was stored on the interRAI Canada secure server at a partner university. No personal identifiers were obtained or stored on this secure server since each participant is assigned a study-specific participant ID number.

Measures

Self-Reported Quality of Life for Children and Youth Mental Health

The QoL-ChYMH (13) is a self-report survey that assesses the subjective well-being and satisfaction of children and youth 7–18 years, who are receiving services from mental health agencies, hospitals, crisis units, schools, youth justice facilities, and other community services. The 33-item questionnaire was developed based on protective factors and indicators of positive mental health well-established in the literature. The structure of the QoL instrument is composed of four major domains: (1) basic needs (living conditions, food, safety/privacy); (2) social (friends and activities, respect from others, family); (3) individual (autonomy, health); and (4) services (school, treatment). Children and youth are asked to rate how true each statement is for them based on a three-point scale. The QoL-ChYMH has been recommended as "Leading Practice" by Accreditation Canada.

interRAI Child and Youth Mental Health Instrument

The interRAI ChYMH (38) is a comprehensive mental health needs assessment. It is comprised of approximately 400 clinical elements that are used to assess medical, psychological, functional, social, and environmental issues for children between 4 and 18 years of age. The instrument is based on a clinician-rated, semi-structured interview format, and completed using all available sources of information, such as direct contact with the child/youth and the family, other service providers (e.g., educators and healthcare professionals), and reviewing previous records (e.g., school records and assessment reports). A number of scales and algorithms are embedded in the instrument that can be used for various applications, including outcome measurement, care planning, resource allocation, and quality improvement. Furthermore, the ChYMH also contains collaborative action plans (CAPs), which are evidence-informed care planning guidelines that can be used to support clinical decision-making (39). These CAPs are triggered based on areas of risk identified through the assessment [e.g., (40)].

Rigorous reliability and validity studies have demonstrated strong psychometric properties across the family of assessment tools targeting various populations, including adults (41–46), as well as children and youth (47–60). For example, one study examined the inter-item reliability of a number of the scales embedded in the ChYMH and several other tools within the interRAI child/youth suite, such as the Anxiety Scale, Aggressive/Disruptive Behavior Scale, Peer Conflict Scale, and Caregiver Distress Scale. The results showed that the scales had strong internal consistency with Cronbach's alpha higher than 0.70 (57).

Instrument Domains From the QoL-ChYMH

Domain-specific QoL was measured using the QoL-ChYMH, which measures the level of endorsement by the child or youth on a number of items related to the four QoL sub-domains (i.e., basic needs, social, individual, and services). Examples of these items include, "I have choices in how to spend my time", "I have enough to eat", and "I get along with other kids". Each item is rated on a scale from 0 to 2 (0 = *Never true*, 1 = *Sometimes true*, and 2 = *Very or often true*). Four domain-specific scores were calculated for each child or youth by summing the number of items on the QoL-ChYMH pertaining to each of the four domains. The four scores reflect quality of life in relation to basic needs (eight items, scores range from 0 to 16), social (13 items, scores range from 0 to 26), individual (seven items, scores range from 0 to 14), and services (five items, scores range from 0 to 10). Higher scores are indicative of higher quality of life within that domain. Raw scores were converted to z-scores for the purpose of comparative analyses.

Scales Obtained From the interRAI ChYMH

Depressive Symptoms

Depressive symptoms were measured using the Depressive Severity Index (DSI) (50), which measures the frequency and severity of indicators of depression, such as self-deprecation, negative statements, feelings of hopelessness, and sad facial expressions. DSI scores were determined by summing five items, which were rated on a scale from 0 to 4 (0 = *Not present*, to 4 = *Exhibited daily in last 3 days, 3 or more episodes or continuously*). Scores of "4" were subsequently recoded to "3"; thus, scores on the DSI range from 0 to 15 where higher scores are indicative of more severe depressive symptoms. The scale was found to have acceptable reliability, $r = 0.78$.

Anxiety Symptoms

Anxiety symptoms were measured using the Anxiety Scale (55), which measures the frequency of the symptoms of anxiety, such as episodes of panic, unrealistic fears, obsessive thoughts, and nightmares. Anxiety scores were determined by summing seven items, which were rated on a scale from 0 to 4 (0 = *Not present*, to 4 = *Exhibited daily in last 3 days, 3 or more episodes or continuously*). Scores on the Anxiety Scale range from 0 to 28 where higher scores are indicative of more severe anxiety symptoms. The scale was found to have acceptable reliability, $r = 0.68$.

Hyperactivity and Distractibility

Hyperactive and distractive behavior was measured using the Hyperactivity-Distractibility Scale (47), which calculates the frequency of hyperactivity and distractibility, such as having difficulty paying attention, having an excessive level of activity, and being impulsive. Hyperactivity and distractibility scores were determined by summing four items rated on a scale from 0 to 4 (0 = *Not present*, to 4 = *Exhibited daily in last 3 days, 3 or more episodes or continuously*). Scores on the Hyperactivity-Distractibility Scale range from 0 to 16 where higher scores indicate greater frequency and diversity of disruptive behaviors. The scale was found to have acceptable reliability, $r = 0.76$.

Positive Symptoms

Positive symptoms were measured using the Positive Symptoms Scale (61), which calculates the frequency of positive symptoms of psychosis, such as abnormal thought processes, delusions, and hallucinations. Positive symptoms scores were determined by summing four items rated on a scale from 0 to 4 (0 = *Not present*, to 4 = *Exhibited daily in last 3 days, 3 or more episodes or continuously*). Scores of "4" were subsequently recoded to "3"; thus, scores on the Positive Symptoms Scale range from 0 to 12 where higher scores indicate higher levels of positive symptoms. The scale was found to have acceptable reliability, $r = 0.73$.

Anhedonia Symptoms

Anhedonia symptoms were measured using the Social Disengagement Scale (57), which assesses the frequency of symptoms related to anhedonia, such as lack of motivation, lack of interest in social interaction, and expressions of a lack of pleasure in life. Anhedonia scores were determined by summing four items rated on a scale from 0 to 4 (0 = *Not present*, to 4 = *Exhibited daily in last 3 days, 3 or more episodes or continuously*). Scores on the Social Disengagement Scale range from 0 to 16 where higher scores indicate higher levels of anhedonia. The scale was found to have acceptable reliability, $r = 0.66$.

Plan for Analysis

First, frequency and descriptive analyses were conducted for all variables. Second, Spearman's correlation and Mann–Whitney *U* tests were conducted, as appropriate, to assess bivariate relationships between each predictor or control variable and domain-specific QoL. Next, the association between each domain of quality of life (basic needs, social, individual, and services), and predictor variables (depressive symptoms, anxiety, hyperactivity/distractibility, positive symptoms, and anhedonia–controlling for age, sex, and patient status) was examined using hierarchical stepwise multiple linear regression analyses. The first step in each of the analyses included the controlled variables- sex, age, and patient status. The second step included the predictor variables of interest, namely the five mental state indicators- depressive symptoms, anxiety, hyperactivity/distractibility, positive symptoms, and anhedonia. Assumptions testing were conducted for each analysis to control for threats to statistical conclusions, and all analyses were performed using SPSS Statistics Version 25 software (SPSS Inc., Chicago, IL, USA).

Prior to running the analyses, several univariate outliers were detected for each of the five dependent variables ($-3.29 > z > 3.29$, $p < 0.001$). These outliers were subsequently trimmed to z-scores within the acceptable range, and analyses were run with both the original and adjusted data. The outcomes showed no differences, and so it was decided to report results of the analyses including outliers. Furthermore, not all variables were normally distributed; however, bootstrapping did not improve normality, and so the original distributions were used.

RESULTS

Preliminary Analyses

The average scores for all dependent and predictor variables are summarized in **Table 2**. Mann–Whitney *U* tests were employed to examine sex differences in domain-specific QoL. These tests revealed no statistically significant differences between males and females, except on the individual QoL sub-domain, $U(293) = 10{,}125.50$, $p = 0.012$. Here, males reported significantly higher individual QoL scores compared to females. Spearman's *r* was employed to examine the bivariate relationship between age and QoL; no significant correlations between age and basic needs, social, and services QoL were found. However, a significant negative correlation was found between age and individual QoL ($r_s = -0.169$, $p = 0.004$). Finally, Mann–Whitney *U* tests were also used to examine differences in QoL scores based on patient status, namely inpatient and outpatient. Here, no differences were found between inpatients and outpatients for the individual or services QoL sub-domains; however, statistically significant differences were found for basic needs [$U(335) = 8{,}875.00$, $p = 0.036$], and social [$U(321) = 8{,}361.50$, $p = 0.037$] QoL sub-domains. More specifically, outpatients reported significantly higher QoL scores pertaining to their basic needs (i.e., food and safety) and social relationships (i.e., friends and family) compared to inpatients.

Primary Analyses

All of the following regression analyses were conducted after controlling for age, sex, and patient status, and included the same five predictor variables, namely depressive symptoms, anxiety symptoms, anhedonia, hyperactivity/distractibility, and positive symptoms. Four hierarchical stepwise multiple linear regression analyses were performed to predict domain-specific QoL, namely basic needs, social, individual, and services. In the regression analysis for basic needs QoL, depressive symptoms was the only factor that made a significant contribution, and thus was included in the final model. Specifically, higher levels of depressive symptoms were found to be associated with lower self-reported basic needs QoL ($\beta = -0.143$, $t = -2.509$, $p = 0.013$), suggesting that children and youth who experienced heightened depressive symptoms reported less satisfaction with their living conditions, food, and safety/privacy. The final model explained 2.9% of the variance ($p = 0.011$). **Table 3** presents the results for the model including the regression coefficients, t-statistics, *p*-values, 95% confidence intervals, and R-squared values (i.e., model fit).

TABLE 2 | Summary of mean scores for dependent and predictor variables.

Variables	*M (SD)*
Quality of Life	
Basic needs	13.36 (2.39)
Social	19.44 (4.05)
Individual	9.88 (2.87)
Services	7.06 (2.19)
Mental state indicators	
Depressive severity index	6.05 (4.05)
Anxiety scale	7.50 (5.32)
Hyperactivity-distractibility scale	10.42 (4.63)
Social disengagement scale	3.51 (3.55)
Positive symptoms scale	0.90 (1.93)

In the regression analysis for social QoL, anhedonia and depressive symptoms both made a significant contribution, and thus were included in the final model. Specifically, higher levels of anhedonia ($\beta = -0.145$, $t = -2.274$, $p = 0.024$) and depressive symptoms ($\beta = -0.122$, $t = -2.006$, $p = 0.046$) were associated with lower self-reported social QoL. This suggests that children and youth who experienced heightened anhedonia and depressive symptoms reported less satisfaction in their relationships with friends and family, in their extra-curricular activities, and generally felt that others did not respect them as much. The final model explained 5.6% of the variance ($p = 0.001$). **Table 4** presents the results for the model including the regression coefficients, *t*-statistics, *p*-values, 95% confidence intervals, and R-squared values (i.e., model fit).

In the regression analysis for individual QoL, depressive symptoms was again the only factor that made a significant contribution, and thus was included in the final model. Specifically, higher levels of depressive symptoms were found to be associated with lower self-reported individual QoL ($\beta = -0.302$, $t = -5.240$, $p = 0.000$), indicating that children and youth who experienced heightened depressive symptoms reported less satisfaction with their autonomy and general health. The final model explained 13.9% of the variance ($p = 0.000$). **Table 5** presents the results for the model including

TABLE 3 | Regression analysis: basic needs quality of life.

Model	*B (SE)*	*β*	*t*	*p*	*95% CI for B*	R^2	ΔR^2	*p*
Step 1						0.012	0.022	0.081
Sex	−0.020 (0.126)	−0.009	−0.156	−0.876	[−0.267, 0.228]			
Age	0.029 (0.020)	0.083	1.444	0.150	[−0.011, 0.070]			
Patient status	−0.316 (0.135)	−0.134	−2.337	−0.020	[−0.583, −0.050]			
Step 2						0.029	0.020	0.011
Sex	−0.026 (0.125)	−0.012	−0.209	0.835	[−0.272, 0.220]			
Age	0.033 (0.020)	0.092	1.608	0.109	[−0.007, 0.073]			
Patient status	−0.273 (0.135)	−0.116	−2.017	0.045	[−0.539, −0.007]			
Depressive symptoms	−0.036 (0.014)	−0.143	−2.509	0.013	[−0.065, −0.008]			

TABLE 4 | Regression analysis: social quality of life.

Model	*B (SE)*	*β*	*t*	*p*	*95% CI for B*	R^2	ΔR^2	*p*
Step 1						0.017	0.027	0.046
Sex	0.129 (0.122)	0.062	1.054	0.293	[−0.112, 0.369]			
Age	−0.036 (0.020)	−0.107	−1.801	0.073	[−0.075, 0.003]			
Patient status	−0.201 (0.132)	−0.090	−1.527	0.128	[−0.460, 0.058]			
Step 2						0.046	0.031	0.002
Sex	0.110 (0.120)	0.053	0.916	0.361	[−0.127, 0.347]			
Age	−0.016 (0.021)	−0.049	−0.795	0.427	[−0.057, 0.024]			
Patient status	−0.223 (0.130)	−0.100	−1.716	0.087	[−0.479, 0.033]			
Anhedonia	−0.051 (0.016)	−0.186	−3.082	0.002	[−0.083, −0.018]			
Step 3						0.056	0.013	0.001
Sex	0.107 (0.120)	0.051	0.892	0.373	[−0.129, 0.343]			
Age	−0.018 (0.021)	−0.054	−0.889	0.375	[−0.059, 0.022]			
Patient status	−0.187 (0.131)	−0.084	−1.435	0.152	[−0.444, 0.070]			
Anhedonia	−0.039 (0.017)	−0.145	−2.274	0.024	[−0.073, −0.005]			
Depressive symptoms	−0.030 (0.015)	−0.122	−2.006	0.046	[−0.059, −0.001]			

the regression coefficients, *t*-statistics, *p*-values, 95% confidence intervals, and R-squared values (i.e., model fit).

Lastly, in the regression analysis for services QoL, none of the factors made a significant contribution, and so no mental state indicators were included in the final model. **Table 6** presents the results for the model including the regression coefficients, *t*-statistics, *p*-values, 95% confidence intervals, and R-squared values (i.e., model fit).

DISCUSSION

While the effect of mental health conditions on QoL has been examined extensively in adult populations, research exploring the relationship between mental health and QoL in pediatric populations is largely lacking. The present study addressed this gap in the literature by examining the association between numerous mental state indicators, namely depressive symptoms, anxiety symptoms, anhedonia, hyperactivity/distractibility, and positive symptoms, and self-reported QoL in children and youth receiving mental health services.

Despite the paucity of extant research examining the relationship between mental health issues and QoL, findings reported herein are consistent with results from the PedsQL, which assessed self-reported QoL in youth with psychiatric disorders. Specifically, the average overall QoL score in the present study was 75.3% compared to 73.3% in the prior study (62). Similar to previous literature, the present study found relatively weak or non-existent relationships between demographic variables and QoL. For example, both sex and age were only weakly correlated with QoL, as no significant differences were found except in the area of individual QoL. Here, males and younger children reported higher QoL scores in this sub-domain than females and older children. Consistent with previous research, boys often report higher QoL compared to girls (particularly within the psychological and physical QoL domains) (63), and younger children (i.e., ages 8–11 years-old) report higher QoL compared to older children (i.e., ages 12–18 years-old) (64).

With respect to the association between patient status (i.e., inpatient vs. outpatient) and QoL, the current study found a significant relationship between patient status and two of the four QoL sub-domains. More specifically, inpatients reported lower social and basic needs QoL compared to outpatients. Of note, because the present study used the pre-service version of

TABLE 5 | Regression analysis: individual quality of life.

Model	*B (SE)*	β	*t*	*p*	*95% CI for B*	R^2	ΔR^2	*p*
Step 1						0.051	0.062	0.001
Sex	0.301 (0.129)	0.141	2.329	0.021	[0.046, 0.555]			
Age	−0.064 (0.021)	−0.187	−3.065	0.002	[−0.105, −0.023]			
Patient status	−0.063 (0.135)	−0.028	−0.467	0.641	[−0.328, 0.202]			
Step 2						0.139	0.090	0.000
Sex	0.268 (0.123)	0.126	2.181	0.030	[0.026, 0.511]			
Age	−0.063 (0.020)	−0.184	−3.167	0.002	[−0.102, −0.024]			
Patient status	−0.003 (0.129)	−0.001	−0.022	0.982	[−0.256, 0.251]			
Depressive symptoms	−0.075 (0.014)	−0.302	−5.240	0.000	[−0.103, −0.047]			

TABLE 6 | Regression analysis: services quality of life.

Model	*B (SE)*	β	*t*	*p*	*95% CI for B*	R^2	ΔR^2	*p*
Step 1						0.013	0.025	0.110
Sex	−0.177 (0.141)	−0.081	−1.257	0.210	[−0.454, 0.100]			
Age	0.009 (0.022)	0.026	0.410	0.682	[−0.034, 0.053]			
Patient status	0.302 (0.148)	0.131	2.045	0.042	[0.011, 0.592]			

the QoL-ChYMH, the inpatient clients are reporting on their home living situation, not their stay in residence. Thus, it can be postulated that certain family factors (e.g., level of family complexity) that are known to influence QoL may contribute to a child/youth requiring inpatient as opposed to outpatient services. This is consistent with a study conducted by Stewart and colleagues (65) that found youth were more likely to be readmitted to inpatient psychiatry if they had a dysfunctional relationship with their family members.

As predicted, depressive symptoms were significantly associated with the greatest number of QoL sub-domains. Specifically, higher depressive symptoms and anhedonia were associated with lower social QoL, and higher depressive symptoms alone were associated with lower individual and basic needs QoL; no mental state indicators were predictive of QoL pertaining to services

This suggests that across all outcome variables, depressive symptoms and anhedonia were the only mental state indicators predictive of a lower QoL, which both fall under the umbrella of internalizing symptoms. Weitkamp et al. (66) similarly found that internalizing, as opposed to externalizing symptoms, predicted lower self-reported QoL. In particular, they found that there was a relationship between higher internalizing symptoms and lower QoL within the psychological and social sub-domains. This supports the present study's findings (as their psychological domain may be likened to our individual domain), with depressive symptoms predicting lower individual QoL and anhedonia and depressive symptoms predicting lower social QoL. Taken altogether, the results of both the present study and prior research (66) indicate that certain mental state indicators have an effect on particular QoL domains, but not a generalized effect across all QoL domains. This underscores the importance of continuing to consider various sub-domains when researching QoL, in order to differentiate the impact of certain determinants on specific areas of QoL.

As previously noted, depressive symptoms was the only predictor of lower QoL on the individual sub-domain. While different QoL measures have varying sub-domains, there is some overlap between the emotional functioning sub-domain of other QoL tools and the individual sub-domain of the interRAI QoL-ChYMH (which includes items such as "I feel good about myself") (13). Bastiaansen and colleagues (67) also found higher depressive symptoms were related to lower emotional functioning. Depressive symptoms were also the only predictor of lower QoL on the basic needs sub-domain, representing a decrease in satisfaction with, for example, safety and food. Similarly, others have found that children from families in disadvantaged social classes had slightly lower HR-QOL compared to children from families in more advantaged social ones (68).

While depressive symptoms were significantly correlated to QoL at both the bivariate and multivariate level, anxiety symptoms were only associated with QoL at the bivariate level. Hence, when the relationship between anxiety and QoL is examined singularly, a significant relationship exists; however, this finding does not hold true when other clinical variables are entered into the analytic model. Similarly, Freire and Ferreira (69) examined the impact of various clinical factors, including stress, anxiety symptoms, and depressive symptoms, on domain-specific (i.e., psychological, physical, social, autonomy, and school) QoL in youth. Similar to the findings reported herein, depressive symptoms predicted the greatest number of QoL sub-domains, and anxiety symptoms did not predict domain-specific QoL in this multivariate model.

While depressive symptoms were also associated with social QoL at the multivariate level, anhedonia was the strongest predictor of this particular QoL domain. Interestingly, Barge-Schaapveld et al. (70) found that even after controlling for physical complaints, mood, and enjoyment of activities, depression continued to have a significant effect on QoL thereby indicating that other unmeasured aspects of depression have an effect on self-reported well-being, such as those related to anhedonia. Overall, the independent effects of anhedonia and mood-related depressive symptoms on QoL sub-domains were able to be teased apart in the present study because they were both included as distinct predictors in the same multivariate model.

Positive symptoms were not a significant predictor of QoL. Previous research conducted on patients with schizophrenia also found that negative, but not positive, symptoms are associated with HR-QOL and subjective QoL (71). Moreover, among individuals who are vulnerable to psychosis, negative symptoms are strongly associated with QoL and functioning ability; however, the same is not true for positive symptoms (72).

Finally, similar to anxiety and positive symptoms, the present study did not find a significant association between hyperactivity/distractibility and domain-specific QoL. Previous research (20) found ADHD to be associated with QoL when parental reports were used to measure QoL. However, there is a much weaker, and at times, non-existent relationship when the child or youth reports on their own QoL. This discordance may be due to the fact that children with ADHD may have an overly optimistic view of their situation, wish to conceal their problems, or rush through the survey due to their impulsive nature (20, 73). Moreover, some explanations for the discordance between parent-proxy and child self-reports of QoL in ADHD populations focus more so on the role of the parent. For example, parent bias could conflate the results (74). Studies have found that parents of children with ADHD tend to report increased marital conflict, parenting stress, depression, and alcohol consumption, potentially influencing perceptions of their own QoL that has been negatively impacted by their child's disorder (75–77). Consequently, future research needs to use self-report QoL measures in order to gain the perspective of the children and adolescents themselves.

Clinical Implications

Because of their significant clinical utility, interRAI QoL measures are increasingly being used within healthcare, including mental health research. On a broad level, interRAI QoL data can inform resource allocation within various health service sectors. On a more individual level, QoL measures can be used to monitor a patient's progression over time and assess the effectiveness of a particular intervention, or provide assistance in the diagnostic process by providing a window into the child or youth's perspective. This allows the clinician to gain insight into the areas of functioning the child or youth is struggling with most, which can subsequently inform care planning.

Anhedonia and depressive symptoms are two core symptoms of major depressive disorder (MDD), which has been described as a major public health problem due to its many negative effects, including disability, secondary morbidity, and high mortality (78). MDD is also correlated with a high economic cost, with annual direct and indirect costs totaling $43 billion (79). Taken altogether, these results point to the potential advantage of regularly screening for depressive and anhedonia symptoms in both preventative work and treatment planning, which could potentially improve individual QoL while also reducing the disorder's economic burden. Overall, domain-specific research can be utilized to achieve a better understanding of which domains of QoL are affected by specific psychopathologies, thereby allowing clinicians the ability to focus on those particular QoL domains during assessment, diagnosis, and treatment planning.

Limitations

While the current study has several notable strengths, including internationally-used assessment instruments, it also has a few limitations. First, due to the fact that both assessment tools (the ChYMH and QoL-ChYMH) were completed at a tertiary facility in the province of Ontario, participants of the study represent a convenience sample and were not randomly selected. Second, the findings may not be generalizable to a community-based sample since all of the children and youth assessed were receiving inpatient or outpatient mental health care from a tertiary facility. Finally, because of the cross-sectional nature of the data, the study is unable to draw any conclusions about causality and, consequently, the directionality of the findings cannot be determined.

Future Directions

There are many interesting avenues for future research that can build upon the present study. For example, one potential area for further investigation is to examine whether the current study's findings are generalizable to a community-based sample. Furthermore, longitudinal studies can be conducted to explore whether there are critical periods during which certain mental state indicators are more predictive of lower QoL; for example, depressive symptoms may be more predictive of QoL in adolescence compared to childhood. There is an important need to develop new knowledge regarding the mitigating factors impacting QoL during critical developmental periods as well as across the lifespan.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Western University's ethics review board (REB #106415, #112885). Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

All authors contributed to the formulation of the ideas presented in the study. AC and NL performed the statistical analysis. All authors were involved in the writing and reviewing of the final manuscript.

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ORIGINAL RESEARCH
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Following the Epidemic Waves: Child and Youth Mental Health Assessments in Ontario Through Multiple Pandemic Waves

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Emerging studies across the globe are reporting the impact of COVID-19 and its related virus containment measures, such as school closures and social distancing, on the mental health presentations and service utilization of children and youth during the early stages of lockdowns in their respective countries. However, there remains a need for studies which examine the impact of COVID-19 on children and youth's mental health needs and service utilization across multiple waves of the pandemic. The present study used data from 35,162 interRAI Child and Youth Mental Health (ChYMH) assessments across 53 participating mental health agencies in Ontario, Canada, to assess the mental health presentations and referral trends of children and youth across the first two waves of the COVID-19 pandemic in the province. Wave 1 consisted of data from March to June 2020, with Wave 2 consisting of data from September 2020 to January 2021. Data from each wave were compared to each other and to the equivalent period one year prior. While assessment volumes declined during both pandemic waves, during the second wave, child and youth assessments in low-income neighborhoods declined more than those within high-income neighborhoods. There were changes in family stressors noted in both waves. Notably, the proportion of children exposed to domestic violence and recent parental stressors increased in both waves of the pandemic, whereas there were decreases noted in the proportion of parents expressing feelings of distress, anger, or depression and reporting recent family involvement with child protection services. When comparing the two waves, while depressive symptoms and recent self-injurious attempts were more prevalent in the second wave of the pandemic when compared to the first, a decrease was noted in the prevalence of disruptive/aggressive behaviors and risk of injury to others from Wave 1 to Wave 2. These findings highlight the multifaceted impact of multiple pandemic waves on children and youth's mental health needs and underscore the need for future research into factors impacting children and youth's access to mental health agencies during this time.

Keywords: COVID-19, child and youth, mental health, interRAI, assessment, referrals, school closures

INTRODUCTION

Many children and families across the globe are now entering their second year of living in a pandemic (1) since the novel coronavirus (COVID-19) was first declared a pandemic by the World Health Organization (WHO) in March of 2020 (2). According to the WHO, even prior to the onset of this pandemic, an estimated 10–20% of children and youth were struggling with mental health problems globally (3), with self-harm being the third leading cause of death for adolescents in 2015 (4). Not only is the estimated prevalence of mental health disorders amongst children and youth on the higher end of this global estimate in Ontario, Canada, but an alarming number of these children and youth did not have their needs adequately met prior to the pandemic (5, 6). While an emerging body of cross-sectional studies globally are currently focusing on the mental health presentations of children and youth during periods of lockdown (7, 8), less attention has been afforded to referral and service utilization trends of service-seeking children and youth, which may constitute a particularly vulnerable group during this time.

School and non-essential service (e.g., childcare facilities, playgrounds, and recreational spaces) closures and limited in-person access to primary care and mental health settings during periods of government lockdowns, alongside widespread social distancing requirements, are expected to not only exacerbate mental health problems amongst a significant proportion of children and youth, but also potentially impact their access to timely mental health services (9–12). In Ontario, professionals in schools, childcare settings, and primary care settings are often involved in the identification of children and youth's mental health needs and subsequentially, providing the appropriate referrals to community mental health agencies (12). As a result of in-person closures of these settings, it is anticipated that many children and youth have been unable to access the appropriate mental health services during periods of government lockdown (12). However, there remains limited empirical data examining the anticipated changes in children's mental health assessments during the pandemic in Canada (13).

Impact of School Closures on Child and Youth Mental Health

Considering that children and youth spend the majority of their time in school, or engaging in school-related activities, school closures have arguably had the greatest impact on their daily lives during this time (14). In addition to opportunities for academic growth, schools also provide children with needed structure and supports that, when disrupted, can impair sleeping patterns, reduce opportunities for physical activities, and limit the restriction of excessive caloric intake and leisure screen use (15), all of which are factors associated with children and youth's mental health and well-being (16–18). Disrupted routines and lack of structure themselves can also be extremely stressful for children and youth with neurodevelopmental disorders that are hypersensitive to changes (14, 19, 20) and for those with behavioral and emotional difficulties that rely on well-structured routines to help effectively cope with daily stressors and symptoms (14, 19).

Schools in North America also provide a continuum of mental health services to children (21). Schools can provide direct mental health services to children (6, 21) and some children rely solely on school-based mental health services to meet their needs, with a greater proportion of these children likely residing in low-income neighborhoods (22, 23). Moreover, some children may also be confined in unsafe homes where they are experiencing child abuse, maltreatment and/or neglect, including child exposure to domestic violence, without the support of a larger circle of adults (e.g., teachers, mental health professionals, and extended family and friends) that could potentially identify signs of abuse, intervene, and/or provide referrals to child welfare agencies (11, 14, 24).

On the other hand, for a subset of children, school closures can also have a positive impact on mental health outcomes. Considering that children and youth are now spending the majority of their time with family, their well-being during this time may be largely dependent on family functioning and their caregiver's abilities to help them effectively manage distressing feelings and emotions that might arise during the pandemic (11, 25). While for some children and youth, increased caregiver burden, distress, and conflict during this time might increase their own distress and inability to cope with pandemic-related stressors, others might benefit from the increased quality time with responsive caregivers that are able to adequately buffer some of their distress (11, 25). Additionally, school closures themselves might also result in temporary alleviation of school-related pressures such as social and performance anxiety (11, 26, 27), as well as a potential reduction stressors such as bullying (28).

Impact of the Pandemic on Pediatric Mental Health Referrals and Related Admissions

Emerging studies globally are reporting a general decrease in pediatric mental health presentations to emergency departments and related hospital admissions and referrals to secondary mental health agencies amongst their samples during the early stages of the lockdown, when compared to either the months leading up to the pandemic or year prior as the pre-pandemic time frame (29–38). This is echoed in Ontario, Canada, where child and youth referrals to select mental health agencies dropped, on average, 38% during the first eight months of the pandemic when compared to the same months pre-pandemic (13). With Ontario currently experiencing its third wave, it remains unclear how the uncertainty and instability of the province moving in and out of lockdown is impacting service utilization and mental health presentations within this vulnerable population throughout the multiple waves. Moreover, although Ontario initially saw a reduction in emergency department visits and admissions related to self-harm for youth during the first wave (39), recent media stories highlight concerns for a rise in mental health related pediatric admissions and hospitalizations, specifically those related to self-harm, as the pandemic progresses into additional waves (40, 41). Therefore, more information is needed regarding the mental health presentations and service utilization of children and youth during multiple waves of the pandemic period.

Current Study

The primary aim of this study was to examine how the volume of assessed children and youth within select mental health agencies in the Province of Ontario, Canada, changed during the distinct pandemic waves, which also correspond to a large degree with in-school learning closure. Using scales and algorithms drawn from standard care assessments within these agencies, we also sought to identify any significant changes in child and youth mental health presentations that occurred during the pandemic in order to identify some of the potential changes in the child and youth mental health system demands during an extraordinary period of societal crisis and uncertainty. A secondary aim of this investigation, extending upon the findings of our previous study (13), was to examine how more vulnerable communities, specifically families living within low-income neighborhoods, might be differentially impacted throughout the multiple waves (42, 43).

To address our research aims, we compared mental health presentations of treatment-seeking children and youth within the Province of Ontario across four timeframes: Wave 1, Wave 2, pre-pandemic comparison for Wave 1, and pre-pandemic comparison for Wave 2. We also utilized area-based measures of income to examine the associations between socioeconomic status and pandemic-related changes in the mental health presentations of children within more vulnerable communities that might be disproportionately impacted by pandemic-related stressors (42, 43).

Since schools play a critical direct and indirect role in the mental health needs and referrals of children, school closure timelines in Ontario were carefully considered in the determination of wave boundaries and the interpretation of our findings. While all students in Ontario were learning remotely from March 2020 to June 2020 (44), in September, all students had the option to resume in-person learning until January 2021 (45). During this time period, elementary schools re-opened full-time and secondary schools re-opened on a part-time capacity only (45). In January 2021, majority of students had to return to online learning due to rising cases of COVID-19 in the province, except in seven regions in Ontario (46).

While we anticipated an overall decline in referrals during the pandemic, we anticipated that this decline would be greater during periods of complete closure of in-person classes during the first wave, as compared to periods where students had the option of returning to school in-person during the second wave. Moreover, we anticipated that children and youth in low-income neighborhoods would experience the greatest decline in assessments overall.

MATERIALS AND METHODS

Procedure

Data used for this study were drawn from assessments conducted as part of standard clinical practice at 53 mental health agencies in Ontario. These agencies assess individuals using the interRAI Child and Youth Mental Health (ChYMH) (47) full assessment, the interRAI Child and Youth Mental Health and Developmental Disabilities (ChYMH-DD) (48), or the interRAI ChYMH Screener (ChYMH-S) (49), described in greater detail below. As part of voluntary implementation of these assessments in the province, these agencies, representing ∼70% of such agencies across Ontario, receive comprehensive training on how to administer and score these instruments and access to secure online software for recording of assessment responses. Although some clinicians might utilize the items on the ChYMH (45) as a part of their diagnostic decision-making, the interRAI ChYMH (45) is a needs-based, rather than diagnostic, assessment system that can be administered by a variety of mental health professionals working with children and youth (e.g., social workers, nurses, psychologists, or physicians) to support their data collection, care formulation, and subsequent care planning. Children and youth can be referred to these agencies through school settings, other professionals providing care to children and families (e.g., healthcare providers, children's aid societies, daycare settings, community centers), and self-referrals. These community-based agencies are funded by the provincial government and do not charge fees for their services.

Data used for this study comprised of all assessment records completed between March 1, 2019 and January 31, 2021 among agencies that conducted assessments throughout the time period examined in this study. These assessment events represent the flow of clinical cases through the agencies, and no additional exclusion criteria were applied in assembling the analytic dataset used in these analyses. Assessment licensing and data sharing agreements allow for the de-identified data to be uploaded onto interRAI's online data server that can be accessed by interRAI fellows for research purposes. InterRAI represents a collaborative network of researchers and practitioners. Both the first and last authors on this investigation are interRAI fellows (see interRAI.org). The Western University Research Ethics Board granted approval for all secondary analyses conducted in this investigation.

Further, we classified periods during the COVID-19 pandemic into two distinct waves: Wave 1 comprised the months of March through June 2020, and Wave 2 the months of September 2020 through January 2021. Boundaries of the waves are similar to other Ontario-based investigations (50, 51), with Wave 1 ending on June 30 and Wave 2 beginning on September 1, avoiding the months of July and August when COVID-19 cases were low (52) and the majority of students would not regularly attend school regardless of the pandemic. These boundaries also allowed for similarity of timeframes (i.e., comparing frames of four months and five months). Assessments completed during these two waves were compared with the equivalent periods 12 months earlier, and with each other, totaling to 35,162 assessments.

Analytical Plan

Analytic measures were taken directly from these assessment instruments, along with computed scales and algorithms described below. Chi-square tests were used for significance testing between pandemic waves and the equivalent period one year earlier, as well as those comparing Wave 1 and Wave 2, with a significance level of 0.05. SAS, Version 9.4 for Windows was utilized to conduct all the statistical analyses for this paper.

In addition, we used the first three digits of the child/youth's postal code (Forward Sortation Area, FSA) to link to public files of the 2016 Canadian census to inform neighborhood median household income for each FSA (53). Each FSA represents one of the 513 geographic areas in Ontario, designed for the administration of the postal system. We subsequently assigned these median incomes into quartiles. The national statistics agency compiles this information based on the total net income, after taxes, of related individuals residing in the same dwelling, and then calculates the median value within each FSA. Income Quartile 1 represents children living in neighborhoods with a median household income that falls within the lowest 25% of income in Ontario and income Quartile 4 represents children living in neighborhoods with a median household income that falls within the highest 25% incomes in Ontario (53).

All assessments were classified as being either a first assessment (of any kind) for the client by the agency, or a subsequent assessment. We chose to adjust for age, sex, neighborhood income, and whether a client was being assessed for the first time by an agency when comparing the pandemic period with the period one year prior. All assessments used in the analysis were assigned an adjusted weight, based on the inverse of the proportion in the pre-pandemic vs. pandemic periods, using the combination of these four measures. For example, if the proportion of males ages seven and under in Income Quartile 1 and new to the agency was 1.0% in the comparable pre-pandemic period, and 0.5% in the pandemic period, the pre-pandemic cases used a weight of one and the pandemic period cases used a weight of two to adjust for the decreased likelihood of selection of that type of case in the pandemic period.

Resulting *p*-values for all chi-square tests are presented without adjustment for multiple testing in the **Supplementary Table 1**. With many of the tested characteristics being correlated with each, other such adjustments may be too conservative. While standard 0.05 levels are used to denote significance it is recognized that there is a risk of results with *p*-values just below this threshold of having lower confidence.

Assessment Tools

InterRAI Child and Youth Mental Health Assessment

The interRAI ChYMH (47) is a 400-item tool used in child and youth populations to obtain a data-driven picture of the individual's various mental health needs. Trained assessors complete this comprehensive assessment by consulting with multiple sources of information including the child or youth, caregivers, teachers, clinicians, and available medical and education records. The interRAI ChYMH is part of an integrated health information assessment system in which psychometrically sound scales and algorithms are embedded within the instrument to support clinicians in identifying the child's strengths and areas of risk and inform care planning (54–65).

InterRAI Child and Youth Mental Health and Developmental Disabilities Assessment

Similar to the ChYMH, the interRAI ChYMH-DD (48) provides a comprehensive, standardized, and empirically-supported mental health measure to support comprehensive care planning (66, 67), outcome measurement (62, 68); quality indicators (69) and case-mix classification (70) to estimate relative resource intensity (48, 65, 70). However, this measure is specifically intended for use with children and youth with developmental disabilities (48).

InterRAI Child and Youth Mental Health Screener

The interRAI ChYMH-S (49) is a short, 99-item assessment which complements the ChYMH full assessment and takes ∼15 min to administer. The instrument aids assessors by assisting in decisions related to triaging, placement, and service utilization (71). It provides a brief snapshot of the child's level of functioning and assists clinicians to ascertain acuity levels, as well as in determining whether a more comprehensive assessment is needed (49, 72, 73).

Scales and Algorithms

Risk of Suicide and Self-Harm in Kids (RiSsK)

The RiSsK algorithm is an empirically-supported decision making tool assessing the child's attempt to kill self, self-harm without attempt to kill, consideration of self-injury, others concerned about self-injury, family feeling overwhelmed, and any self-injurious behaviors (61). With a range of 0 to 6 and higher values denoting higher risk (61), this scale was dichotomized as 0 vs. 1 to 6.

Risk of Injury to Others (RIO)

The RIO is an empirically-support decision making tool which measures risk of harm to others in clinically-referred children and youth populations. The algorithm assesses violent ideation, threatened violence, violence to others, verbal abuse, socially inappropriate or disruptive behavior, family overwhelmed, impulsivity, and physical abuse[1]. With a range of 0 to 6 and higher values denoting higher risk[1], this scale was dichotomized as 0 vs. 1 to 6.

Disruptive/Aggression Behavior Scale (DABS)

The frequency and severity of aggressive and disruptive behavior is assessed using the DABS. Items include physical abuse, verbal abuse, socially inappropriate or disruptive behavior, destructive behavior toward property, and outbursts of anger (54). With a range of 0 to 20 and higher values denoting greater severity of behaviors (54), this scale was dichotomized as 0 to 3 vs. 4 to 20.

The Depression Severity Index (DSI)

The DSI measures depressive symptoms in child populations including sad or pained facial expressions, making negative statements, self-deprecation, guilt/shame, and hopelessness (57, 74). With a range of 0 to 15 and higher values denoting greater

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[1] Stewart SL, Celebre A, Hirdes JP, Poss JW. Risk of injury to others: the development of an algorithm to identify youth at high-risk of violence perpetration within the mental health system. (under review).

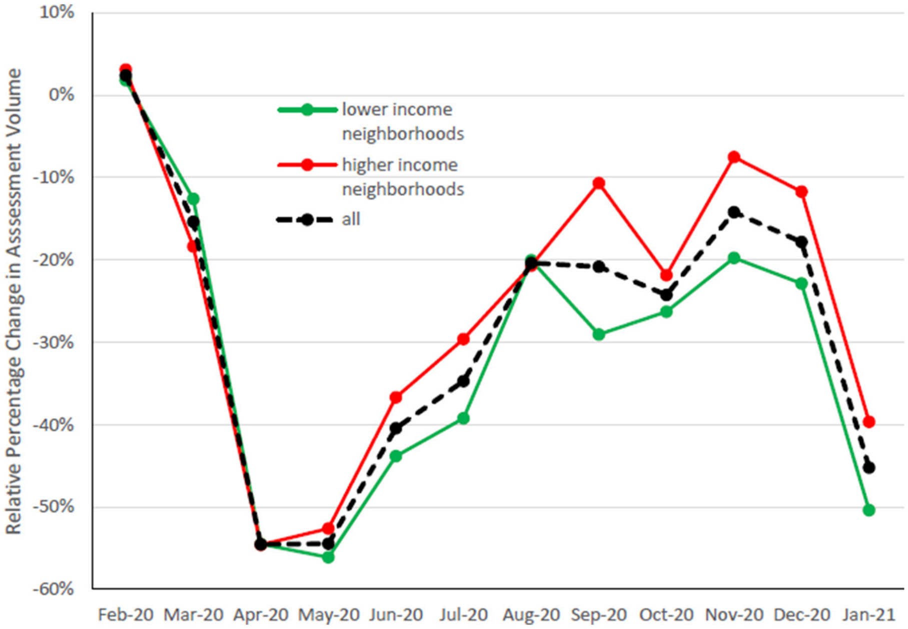

FIGURE 1 | This represents the relative percentage change in assessment volumes for each month, as compared to the same month one year prior.

depressive symptoms (57), this scale was dichotomized as 0 to 3 vs. 4 to 15.

Anxiety Scale

The anxiety Scale assesses anxiety systems through six items such as: anxious complaints or concerns, unrealistic fears, obsessive thoughts, intrusive thoughts or flashbacks, episodes of panic, and nightmares (62). With a range of 0 to 28 and higher values denoting higher levels of anxiety (62), this scale was dichotomized as 0 to 2 vs. 3 to 28.

Hyperactive/Distraction Scale (HDS)

Hyperactivity and distractibility are assessed by the empirically supported HDS. Items include impulsivity, ease of distraction, hyperactivity, and disorganization (54). With a range of 0 to 16 and higher values denoting higher risk (54), this scale was dichotomized as 0 to 8 vs. 9 to 16.

RESULTS

Shown in **Figure 1**, year-over-year assessment volume dropped by over 50% during the first two months of the pandemic, then recovered somewhat to about 20% lower by the start of the second wave in September, when in-class learning was occurring for some students. In January 2021, it plunged again to 45% below January 2020, a month when most of the province did not have in-class learning and when COVID-19 cases were recording new daily highs. **Figure 1** also shows assessment volume change stratified by neighborhood income, split into those above and below the median; no significant difference in volume among income quartiles is seen in Wave 1 ($p = 0.40$), but in Wave 2, there was a greater reduction in assessments of children and youth from the two lower income quartile neighborhoods than those from the higher two income neighborhoods ($p < 0.0001$). This Wave 2 difference can also be seen at the income quartile level in **Table 1**.

Table 1 presents the proportional change in year-over-year assessment volume in Wave 1 and Wave 2. In both waves, assessments of younger clients declined more than older ones and assessments of boys more than girls. Language (English/French/other) showed differing rates of change in Wave 1, but not in Wave 2. The proportion of assessments completed for clients new to an agency declined in both waves. Unsurprisingly, many more assessments were conducted by phone or by video, and fewer in-person, in both waves.

Table 2 presents the rate of a number of dichotomous measures for Wave 1 and Wave 2 and for the equivalent period one year earlier, adjusted for age, sex, neighborhood income and initial agency encounter. More prevalent in both waves were having witnessed domestic violence in the last year and having a parent experience a major life stressor in the last 90 days. Less prevalent in both waves were caregiver distress and having received child protection services in the last 90 days. Many more characteristics showed lower prevalence during Wave 2, compared to the year prior, including risk of harm to others, disruptive/aggressive behavior, hyperactivity, emotional abuse, youth justice involvement, drug use, child/youth having one parent as the legal guardian, family overwhelmed, and economic trade-offs. Higher prevalence in Wave 2 compared to the year prior were found for depressive symptoms and self-injurious attempts. Comparing the two waves, risk of injury to others, disruptive/aggressive behavior, involvement with youth criminal justice, and family overwhelmed were less prevalent in Wave 2, and depressive symptoms and a recent self-injurious attempt were more prevalent in Wave 2.

TABLE 1 | Change in assessment volume, by characteristic, during wave 1 and wave 2, compared to one year prior.

Characteristics[a]	Wave 1 (4 months)				Wave 2 (5 months)			
	Mar 2019 to Jun 2019 n (%)	Mar 2020 to Jun 2020 n (%)	% change	*P* value	Sep 2019 to Jan 2020 n (%)	Sep 2020 to Jan 2021 n (%)	% change	*P* value
Total number of assessments (ChYMH, ChYMH-DD, and ChYMH-S)	9,953	5,690	−42.8%		11,176	8,343	−25.3%	
Age (years)								
7 & under	1,803 (18.1%)	944 (16.6%)	−47.6%	0.262	1,833 (16.4%)	1,067 (12.8%)	−41.8%*	<0.0001
8–11	3,392 (34.1%)	1,672 (29.5%)	−50.7%*	<0.0001	3,451 (30.9%)	2,327 (27.9%)	−32.6%*	<0.0001
12–15	3,567 (35.9%)	2,198 (38.7%)	−38.4%*	0.048	3,984 (35.7%)	3,376 (40.5%)	−15.3%*	<0.0001
16–21	1,181 (11.9%)	863 (15.2%)	−26.9%*	<0.0001	1,889 (16.9%)	1,560 (18.7%)	−17.4%*	0.001
Sex								
Males	5,253 (52.9%)	2,801 (49.3%)	−46.7%*	<0.0001	5,938 (53.2%)	3,780 (45.4%)	−36.3%*	<0.0001
Females	4,678 (47.1%)	2,876 (50.7%)	−38.5%*		5,221 (46.8%)	4,539 (54.6%)	−13.1%*	
First assessment for this client in this agency	6,470 (65.0%)	3,374 (59.3%)	−47.9%*		7,305 (65.4%)	5,132 (61.5%)	−29.7%*	<0.0001
Method of Assessment[b]								
Conducted in person	2,443 (83.6%)	422 (19.8%)	−82.7%*	<0.0001	2,791 (81.3%)	538 (16.7%)	−80.7%*	<0.0001
Phone	478 (16.4%)	1,255 (58.8%)	+162.6%*	<0.0001	629 (18.3%)	1,572 (48.8%)	+149.9%*	<0.0001
Video	2 (0.1%)	459 (21.5%)	+22,850%*	<0.0001	11 (0.3%)	1,114 (34.6%)	+10,027%*	<0.0001
Primary language								
English	9,388 (94.3%)	5,484 (96.4%)	−41.6%*	<0.0001	10,774 (96.4%)	8,019 (96.1%)	−25.6%	0.295
French	194 (1.9%)	84 (1.5%)	−56.7%*	0.031	175 (1.6%)	131 (1.6%)	−25.1%	0.981
Other	370 (3.7%)	121 (2.1%)	−67.3%*	<.0001	227 (2.0%)	192 (2.3%)	−15.4%	0.198
Area median household income quartile after tax								
1st < $57,367	2,910 (30.0%)	1,624 (28.8%)	−44.2%	0.356	3,406 (30.8%)	2,252 (27.3%)	−33.9%*	<0.0001
2nd $57,367 to $70,334	2,204 (22.7%)	1,307 (23.2%)	−40.7%	0.234	2,567 (23.2%)	1,912 (23.1%)	−25.5%	0.933
3rd $70,335 to $84,750	2,759 (28.4%)	1,613 (28.6%)	−41.5%	0.400	3,052 (27.6%)	2,407 (29.1%)	−21.1%*	0.018
4th > $84,750	1,828 (18.8%)	1,092 (19.4%)	−40.3%	0.203	2,048 (18.5%)	1,689 (20.4%)	−17.5%*	0.001

[a] *Some characteristics do not total 100% due to small number of missing responses.*
[b] *ChYMH and ChYMH-DD assessments only.*
**Denotes significance, $p < 0.05$.*

Figures 2A,B show four periods of time (year prior to Wave 1, year prior to Wave 2, Wave 1, Wave 2) stratified by neighborhood income quartile for subgroups selected using some of the largest time-related differences. The first group are female clients aged 12 and older, with depressive symptoms (DSI 4 or greater) and risk of self-harm (RiSsK 1 or greater). The second group are male clients aged 11 and younger at risk of injuring others (RIO 3 or greater) and with disruptive/aggressive behavior (DABS 4 or greater). The first group are more prevalent in the higher half of neighborhood incomes ($p = 0.0001$), and the second group are more prevalent in the lower half of neighborhood incomes ($p < 0.0001$). Over time, the first group shows significantly greater prevalence ($p < 0.0001$) and the second group significantly lower prevalence ($p < 0.0001$).

DISCUSSION

This study highlights an overall decline in the number of child and youth mental health assessments across 53 select mental health agencies in Ontario during the first wave of the pandemic, with some recovery during the second wave. Regarding the mental health presentations of children and youth during the COVID-19 pandemic, there were declines noted in the proportion of children exhibiting disruptive/aggressive behaviors and risk of harm to others, with increases in depressive symptoms and recent incidents of self-harm noted in both waves when compared to the year prior, with these findings remaining significant during the second wave when adjusted for factors such as age and sex. Moreover, it was in the second wave, when students had the option of attending in-person classes, that a higher number of significant differences were observed between the two waves, with notable increases in depressive symptoms and recent self-injurious attempts, alongside decreases in risk of injury to others and disruptive/aggressive behaviors from the first to second wave. We also observed significant increases in the proportion of children and youth experiencing domestic violence, along with parents having had a recent major life stressor, in both waves. Surprisingly, these changes were accompanied by declines in child protection service involvement in both waves.

These findings largely align with other previously cited international investigations noting concerning declines in

TABLE 2 | Outcome scales and selected measures during wave 1 and 2 of the COVID-19 pandemic compared to the period one year prior – adjusted**.

Outcome Scales and Selected Measures	Wave 1[a]			Wave 2[b]			Difference between Wave 1 and Wave 2	
	Period 1-year prior	COVID-19 period	*P*	Period 1-year prior	COVID-19 period	*p*	*p*	Change from Wave 1 to Wave 2
Risk of Suicide and Self Harm in Kids (RiSsK) 1+	48.6%	49.6%	0.174	49.2%	49.7%	0.392	0.758	
Risk for Injury to Others (RIO) 1+	47.9%	47.0%	0.228	**48.1%**	43.3%	<0.0001*	<0.0001*	Decrease
Disruptive/Aggressive Scale (DABS) 4+	39.3%	38.8%	0.511	**39.2%**	36.1%	<0.0001*	0.002*	Decrease
Depressive Symptom Inventory (DSI) 4+	47.4%	48.7%	0.068	49.0%	**50.4%**	0.027*	0.015*	Increase
Anxiety Scale 3+	56.3%	57.4%	0.139	57.0%	57.9%	0.145	0.322	
Hyperactivity/Distractibility Scale (HDS) 9+	30.2%	31.4%	0.090	**30.8%**	29.6%	0.038*	0.100	
Witnessed domestic violence within last month	1.0%	1.2%	0.381	1.2%	1.1%	0.259	0.942	
Witnessed domestic violence within last year	5.0%	**5.9%**	0.007*	5.4%	**6.0%**	0.029*	0.997	
Experienced sexual assault/abuse within last year	2.2%	1.9%	0.239	2.3%	2.1%	0.198	0.734	
Experienced physical assault/abuse within last year	4.3%	4.6%	0.346	4.6%	4.0%	0.016*	0.088	
Experienced emotional abuse within last year	9.2%	9.9%	0.071	**10.4%**	9.5%	0.028*	0.776	
Self-injurious attempt in the last month	8.3%	7.8%	0.194	7.9%	**9.0%**	0.001*	0.010*	Increase
Referral as a result of involvement with youth justice system	5.1%	6.0%	0.135	**5.6%**	3.7%	<0.0001*	0.000*	Decrease
Street drug use (illegal or legal) last 14 days	5.8%	5.4%	0.285	**6.7%**	5.4%	0.001*	0.818	
Legal guardian mother or father only	29.5%	29.4%	0.812	**29.1%**	27.3%	0.002*	0.060	
Current custody dispute	5.3%	4.3%	0.060	4.2%	4.6%	0.448	0.487	
Parent/primary caregiver expresses feelings of distress, anger, or depression	**31.1%**	27.5%	0.002*	**34.0%**	25.8%	<0.0001*	0.184	
Family members report feeling overwhelmed	35.6%	36.0%	0.622	**37.8%**	33.5%	<0.0001*	0.008*	Decrease
Parent experienced major life stressor last 90 days	26.8%	**31.8%**	<0.0001*	26.9%	**29.1%**	0.042*	0.081	
Parental addiction in the last month	3.9%	3.4%	0.063	3.7%	3.6%	0.712	0.715	
Limited funds resulted in child/youth or parent making economic trade-offs	3.4%	2.6%	0.086	**3.6%**	2.6%	0.009*	0.715	
Child protection services received last 90 days	**21.1%**	17.4%	0.001*	**19.3%**	16.9%	0.004*	0.594	

Bolded numbers denote the period with the higher % to indicate the direction of the change from the COVID-19 period and the period prior, where the difference is statistically significant.

[a] *Wave 1 represents March 2020 to June 2020 (4 months).*

[b] *Wave 2 represents September 2020 to January 2021 (5 months).*

*$p < 0.05$.

***Wave 1 and Wave 2 columns adjusted for age, sex, neighborhood income, first encounter with the service agency.*

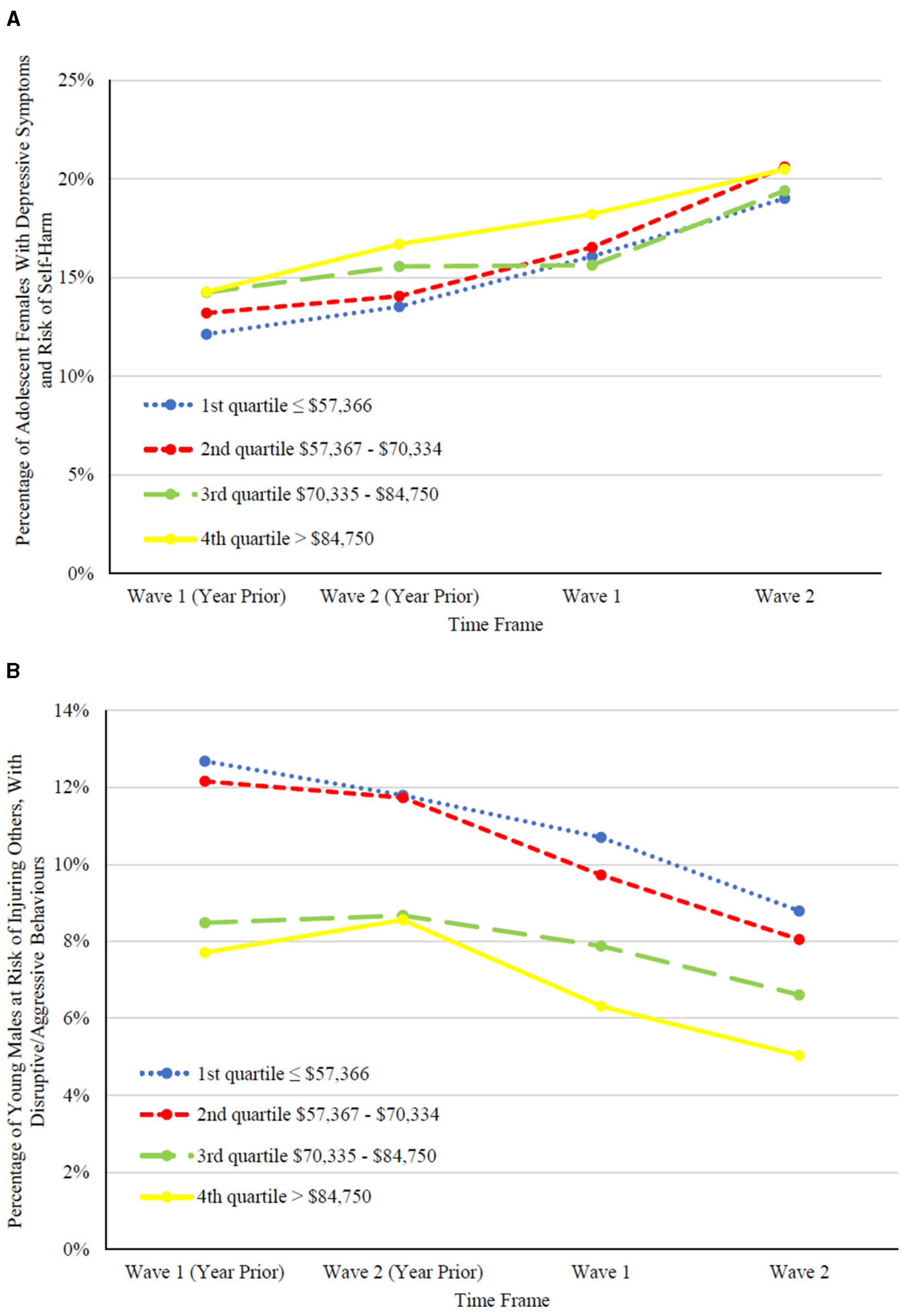

FIGURE 2 | Examples of significant symptom changes observed in children and youth by income quartile. **(A)** represents the percentage of assessments for adolescent females, 12 years or older, with depressive symptoms, DSI ≥ 4, and risk of self-harm, RiSsK ≥ 1, by income quartile. **(B)** represents the percentage of assessments for young males, 11 years or younger, at risk for injuring others, RIO ≥ 3, with disruptive/aggressive behaviors, DABS ≥ 4, by income quartile.

children and youth accessing mental health services during periods of lockdown (29–38). When examining potential changes in mental health presentations within hospitals and emergency department settings outside of Canada, Ougrin et al. (36) noted an increase in proportion of children and youth presenting with self-harm while four other studies (31–33, 37) noted no significant difference or a decline in the proportion of children and youth in their sample presenting with self-harm and suicidality during the pandemic when compared to comparable pre-pandemic time frames. However, at the time of our investigation, we were unable to locate any studies examining specific changes in mental health presentations compared to overall assessment volumes to community mental health settings or emergency rooms within Canada. Due to a myriad of factors such as the scarcity of the research in this area, differences in referral pathways and nature of services within different settings providing mental health services to children and youth (e.g., community mental health, emergency, psychiatric hospitals), differences in government regulations across settings and areas served, differences in the selection of a comparison frame, and service equity and differential client access to services, any similarities and differences noted here should be interpreted with caution and no firm conclusions about specific changes in treatment-seeking children's mental health presentations during the pandemic can be drawn at this current time.

However, the sharp decline in children and youth accessing services across multiple studies and settings warrants attention. Considering the critical role that schools and educational childcare settings play in the identification of the mental health needs of children and service referrals to mental health agencies in Ontario (9, 12), it is possible that a large proportion of these findings are related to school and childcare setting closures. Educators are in a unique position to identify mental health needs of specific students (75, 76) and are often one of the first professionals that parents contact with respect to concerns about their children's mental health needs (77). Moreover, teachers tend to report higher rates of problematic symptoms than parents alone (75). Schools are also often one of the top referral sites to child protection services for young children in Ontario (78). In the absence of in-person classes, it is possible that the various needs of students are not being identified through online modules to the same level of efficiency as before. Moreover, aside from schools, primary care settings in Canada also play a critical role in identifying and addressing the mental health needs of children, including providing referrals to mental health specialists (79). Parents might have been hesitant to access primary care settings during periods of lockdown due to fears of contracting the virus or public messaging discouraging in-person service access, aside from cases of emergencies (35). In relation to online service delivery, concerns of confidentiality of sessions, privacy of client information, and clinician competency and training in online service provision also have the potential to impact the uptake of these services during this time (80–83).

Interestingly, assessment volumes in low-income neighborhoods declined more than those in high income neighborhoods during the second wave of the pandemic. Considering that families in these neighborhoods are at the greatest risk for exposure to pandemic-related stressors (42, 43), this decline likely does not reflect a decline in need for such services within these communities. While many mental health agencies shifted to online service delivery during the pandemic (80), this mode of service delivery may not be accessible to all families, especially those living in low-income neighborhoods who might not have access to the tools and technology required for online assessments (42, 84). For example, children living within families with lower incomes are disproportionately less likely to have access to internet at home, and more than one device per household, for the use of online services (80, 84). Moreover, considering that areas with the highest levels of material deprivation (e.g., educational attainment, income, and housing) in Ontario experienced disproportionately higher rates of transmission (85), it is also possible that families within lower income neighborhoods were more hesitant to send their children back to school during the second wave (86, 87). However, due to the lack of empirical data exploring the intersectionality of income and access to child and youth mental health services during the pandemic in Ontario, these hypotheses should be interpreted with caution.

In the second wave, disruptive/aggressive behaviors, risk of harm to others, and youth justice involvement also declined when compared to both one year prior and the first wave. These behaviors have been associated with peer rejection and victimization in previous studies (88–90). School closures might present with fewer opportunities for peer socialization and victimization, thus resulting in a reduction in the presentation of these behaviors. Given that teachers are in a unique position to identify such behavioral issues that might emerge within the classroom (76, 91), it is possible that some of these behaviors are currently under-detected and will re-emerge once all children have resumed in-person learning.

In our sample of treatment-seeking children and youth, we also noted a significant increase in depressive symptoms and recent self-injurious behaviors in the second wave when compared to the year prior and the previous wave. Self-harm behaviors can be used as coping strategies which alleviate feelings of negative affect, such as anger, depression, loneliness, and frustration (92, 93). These emotions may be experienced at heightened levels throughout the COVID-19 pandemic (10, 11, 27), becoming further exacerbated as the pandemic continues to unfold. Moreover, the length of social isolation may be more detrimental to youth psychological well-being, as measured by anxiety and depression, than the severity of the isolation itself (27).

There is also some evidence to suggest resilience in certain families during the pandemic. In our sample, there was an overall decline in the proportion of families reporting caregiver distress in both waves and the family reporting feeling overwhelmed in the second wave. Canada was able to implement its financial relief program, the Canadian Emergency Relief Benefit, early in the pandemic (94), which may have mitigated some of the potential negative impacts of unemployment and financial stress on caregiver stress and coping in treatment-seeking families. Moreover, some children might be benefiting from increased quality time and attention from caregivers (26, 95). For children who experience school as a major source of distress (e.g., bullying), school closures may also come as a relief for both the parent and child and may allow for these children to spend more time in a safer and more relaxed environment (26, 28).

Limitations, Implications, and Future Directions

The data in this study only consists of treatment-seeking children from select mental health agencies within the Province of Ontario, and hence these findings might not be representative of all children in the province, those seeking secondary mental health services outside of these agencies or within emergency settings, or those in other regions that may be differently impacted by the pandemic and related government restrictions and closures. We also want to acknowledge that this investigation utilized an indirect measure of family income to analyze income related trends in child and youth mental health referrals and needs. Therefore, the subset of our findings that account for the impact of socioeconomic status on these mental health trends reflect aggregated neighborhood-level trends, not individual-level data.

Moreover, in this study, we classified pandemic period data from March 2020 to January 2021 into two distinct waves, discounting summer months. This resulted in shorter pandemic comparison periods than our previous eight-month investigation (13). The difference in timeframe, and subsequently the number of participants, resulted in this paper not capturing the modest increase in anxiety reported in our previous study (13). It is important to note that due to school closures, it is likely that our investigations are also not representative of the full scope of changes in domestic violence cases in the province. Furthermore, the data represents a limited time period as it only considers the first two waves of the pandemic in Ontario. Future research is needed to examine both the referral trends and the various mental health presentations of children not only throughout all potential waves of the pandemic in Ontario, but also once the pandemic subsides (10, 96).

We also want to address that in this study, we did not directly measure the COVID-19 impact on children, families, and agencies. While we provide a summary of children's mental health referral trends and presentations, as well as socioeconomic and familial factors related to children's mental health (e.g., caregiver distress or financial trade-offs), during the first two waves of the pandemic, future studies are needed to examine the ways that these socioeconomic and familial factors, and any potential pandemic-related changes in these factors, might interact with children's mental health presentations during periods of lockdown. Moreover, the direct impacts of COVID-19 pandemic on individual participants and their families (e.g., exposure to the illness, caregiver unemployment, or level of social isolation) that might impact children and adolescent' mental health needs during this time are not measured in our study and warrant future investigation. We also did not examine the ways that lockdowns and online service provision might impact service availability. Therefore, empirical research examining factors related to mental health service availability that might impact referrals to mental health services in the context of lockdown, where in-person services might not be available for long periods of time, is required to better understand the needs of this population during pandemics.

Despite these limitations, this study utilized a large sample of thousands of children and youth from the Province of Ontario, highlighting the imminent need for research into factors that impact service utilization of children and youth during this time. While these analyses focus on the proportions of individuals with the measured characteristics of interest, it is also important to pause and consider the absolute decline in the volumes of individuals with serious mental health characteristics who are observed seeking service during the pandemic. It is highly unlikely that the pandemic resulted in fewer persons with these needs, but rather this absolute decline was due to a combination of factors, including fewer cases identified and referred by schools and primary care, hesitancy of clients or families in seeking care due to risk of COVID exposure, and the child/youth mental agencies altered ability to offer services in the same way during the pandemic. One can infer that the true number of needy cases is at least as high as before the pandemic (if not higher), which suggests that a large number of cases are going without contact with the formal system. Our finding that cases newly referred to agencies declined more than existing cases hints at the large number of families with new onset conditions that would have been accessing services, if not for the pandemic. There might be an exponential increase in services needs and utilization of children and youth once public spaces and schools completely re-open in person and mental health services resume as normal (12).

Overall, this reduction in mental health utilization also reflects the need for the prioritization of the implementation of evidence-based assessment tools that can be easily transferable to online services (71, 73). Further, increased structural and financial support for children, youth, and their families within vulnerable communities during this time is needed to ensure appropriate, and timely access to services and devices required for online service delivery (22). Lastly, professional development opportunities and support for teachers to help increase their competency in identifying and supporting children presenting with mental health needs, or at risk for harm (24), during periods of lockdown is of upmost importance.

CONCLUSION

The present study provides insight into the mental health needs and referral trends to mental health services of a subset of treatment-seeking children across select mental health agencies within province of Ontario during the first two waves COVID-19 pandemic. Overall, our investigation found a decline in assessments of children at mental health agencies in Ontario compared to pre-pandemic periods, with the greatest decline in assessments seen in low-income neighborhoods during the first wave. This was coupled with an increase in the proportion of certain mental health concerns, such as depression and self-harm, and a decrease in the proportion of others, such as disruptive and aggressive behavior and risk of injury to others. Overall, the shifts in these client characteristics during the pandemic needs to be considered along with the overall decline in treatment-seeking cases, which suggests large numbers of untreated cases during the pandemic. Moreover, these findings provide insight for clinicians and researchers into the evolving needs of treatment-seeking children and youth during periods of uncertainty and duress.

DATA AVAILABILITY STATEMENT

The data analyzed for this study was de-identified standard client care data that was obtained from the interRAI database.

This data is made available to interRAI Research Fellows and their students, for research purposes under an existing license agreement with the Canadian Institute for Health Information. Under this agreement, this data may not be transmitted to third parties; hence, it cannot be included as **Supplementary Materials** for this study. Those who would like to access the data obtained for this study can apply to the Canadian Institute for Health Information for access to this data. Requests to access these datasets should be directed to https://www.cihi.ca/en/access-data-and-reports/make-a-data-request.

ETHICS STATEMENT

Ethics clearance for secondary analyses of interRAI data gathered by other organizations was obtained from Western University (REB #106415).

AUTHOR CONTRIBUTIONS

All authors contributed to the formulation of ideas presented in this study and provided critical feedback to the manuscript. SS drafted the first version of the materials, procedure, and methodology sections. AV and JV drafted the first version of the introduction and discussion sections collaboratively. JP conducted all the analyses. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.730915/full#supplementary-material

Supplementary Figure 1 | This represents 14-day averages of COVID-19 cases in Ontario (92) and our selected COVID-19 wave boundaries.

Supplementary Table 1 | This includes unadjusted values for the outcome scales and select measures utilized in this study, during the first two waves of the pandemic, when compared to one year prior and each other.

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BRIEF RESEARCH REPORT
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Does the Person-Centered Care Model Support the Needs of Long-Term Care Residents With Serious Mental Illness and Intellectual and Developmental Disabilities?

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Person-centered care approaches continue to evolve in long-term care (LTC). At the same time, these settings have faced increased challenges due to a more diverse and complex population, including persons with intellectual and developmental disabilities (IDD) and serious mental illness (SMI). This study examined the mental, social, and physical wellbeing of residents with different diagnoses, within a person-centered care model. It was hypothesized that individual wellbeing would be comparable among all residents, regardless of primary diagnosis. The study cohort was drawn from all admissions to long-term care facilities in the USA from 2011 to 2013. Data are based on admission, 3 and 6 month follow-up Minimum Data Set (MDS) 3.0 assessments. The groups examined included: schizophrenia, other psychotic disorders, IDD, dementia, and all others (i.e., none of the above diagnoses). The wellbeing outcomes were depression (mental), pain (physical), and behaviors (social). All residents experienced improvements in pain and depression, though the group without the examined diagnoses experienced the greatest gains. Behaviors were most prevalent among those with psychotic disorders; though marked improvements were noted over time. Improvement also was noted among persons with dementia. Behavior worsened over time for the three other groups. In particular, those with IDD experienced the highest level of worsening at 3-month follow-up, and continued to worsen. The results suggest person-centered care in US nursing homes provides the necessary foundation to promote mental and physical wellbeing in persons with complex needs, but less so for social wellbeing.

Keywords: person-centered care, nursing homes, interRAI, serious mental illness, intellectual and developmental disabilities

INTRODUCTION

As health care systems struggle to evolve and transform to meet changing needs of the population, long term care settings face increased challenges to support an increasingly diverse and frail adult population—many, but by no means all of whom, can be classified as elderly. Contributing to the diversity of residents served is the unfolding impact of providing care to persons with intellectual and developmental disabilities (IDD) and serious mental illness (SMI), persons who previously (and in some cases, still are) were served in specialized institutions. As individuals with SMI age, their needs are less likely to be met through a combination of family support and community-based programs. Additionally, the life expectancy of persons with IDD continues to increase; although notably, premature aging occurs in this population with the designation of "old" occurring at a younger age than the general population (1, 2). Consequently, there is a growing prevalence of long-term care residents with mood and behavior issues that may challenge implementation of therapeutic interventions designed for others (3, 4).

In the US, more than three decades have passed since there were major reforms within LTC settings stemming from nursing care being deemed inadequate for meeting the needs of the older adult population. Central to the reform was a major shift from a nursing and institutional based approach to that of a person-centered culture. Formerly known as the National Citizen's Coalition for Nursing Home Reform, the National Consumer Voice for Quality Long-term Care is often credited with initial reform efforts, focusing on the rights of residents (5). Building upon the recommendations of the Coalition, the Institute of Medicine issued a report in 1986 that advocated for a home-like atmosphere and improved quality of care in an attempt to address the needs of the individuals in nursing home (6). The Omnibus Budget Reconciliation Act of 1987 included the Nursing Home Reform Act that required provision of person-centered care that promoted individual well-being (7, 8). While the term well-being is widely used, there exists no universally agreed-upon definition, resulting in it being understood and measured in different ways. A recent systematic review identified 99 different measures of wellbeing designed for adults (18 years or more) that touched on nearly 200 different dimensions (9). They noted that definitions and measures most commonly used included consideration of mental, social, and physical wellbeing.

Admission to LTC

Long-term care settings commonly are regarded as placements for older individuals with cognitive and/or functional losses necessitating assistance with daily care activities. Historically, there has been a reluctance to accept persons with SMI into long-term care because of fear of mental illness and violence (10) as well as a concern for the limited availability of gero-psychiatric consultations within these settings (11). Yet, as time has passed a significant and increasing proportion of adults entering long-term care facilities in the US have prior or existing mental health diagnoses and IDD associated with mood and behavioral issues, creating complex challenges to optimal care provision. Published reports internationally cite that up to 8% of the nursing home population has a chronic mental health illness (12). A recent Canadian study found 40% of residents had SMI (13) and in the US, reports indicate up to 50% of nursing home residents have a diagnosed mental illness (3, 4, 14).

Individuals with a SMI diagnosis tend to enter nursing homes at a younger age despite having lower rates of cognitive impairment, and functional limitations (15–19). Similarly, while representing a small proportion of the LTC population, adults with IDD are, in fact, over-represented in the setting. A recent study found that rates of admission to LTC was up to nine times higher among those with IDD compared to the general population; this study also showed they were, on average, 25 years younger when admitted (19, 20).

Stigma and SMI and IDD

Historically, negative societal attitudes toward deinstitutionalization have adversely affected persons with SMI (21) with self-stigma or the negative perception of self being not the least withstanding (22). Both public and self-stigma contribute to common behavioral manifestations of disinterest, distraction, avoidance, fear, shame and withdrawal (23). Because of increased vulnerability of LTC residents with SMI, they are more likely to exhibit aggressive and behavioral disturbances (23).

Just as much as in the general population, living and aging in the community is a high priority for individuals with IDD and their caregivers (24–26). In fact, given long-standing efforts to move away from institutional settings and toward community living in this field, remaining in the community becomes even more important. A recent study of professionals in the field of IDD reported that persons with IDD experience stigmatization within LTC by both the professionals who work there, and by other residents (27). Admission to LTC was itself stigmatized with many suggesting that it should be considered only as a last resort, upon the failure of community-based services to meet the needs of adults with IDD and their caregivers. For many, and especially older adults with IDD, admission to LTC represents a form of re-institutionalization.

Physical Health, Mental Health, and Behavior

LTC residents with SMI often carry the dual burden of mental and physical co-morbidities (28). Older adults with SMI face challenges with mobility and functional capacity and experience higher rates of mortality and illness (29, 30). When compared with persons living with family, LTC residents with schizophrenia are more likely to have a decreased quality of life (31). Outside the United States, across nursing homes in the Netherlands, van den Brink et al. (32) found that 8 months after admission, those with mental-physical multimorbidity demonstrated increased hyperactivity, irritability occurring most commonly, and also a high persistence of depression. Additionally, residents in nursing homes in the Netherlands experiencing depression, had decreased well-being (33).

Adults with IDD of all ages also have more health conditions compared to the general population, a trend that continues throughout life. While Marengoni and colleagues (34) estimated that about half of older adults in the general population experience multi-morbidity, McCarron and colleagues (35) reported that about 71% of adults with IDD aged 40 years or higher had multi-morbidity, and about 80% of those 50 years of age or higher (36). Not surprisingly, adults with IDD have higher rates of health care service utilization overall (37). A group with many challenges, but a good one in which to test whether the Centers for Medicare and Medicaid Services (CMS) mandated personal model of care can result in outcomes that parallel those of other groups under study.

Nursing home residents with SMI may present with various behaviors that challenge including verbal aggression, repeated requests for attention, delusions, irritability and apathy (38). Among cognitively intact nursing home residents, depression, anxiety and a lack of social contact contribute to reduced quality of life and increased suffering (39, 40). The overall effects of these manifestations are associated with a reduced level of well-being (41–43).

In addition to impairments in cognition, social skills, and functioning, adults with IDD are also at increased risk for mental illness and behaviors that challenge (e.g., aggression, self-injury, destruction, pica) (37, 44). Schizophrenia and other psychotic disorders, for example, are prevalent in ∼5–10% of adults with IDD (45), though many have suggested that this condition may be over-diagnosed (46). Others have reported on the higher prevalence of several other mental health conditions among adults with IDD, such as depression (47) and dementia (48, 49). The prevalence of mental health conditions in this population varies widely based on the setting (e.g., community, institution) and sample (e.g., age, type of IDD, level of IDD severity), but it is thought to be up to five times higher than in the general population (50). For their part, behaviors are among the most widely studied issues in this field (51); such behaviors have a tremendous effect on the quality of life of individuals (52) and contribute to the complexity of supports (3, 4, 53). Similar to prevalence of mental health issues, the prevalence of behaviors is difficult to determine—again due to study setting and populations studied, and also to the definition of "challenging" used (54). Consequently, prevalence ranges from 14 to 67% (55).

The prevalence of mental, physical, and multiple comorbidities among long term care residents requires the CMS mandated emphasis on person-centered care with a focus on symptoms and associated behaviors rather than diagnosis, to better address their needs and improve well-being (56).

The primary purpose of this paper is to examine elements of mental, social, and physical wellbeing among persons living in long-term care, and compare them among those with dementia, IDD, and SMI. Specifically, mood, behavior, and pain will be examined at admission (i.e., baseline), and at 3 and 6 month follow-up. The changes in measures of well-being are compared over time, and the differential subgroup effects over those time periods examined. It is hypothesized that with implementation of the person-centered care model, individual wellbeing will not differ among subgroups (i.e., dementia, SMI, and IDD).

MATERIALS AND METHODS

Anonymized data are held on a secure server at the Marcus Institute for Aging Research at Hebrew SeniorLife in Boston, Massachusetts. The data are analyzed subsequent to an ethics board approval through that institution.

Data and Study Population

The study cohort was drawn from all admissions to US LTC facilities in the years 2011–2013; there were 2,286,724 admission assessments. The number of cases declined for the 3-month ($n = 1{,}752{,}344$) and 6-month ($n = 1{,}093{,}890$) subsets of data. Over the study time period, loss of subjects was due to multiple factors including hospital admissions, transfer to another LTC facility, and death.

The new admissions sample was grouped according to the following diagnoses, recorded in the assessment: schizophrenia (i.e., schizoaffective and schizophreniform disorders), mental health disorder other than schizophrenia, intellectual and developmental disability (i.e., Down syndrome, autism, epilepsy, other organic condition related to IDD, IDD with no organic condition), dementia (i.e., Alzheimer's disease, vascular or multi-infarct dementia, mixed dementia, frontotemporal dementia, r/t stroke, Parkinson's disease dementia, and Creutzfeldt-Jakob disease dementia; note: without schizophrenia, psychotic disorder, or IDD diagnosis), and all others (i.e., none of the above diagnoses).

Instrument

Data used in the secondary analysis come from the Minimum Data Set (MDS) 3.0 (57). Containing over 300 items targeting the key domains of personal information, cognition, function, diagnoses, physical and mental health, behavior, service use, the MDS is the primary screening and comprehensive geriatric assessment of health status for patients in LTC. The MDS is completed by trained facility clinical staff at admission and quarterly thereafter, for the duration of the person's stay in LTC, as mandated by the Centers for Medicare and Medicaid in the US.

Variables

Three primary outcomes included within the MDS assessment system were examined: depression, pain, and behaviors that challenge. The presence of depression was measured using the PHQ-9 tool contained in the MDS 3.0 (58, 59). It assesses mood status over the past 14 days, and uses a scale of 0 to 3 to score each of its nine items (0 = "not at all" to 3 = "nearly all the time"). Total scores range from 0 to 27 with higher scores representing more severe depression. Scores 0–4 were categorized as no depression and scores 5 or higher represented the continuum of mild to severe depression (58). The assessment item on pain frequency was used to identify the presence of pain. Presence of pain was indicated if the trained assessor scored the person as having any sign of pain.

Behaviors that challenge were defined as present if any of the following was exhibited by the individual: wandering, physical behaviors directed toward others, verbal behavior directed toward others, self-injuring behaviors (e.g., hitting or scratching self), socially inappropriate behaviors (e.g., rummaging, public sexual acts, disrobing in public), and disruptive behaviors (e.g., throwing or smearing food or bodily waste, screaming, disruptive sounds).

Analysis

Descriptive statistics (%, mean, standard deviation) are used to report on all considered characteristics. Multiple analysis of variance was used to examine differences in each of the well-being measures among the designated groups over time. SPSS version 24 was used to analyze the data.

RESULTS

Study Population Characteristics

Approximately 29.8% of admissions to LTC facilities in the study period had a diagnosis of dementia, 2.9% with schizophrenia, 4.3% with a mental health disorder, and 1.0% with an IDD.

TABLE 1 | Study population characteristics overall and by diagnostic group.

	All admissions *N* = 1,093,890	Subgroups				
		Schizophrenia *N* = 31,723	Mental health *N* = 47,037	ID *N* = 10,939	Dementia *N* = 325,979	All others *N* = 678,212
Mean age in years (sd)	76.2 (14.5)	61.9 (14.1)	75.7 (14.0)	56.6 (19.2)	83.2 (9.2)	74.1 (14.8)
Gender						
Male	38.3%	48.8%	40.7%	50.4%	33.8%	39.4%
Female	61.7%	51.2%	59.3%	49.6%	66.2%	60.6%
Mean depression score (sd)						
Baseline	3.1 (4.0)	3.3 (4.3)	3.3 (4.3)	2.6 (3.9)	3.1 (4.0)	3.1 (4.1)
3-months	2.5 (3.8)	2.9 (4.1)	2.9 (4.1)	2.2 (3.7)	2.7 (3.8)	2.3 (3.5)
6-months	2.4 (3.6)	2.7 (4.0)	2.7 (3.9)	1.9 (3.4)	2.7 (3.9)	2.3 (3.5)
Pain						
Baseline	56.5%	43.7%	43.9%	53.3%	41.6%	63.9%
3-months	47.6%	38.1%	39.2%	48.2%	35.9%	53.6%
6-months	42.7%	32.9%	38.1%	43.4%	35.9%	47.0%
Behavior						
Baseline	11.7%	21.3%	32.8%	17.3%	23.5%	5.1%
3-months	12.6%	22.9%	29.3%	19.3%	23.0%	6.1%
6-months	13.2%	23.5%	25.7%	18.9%	20.5%	7.9%

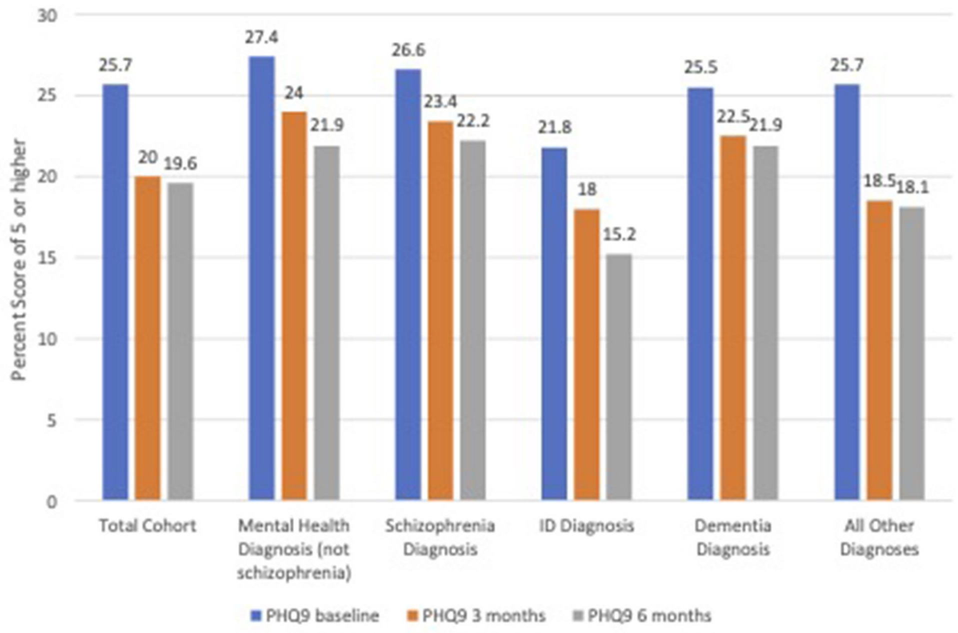

FIGURE 1 | Percent of residents with PHQ-9 score of five or greater at follow-up.

Table 1 shows personal and admission characteristics. Notably, those with schizophrenia and IDD were much younger compared to those with dementia or other mental health diagnoses. Both of these diagnostic subgroups had the largest number of residents <65 years old (schizophrenia: 66.0% and IDD: 57.5%), whereas in the group with dementia, only 4.5% were under 65 years.

While 61.7% of all residents were female, the percent was much lower for the schizophrenia and IDD cohort—51 and 50% respectively. In terms of marital status, 16.5% of residents had never been married, while a majority of those with schizophrenia and IDD had never been married (54.5 and 74.1%, respectively).

Mental Wellbeing: Depression

Table 1 shows the mean PHQ 9 scores over time and by group. Overall, average scores reflected a low level of depression at baseline; residents with IDD had the lowest average depression score, while those with schizophrenia and mental health diagnoses had the highest mean scores. Improvements were noted over time in all subgroups, with the largest improvement in the "all others" group and the smallest among those with dementia. Creating of dichotomy of those with no depression (scores 0–4) and those with depression (scores five or greater), **Figure 1** displays the percent of residents with depression for the three assessments. The percentage of those assessed as depressed declined over time, with greatest decline in the "all other diagnoses" category.

Physical Wellbeing: Pain

The percentage of residents with pain across diagnostic groups and follow up periods are presented in **Table 1**. Those with a dementia diagnosis had the lowest percentage presenting with

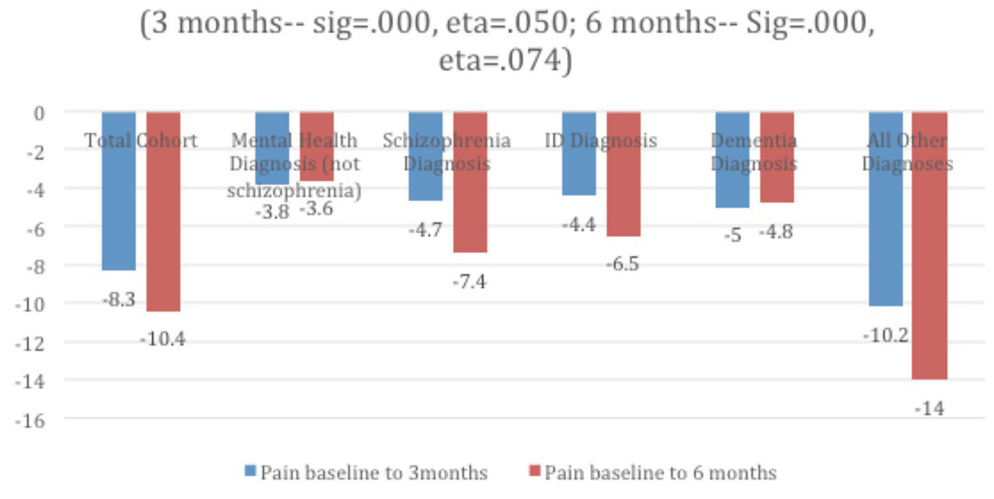

FIGURE 2 | Mean decline in pain % over time and by diagnostic group.

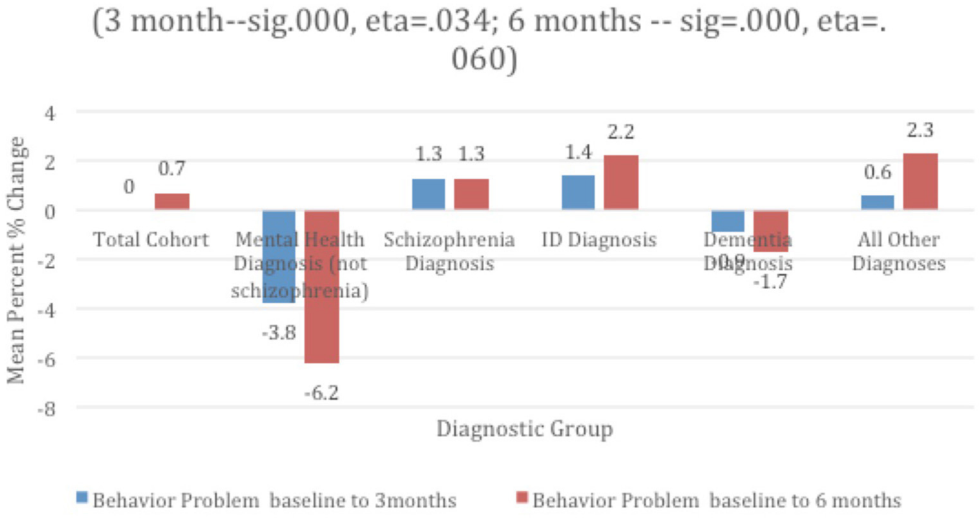

FIGURE 3 | Mean % change in problem behavior over time and by diagnostic group.

pain at baseline and at 3 month follow-up, while those with schizophrenia had the lowest levels of pain at 6 month follow-up. Improvements were noted over time in all subgroups, with the largest improvement in the "all others" group and the smallest among those with a mental health diagnosis (**Figure 2**).

Social Wellbeing: Behaviors

Table 1 displays the percentage of persons in the total group and within each subgroup manifesting any one of the behaviors identified as behaviors that challenge. Those with a mental health diagnosis had the largest percentage exhibiting behaviors that challenge at baseline and each follow-up, and it was consistently lowest among the "all others" group. Marked improvements were noted in the group with mental health diagnosis; those in the dementia group also improved over time, but not by as much. Behavior worsened over time for those with schizophrenia and IDD, as well as in the "all others" group. In particular, those with IDD experienced the highest level of worsening at 3 month follow-up and continued to worsen (**Figure 3**).

DISCUSSION

This paper examined the extent to which the person-centered care model, that is supposed to underly nursing homes in the United States, is able to improve the individual wellbeing of residents with SMI, IDD, and dementia as well as it does for other residents without such diagnoses. The answer is yes, mostly, and for most.

All study sample LTC residents, regardless of their subgroup membership, experienced improvements in pain and depression, though the group without diagnoses (i.e., "all others") experienced the greatest gain in both areas. Among the four considered diagnostic groups, those with IDD experienced the largest improvement in depression, while those with dementia experienced lesser levels of improvement in this area over both follow-up periods. The proportion of improvement in pain was similar across the four diagnostic groups at the 3 month follow-up, but varied considerably at 6 months. Here, those with schizophrenia and IDD had the greatest improvement in pain overall; the improvement experienced by those with schizophrenia almost doubled that of persons with mental health disorders. Those with mental health disorders saw the least improvement in pain over time. The pain outcome has to be interpreted with some caution. In a recent Canadian study, a large proportion of long-term care residents with mental and cognitive disorders either did not report pain or reported pain less than daily (13). The challenge of identifying pain among adults with intellectual and developmental disabilities has also been reported (60). The chance for underreporting of pain also may exist in the study population reported here, although we cannot confirm such a bias.

With respect to behaviors that challenge, these were most prevalent among persons with mental health disorders and dementia at baseline and follow-up. These groups were also the only ones to experience overall improvement in behavior over time. It should be noted that the proportion of improvement of those with mental health disorders greatly exceeded that seen among persons with dementia. Behaviors worsened in all other groups. Persons without diagnoses least commonly exhibited behaviors that challenge, and experienced a high level of decline by 6 months. This level of decline was also experienced by persons with IDD, who had the highest rates of worsening overall. At the same time, the rates are much lower, and a lingering effect of both public and self-stigma may be an influencing factor as they contribute to fear, reluctance for social interaction, shame and avoidance (22).

So, it appears that the care provision model in US nursing homes provides the necessary foundation for staff to address depression and pain in persons with complex needs, but less so for behaviors that challenge. Although, when there is an improvement of note, it is for those in the mental health diagnostic group; in this respect, the groups with SMI and IDD did not underperform compared to other groups.

There are a number of possible reasons supporting this outcome. It is possible that LTC staff, most often clinicians, have adequate knowledge and skills to assess and treat depression and pain—two common conditions among older adults. The origins and ways of supporting people with behaviors that challenge may be less straightforward. That said, staff have some better experience with some behaviors like wandering, as it is prevalent among those with dementia. LTC homes take wandering into account when designing facilities, and have appropriate strategies in place to monitor and manage wandering (e.g., alarms, locked doors). As seen in the results, persons with dementia were among the two groups who saw improvements in behavior over time.

We should also note that LTC staff may have less experience with behaviors that are more common among persons with schizophrenia and those with IDD, such as self-injury, socially inappropriate, and destructive behaviors, and they may have received less training in how to recognize—and prevent conditions that lead to such behaviors. Future work is needed to explore the different forms of behaviors that challenge seen in LTC and to determine which behaviors in particular, should be the focus of additional attention to promote wellbeing and quality of life. While both diagnostic groups represent a relatively small proportion of LTC admissions, they are admitted at much younger ages and therefore may have an extended length of stay compared to other residents. There is therefore impetus to understand how LTC staff may better support their needs to prevent or reduce such behaviors. Note, this is an issue for those with dementia as well, thus suggesting that the lack of an approach to address behaviors is not limited to groups with IDD and schizophrenia.

The work presented here was a secondary data analysis and, as such, we were unable to dictate specific data collection elements or scales. We used response categories and scales as they existed in the MDS. We focused on the primary diagnosis recorded during the baseline assessment and did not consider individuals who may have had multiple diagnoses.

CONCLUSION

The use of a person-centered model of care in US LTC has been mandated for more than 30 years. This study showed that staff in these settings are able to provide for the mental and physical wellbeing with respect to depression and pain, and this is true even for those with complex needs—defined in this study as persons with schizophrenia, psychotic disorders, and IDD. There remains, however, room for improvement with regard to social well-being and minimizing the occurrence of behaviors that challenge among persons with IDD and schizophrenia. Given the movement away from segregated, specialized institutions and toward use of community-based supports and services, increasing numbers of persons with such diagnoses are being admitted to LTC. Adults with schizophrenia and IDD are admitted at much earlier ages than those without such diagnoses—as many as 20 years earlier, on average. Consequently, more attention to how best to support them is warranted, and in fact, mandated.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Hebrew SeniorLife, the Marcus Institute for Aging Research. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

EH drafted the initial version of the manuscript, with major contributions by LM. JM conducted the analyses and provided major contributions to the writing. GAH provided valuable and important feedback on the manuscript prior to its completion. All authors contributed to the development of the study topic and design.

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The Association Between Possible Stressors and Mood Outcomes in Older Residents of Long-Term Care Facilities

Toward Studying Resilience in Long-Term Care Facilities

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Introduction: Resilience incorporates the presence of a positive response to some type of stressor. To properly explore resilience, it is important to systematically identify relevant stressors. We aimed to identify (combinations of) stressors with the strongest relationship with observer-reported and self-reported mood outcomes in older residents of long-term care facilities (LTCFs) in The Netherlands.

Materials and Methods: We included 4,499 older ($\geq$60) residents of 40 LTCFs who participated in the Dutch InterRAI-LTCF cohort between 2005 and 2018. The association of possible stressors (single stressors, number of stressors, and combinations of two stressors) in this population with observer-reported (Depression Rating Scale) and self-reported mood outcomes was analyzed using multilevel tobit models and logistic regressions.

Results: Major life stressor ["experiences that (threatened to) disrupt(ed) a person's daily routine and imposed some degree of readjustment"] and conflict with other care recipients and/or staff were most strongly associated with both mood outcomes. Furthermore, conflict was a particularly prevalent stressor (24%). Falls, fractures, and hospital visits were more weakly or not associated at all. Overall, the associations were similar for the mood outcomes based on observer-report and self-report, although there were some differences. Multiple stressors were more strongly associated with both mood outcomes than one stressor.

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Conclusion: Major life stressor and conflict emerged as important stressors for resilience research within the psychological domain in LTCF residents. Further (longitudinal) research is necessary to determine the directionality and relevance of the strong association of conflict with mood for LTCF practice.

Keywords: resilience, mood outcome, self-report, stressor, conflict, major life stressor, LTCF, nursing home

INTRODUCTION

In recent years, the concept of resilience has gained popularity in aging research. This concept encompasses the presence of a positive response (outcome) to some type of stressor (adversity) and the mechanism by which that positive response is achieved (1). However, there is some scientific discussion on what a stressor should entail (2, 3).

One perspective is that a stressor should ordinarily "pressure adaptation and lead to negative outcomes in a majority of people" (4, 5). An earlier study operationalized this perspective in community-dwelling older adults by requiring a significant negative relationship with quality of life for each stressor included in their resilience analyses (6). This is a uniquely thorough approach as the choice of stressor is often not substantiated in resilience research (2). Although stressors have been explored in community-dwelling older adults using both quantitative and qualitative research methods, to our knowledge, this has not been done in older adults living in long-term care facilities (LTCFs) (6, 7). To properly explore resilience in LTCFs, it is important to systematically identify stressors this population as well.

There are several aspects to take into account when studying stressors in the context of resilience. Hildon et al. showed that stressors often cluster within an individual and that a combination of stressors had a greater impact on quality of life than one stressor (2, 6). Investigating the combinations of stressors may be of extra importance in older adults as there is an abundance of possible stressors in old age, such as personal illness, illness or death of relatives, and cognitive impairment (1).

In addition, a common perspective is that resilience is not generalizable across domains (2). Therefore, when identifying relevant stressors for resilience research, the relationship with the specific outcome domain of interest should be explored. The majority of resilience research in older adults has occurred within the psychological domain. In most of these studies, the outcome has been defined as the absence of psychological distress as operationalized by the absence of depressive/mood symptoms (8). Given the relation between mood symptoms and quality of life, investigating resilience, and thus stressors, in relation to mood symptoms can play a great role in identifying factors that can reduce the burden of these stressors (9).

Furthermore, it is important to consider that the meaning of a possible stressor for the person experiencing this stressor can be different from the meaning assigned by an observer/researcher/professional to the stressor (1, 10, 11). It has therefore been proposed that an ideal resilience research design includes both objective and subjective outcomes (4).

The aim of this study is to identify (combinations of) stressors with the strongest relationship with observer-reported (objective) and self-reported (subjective) mood outcomes in older residents of LTCFs in The Netherlands.

MATERIALS AND METHODS

Study Design

In this cross-sectional study, the association of possible stressors with observer-reported and self-reported outcomes was determined in older residents of LTCFs using the Dutch InterRAI-LTCF cohort.

Data and Population

Analyses were conducted with assessments of residents (≥60 years) of LTCFs throughout The Netherlands using the interRAI LTCF assessment instrument. The routine care assessments consist of ±250 items across 19 domains of health and functioning and are conducted by nursing staff. All items are scored by the assessors, unless stated otherwise (i.e., self-reported). The assessments were an element of the standard care for the residents of each of the participating facilities. Data collection has been described in detail previously (12).

After de-identification, data were transferred to the interRAI-LTCF database at Amsterdam University Medical Centers–location VU. Data collection occurred in compliance with European Union (EU) legislation. Since 2014 an opt-out procedure was applied in compliance with the EU General Data Protection Regulation. Residents were informed by facility staff that their data could be used for research purposes and they had the opportunity to object. The VU ethics committee approved the use of data for research in this way.

Assessment Selection

The data utilized for this study were collected from 2005 to 2018 and consist of a total of 29,199 assessments involving 7171 residents. Assessments from eight facilities that participated in a temporary pilot (≤15 total assessments) were excluded. Subsequently, we selected the first assessment for each resident, which met these criteria: 1. not a discharge assessment, 2. length of stay of ≥90 days, and 3. the resident was ≥60 years old. A stay of ≥90 days was required because of our interest in stressors that occurred within the LTCF setting. Discharge assessments were excluded as these are utilized to register discharge/death and are thus incomplete.

Measures

Stressors

Possible stressors within the LTCF-assessment were identified in several stages.

First, six experts individually selected possible stressors relevant to this population from the complete LTCF item list based on their expertise [e.g., (elderly care) medicine and aging research]. In a subsequent group discussion, these possible stressors were narrowed down to events, whereas symptoms such as pain and dizziness were excluded. This led to eight possible stressors as described in **Table 1**. An association between the variable major life stressor and mood symptoms in older adults has been established previously in community-dwelling older persons (13). Conflict with other residents and staff has been shown to be associated with sadness in a Canadian sample of LTCF residents with dementia (14). The other events are health-related (such as hospitalization, fractures, and falls). The theoretical basis of including these events is that they lead to a disruption in daily routine and often functional decline, which, in turn, can affect mood.

TABLE 1 | Possible stressors.

Hospital stay in the last 90 days
Major life stressor in the last 90 days
Conflict with or repeated criticism of staff and/or other care recipient
Hip fracture in the last 30 days
Other fracture in the last 30 days
Falls in the last 90 days (1 or more)
Inpatient acute care in hospital with overnight stay in the last 90 days
Emergency room visit in the last 90 days

The stressor hospital stay was based on the interRAI variable "time since last hospital stay". This variable was dichotomized: indicating the occurrence of any type of hospital stay (both planned and acute) in the previous 90 days.

The dichotomous (yes/no) variable "major life stressors in the last 90 days" is defined by the interRAI manual as "experiences that either disrupted or threatened to disrupt a person's daily routine and that imposed some degree of readjustment". Several examples are provided, such as the death or severe illness of a close family member or friend (15).

The stressor conflict was based on two items, namely, "conflict with or repeated criticism of staff" and "…other care recipients". These dichotomous items are described as the presence of "a reasonably consistent pattern of hostility or criticism directed toward one or more staff" and "other care recipients", respectively, over the last 3 days. We created a dichotomous variable indicating conflict with staff and/or other care recipient.

The stressors hip fracture and other fracture are based on the interRAI items "hip fracture during last 30 days" and "other fracture during last 30 days". These items were dichotomized into two variables indicating the presence of the diagnosis hip fracture/other fracture in the previous 30 days.

The interRAI item "falls" with four categories ranging from no falls in last 90 days to two or more falls in last 30 days was dichotomized into a variable indicating the occurrence of falls in the last 90 days.

For the acute hospital care stressors, the interRAI items "inpatient acute care hospital with overnight stay" and "emergency room visit (not counting overnight stay)" were used. These were recoded into two dichotomous variables indicating the occurrence of the specifically acute hospital stay and emergency room visit, respectively, in the previous 90 days.

Outcomes

The association of the possible stressors with two mood outcomes was explored:

1. The Depression Rating Scale (DRS) represents observer-reported mood symptoms. It is based on seven observed mood symptoms: made negative comments; persistent anger with self or others; expression of unrealistic fears; repetitive health complaints; repetitive anxious complaints/concerns (non-health–related); sad, pained, worried facial expression; and crying/tearfulness. Each of these items is scored 0 to 3 with 0 indicating that the symptom is not present and 3 indicating that the symptom is present every day for the last 3 days. These are recoded to three categories: not present, present up to 2 of the last 3 days, and present every day of last 3 days. The total score ranges from 0 to 14, with 14 indicating that all mood symptoms were present during the last 3 days (16). In a sample of 4,156 residents in seven EU countries the average weighted kappa's for test-retest and interrater reliability were 0.75 and 0.70, respectively, across all 14 interRAI mood symptoms, both observer-reported and self-reported (17). In a Korean sample of 434 residents, the kappa for interrater reliability for all (11) observer-reported mood outcomes was 0.67. The Cronbach's alpha for internal consistency of the items in the DRS in this sample was 0.82 (18).
2. Self-reported mood was measured in the LTCF assessment with three self-reported mood items: loss of interest, sadness, and anxiety. The resident is asked to report whether they have experienced these mood symptoms in the last 3 days. We created a composite score, which we call SRM, ranging from 0 to 6, in a similar fashion as the DRS. Not willing/able to respond was coded as missing. A score of 6 signifies that all three mood symptoms were present during the last 3 days. In the Korean sample, the kappa for the interrater reliability for the three self-reported symptoms was 0.72 (18).

Covariates

Covariates included demographics such as age, gender, and length of stay within the facility. Other covariates were indicators of health: 1. the number of a total of 15 common somatic diagnoses (neurological, cardiac/pulmonary, infections, cancer, and diabetes mellitus) and 2. the presence of a psychiatric diagnosis (anxiety, depression, and/or schizophrenia).

Several interRAI scales were used as indicators of functioning in different domains. Cognitive functioning was assessed with the Cognitive Performance Scale (CPS) including items on memory impairment and executive functioning. Scores range from 0 (intact) to 6 (very severe impairment). A score of 3 or more indicates moderate to severe impairment. The CPS has been shown to be correlated with the mini-mental state examination (MMSE) in validation studies (19, 20). Activities of daily living (ADL) functioning was represented by the ADL Hierarchy scale

(ADLH), in which scores range from 0 (no impairment) to 6 (total dependence) (21). Social functioning was represented by a Revised Index of Social Engagement (RISE). Scores range from 0 to 6, with higher scores indicating greater social engagement within the facility (22).

Analyses

Descriptive analyses revealed substantial floor effects in both the DRS and SRM (37% and 60% of the scores being 0, respectively). Therefore, the relationship between each stressor and outcome combination was explored using multilevel tobit models. Tobit models have been proven to ameliorate the problems caused by floor effects (23, 24). A latent outcome variable is estimated for those with a score of 0, representing what the outcome would have been for this individual if scores below 0 were possible. The regression line is based on the true outcome score for those with a score above 0 and the latent outcome score for those with a 0 on the true outcome score (23).

All data preparation and descriptive statistics were performed in IBM SPSS statistics version 26 (25). All analyses were performed in STATA version 14 (26).

We performed complete case analyses as there was a minimal amount of missing data for all variables, except SRM. Approximately 18% of the residents did not respond to the self-reported questions. Therefore, the models with SRM as outcome were based solely on the population that was capable/willing to respond to the questions. Using descriptive statistics (Mann–Whitney, T-, and χ^2-tests), the differences between those with and without complete SRM were explored.

Single Stressor

An unadjusted and an adjusted model were generated to determine the association between each stressor and each outcome (DRS and SRM), leading to four models per stressor. The care facility was included as a second level in each model.

All covariates described above were added to the adjusted models. Gender and cognition (dichotomously, based on the cutoff for CPS of $\geq$3) were explored as effect modifiers by adding their interaction term with the stressors to each adjusted model. Gender differences in the experience of mood symptoms have been extensively described (27, 28). Cognitive functioning may have an effect on how stressors are experienced and, therefore, on their relationship with mood.

Combination of Stressors

Analogous to the single stressors analyses, four tobit models were generated in which the independent variable was the number of stressors at the time of assessment (0, 1, 2, 3, or more). Similarly, four tobit models were performed for each of the most common (at least as common as the least common single stressor) combinations of two stressors.

Sensitivity Analyses

To explore the robustness of the associations between stressors and outcomes, we performed unadjusted and adjusted multilevel binary logistic regressions for each of the stressor–outcome combinations described above. For these analyses, the outcomes were dichotomized. For the DRS, the standard cutoff of 3 or more, indicating clinically significant mood symptoms, was utilized for the dichotomization (16). For the SRM, a cutoff of 2 was determined on the basis of the distribution of the SRM scores relative to the DRS scores across all baseline assessments of the complete the Dutch InterRAI-LTCF cohort.

TABLE 2 | Description of the complete study population.

Characteristic	*n* (Complete sample = 4,499)	Descriptives
Age in years, mean (SD)	4,499	83.5 (7.74)
Women, *n* (%)	4,494	3,183 (70.7%)
LOS in days, mean (SD)	4,499	711.1 (1499.9)
Number of somatic diagnoses, mean (SD)	4,499	1.74 (1.25)
Presence of psychiatric diagnoses, *n* (%)	4,499	1,110 (24.7%)
CPS, mean (SD)	4,460	1.93 (1.70)
ADLH, mean (SD)	4,499	2.15 (1.78)
RISE, mean (SD)	4,496	3.64 (2.10)
Presence of stressor, *n* (%)		
Conflict with staff and/or other care recipient	4,496	1,058 (23.5%)
Falls	4,499	960 (21.3%)
Major life stressor	4,496	846 (18.8%)
Hospital stay	4,499	424 (9.4%)
Inpatient acute care	4,496	292 (6.5%)
Hip fracture	4,499	155 (3.4%)
Emergency room visit	4,499	123 (2.7%)
Other fracture	4,499	91 (2.0%)
DRS, median/mean (SD)	4,497	1/2.35 (2.84)
SRM, median/mean (SD)	3,705	0/1.00 (1.56)

CPS, Cognitive Performance Scale (range 0–6); ADLH, Activities of Daily Living Hierarchy Scale (range 0–6); RISE, Revised Index of Social Engagement (range 0–6); DRS, Depressive Rating Scale (range 0–14); SRM, Self-reported Mood scale (range 0–6).

RESULTS

We included 4,499 residents from 40 facilities. **Table 2** shows the baseline characteristics. Prevalence of the stressors ranged from 2.0% (other fracture) to 23.5% (conflict).

Those with SRM were slightly older (83.6 vs. 82.7 years), had a shorter average length of stay (700 vs. 764 days), had less somatic diagnoses (1.7 vs. 2.0), were less cognitively impaired (CPS: 1.6 vs. 3.6), were less impaired on ADL functioning (ADLH: 1.9 vs. 3.4), had a greater level of social engagement (3.9 vs. 2.4), and had a lower score on the DRS (mean: 2.1 vs. 3.5; median score: 1 vs. 3). In addition, they were less likely to have a psychiatric diagnosis (23% vs. 31%).

Single Stressor

Table 3 provides insight in the association between the presence of each stressor and the two outcomes. The stratified adjusted regression coefficients for those stressors that showed a statistically significant interaction with cognition or gender are provided in the **Supplementary Materials**

TABLE 3 | Overview of the association between single stressors and: a. observer-reported mood (DRS); b. self-reported mood (SRM) in the subpopulation with SRM complete.

a. DRS

	Unadjusted		**Adjusted[a]**	
Single stressor	***n***	**Regression coefficient (95% CI)**	***n***	**Regression coefficient (95% CI)**
1. Conflict	4,496	**3.69 (3.43–3.95)**	4,454	**3.07 (2.83–3.30)**
2. Falls	4,497	**1.18 (0.88–1.48)**	4,454	**0.86 (0.59–1.12)**
3. Major life stressor	4,496	**1.58 (1.27–1.89)**	4,454	**1.46 (1.18–1.74)**
4. Hospital stay	4,497	**−0.57 (−1.01–0.13)**	4,454	−0.05 (−0.45–0.35)
5. Inpatient acute care	4,494	**−0.57 (−1.10–0.05)**	4,451	−0.10 (−0.56–0.37)
6. Hip fracture	4,497	0.65 (−0.02–1.33)	4,454	**0.74 (0.14–1.35)**
7. Emergency room visit	4,497	0.60 (−0.16–1.36)	4,454	0.65 (−0.03–1.33)
8. Other fracture	4,497	0.06 (−0.84–0.95)	4,454	0.04 (−0.75–0.84)

b. SRM

	Unadjusted		**Adjusted[a]**	
Single stressor	***n***	**Regression coefficient (95% CI)**	***n***	**Regression coefficient (95% CI)**
1. Conflict	3,704	**1.83 (1.56–2.10)**	3,681	**1.09 (0.86–1.32)**
2. Falls	3,705	**0.95 (0.67–1.22)**	3,681	**0.61 (0.37–0.85)**
3. Major life stressor	3,704	**1.15 (0.87–1.43)**	3,681	**0.97 (0.73–1.22)**
4. Hospital stay	3,705	0.02 (−0.38–0.43)	3,681	**0.45 (0.10–0.80)**
5. Inpatient acute care	3,702	0.08 (−0.39–0.55)	3,678	**0.47 (0.06–0.87)**
6. Hip fracture	3,705	**0.67 (0.06–1.28)**	3,681	0.50 (−0.03–1.03)
7. Emergency room visit	3,705	0.40 (−0.31–1.12)	3,681	0.35 (−0.27–0.98)
8. Other fracture	3,705	0.73 (−0.02–1.49)	3,681	0.59 (−0.06–1.24)

Statistically significant regression coefficients are bolded.

DRS, Depressive Rating Scale; SRM, Self-reported Mood scale.

In all models, facility was included as a second level.

[a] Adjusted for age, gender, length of stay, number of somatic diagnoses, the presence of a psychiatric diagnosis, cognitive functioning, ADL functioning, and social involvement.

(**Supplementary Table E-1**). All statistically significant associations in the adjusted models were positive. We will describe the results of the adjusted models, including the significant interactions with cognition and gender. Unless stated otherwise, the unadjusted results were similar.

Adjusted Model With Outcome DRS

Conflict clearly had the strongest association with the observer-reported mood symptoms, on average, those with conflict had a DRS score that was 3 points higher than those without (regression coefficient = 3.07). The second largest adjusted regression coefficient was 1.46 for major life stressor. The association with conflict was greater in females than in males and greater in those with no to mild cognitive impairment than those with at least moderate impairment. Falls and hip fracture were also significantly associated with observer-reported mood symptoms. Upon stratification, the association with hip fracture remained significant in women, but not in men. Hospital stay and inpatient acute care had a negative association with DRS only in the unadjusted models.

Adjusted Model With Outcome SRM

Conflict and major life stressor also had the strongest association with self-reported mood symptoms. The adjusted regression coefficients were similar, 1.09 and 0.98, respectively. Again, the association between conflict and mood symptoms was greater in females and those with no to mild cognitive impairment. Falls, hospital stay, and inpatient acute care were also positively associated with self-reported mood.

The findings of the sensitivity analyses employing binary logistic regression to explore the association with the dichotomized outcomes were similar (**Supplementary Table E-2**).

Combination of Stressors

Zero, one, two, and three or more stressors were reported for 45%, 33%, 15%, and 7% of the residents, respectively. Any number of stressors was associated with more mood symptoms than no stressors. Multiple stressors had a stronger association with mood on both outcomes than one stressor (**Table 4**). **Supplementary Table E-3** provides the similar results of the binary logistic regressions examining the relationship between the number of stressors and the dichotomized outcomes. **Supplementary Tables E-4**, **E-5** present the prevalence of the most common combinations of two stressors and their association with the mood outcomes.

DISCUSSION

Single Stressors

Major life stressor and conflict with staff and/or other care recipients were the most commonly occurring stressors and were also most strongly associated with both mood outcomes. These stressors are therefore particularly suited for use in resilience research within the psychological domain in older residents of LTCFs. Falls are also unambiguously and significantly associated with both mood outcomes and may therefore be considered a stressor within the psychological domain. Events related to acute health issues or health care, such as inpatient/outpatient acute hospital care and fractures, were less strongly associated or not associated with mood outcomes in this population.

As mentioned, Garms-Homolová et al. recently reported a significant association of major life stressor in the last 90 days with DRS score in home care patients (13). More generally, the association between stressful life events and mood symptoms in older adults has been described repeatedly (29, 30).

The importance of conflict with care staff and/or other care recipients as a stressor in LTCF residents is a more novel finding. Not only did conflict have a strong association with mood symptoms, it is also the most prevalent (24%) stressor in this study. Although conflict has been acknowledged as an important point of attention within LTCF policy (31, 32), little empirical research is available on the topic (14). O'Rourke et al. described a positive association between conflict with staff and residents and sadness in LTCF residents in Canada with moderate (and severe) dementia (14). Interestingly, the prevalence of conflict was much lower in the Canadian population. Conflict with staff was described in 6% and with another care recipient in 7% of the residents, compared to 23% and 27%, respectively, of the residents with moderate to severe dementia in the current study. Characteristics such as age, gender, and length of stay were similar in the two (sub-)populations. The discrepancy may be a result of interpretation of conflict, cultural differences, or differences in characteristics of the LTCFs (for example, staffing levels and group activities within the LTCF).

The results of this study suggest that conflict is strongly associated with mood symptoms for older LTCF residents irrespective of their cognitive status. In an attempt to specify the stressor conflict further, we explored the association of "conflict with or repeated criticism of staff" (prevalence 16%) and "conflict with or repeated criticism of care recipient" (prevalence 18%) separately in **Supplementary Material**. The regression coefficients did not significantly differ from each other or from the coefficient for the combined stressor conflict with staff and/or care recipient (results not shown).

Future research should explore the impact of conflict on mood and quality of life of residents, both quantitatively and qualitatively. Subsequently, if relevant, research can focus on possibilities to prevent and resolve conflict with other residents as with staff at both the individual and LTCF policy level (14). Different nursing home conflict prevention strategies have been proposed previously, such as training staff to handle provocations and recognize inter-resident conflict, rotating staff responsibility for "difficult" residents, and facilitating open communication between staff and management (32). For now, this studies' results may motivate LTCF care providers and staff to be extra alert to resident conflict (both with other residents as with staff) and its consequences.

TABLE 4 | Overview of the association between the presence of one or more stressors and: a. observer-reported mood (DRS); b. self-reported mood (SRM) in the subpopulation with SRM complete.

a. DRS

Number of stressors (reference = 0)	Unadjusted regression coefficient (95% CI) *n* = 4,493	Adjusted[a] regression coefficient (95% CI) *n* = 4,451
1	**1.96 (1.69–2.24)**	**1.66 (1.42–1.91)**
2	**3.00 (2.64–3.35)**	**2.59 (2.28–2.90)**
3 or more	**2.76 (2.29–3.22)**	**2.59 (2.17–3.00)**

b. SRM

Number of stressors (reference = 0)	Unadjusted regression coefficient (95% CI) *n* = 3,701	Adjusted[a] regression coefficient (95% CI) *n* = 3,678
1	**1.22 (0.95–1.48)**	**0.82 (0.59–1.05)**
2	**1.81 (1.48–2.15)**	**1.32 (1.01–1.59)**
3 or more	**1.98 (1.55–2.41)**	**1.63 (1.25–2.00)**

Statistically significant regression coefficients are bolded.
DRS, Depressive Rating Scale; SRM, Self-reported Mood scale.
In all models, facility was included as a second level.
[a]Adjusted for age, gender, length of stay, number of somatic diagnoses, the presence of a psychiatric diagnosis, cognitive functioning, ADL functioning, and social involvement.

The association between conflict and observer-reported mood was particularly high. Possibly, the strong association is a result of the fact that items within the DRS may also be indicative of conflict, e.g., "persistent anger with self or others" and "made negative statements". The SRM, on the other hand, only includes self-reported feelings of sadness, loss of interest, and anxiousness. To explore this possibility, sensitivity analyses were performed in which the association between conflict and an adapted DRS score in which the items that were theoretically also strongly indicative of conflict were removed. The two items "persistent anger with self or others" and "made negative statements" were removed, and an adapted score was calculated from a total of five items, leading to a maximum total score of 10. Removing these items only had a slight impact on the strength of the association between conflict and DRS (results not shown). Therefore, a theoretical overlap does not appear to explain the strong association between conflict and DRS.

Because, on average, major life stressor and conflict were negatively associated with mood, they are suited for resilience research (4, 6). In a next step, a longitudinal operationalization of resilience may involve having relatively little/no extra mood symptoms despite having undergone these stressors. Subsequently, individual and social factors that are associated with this resilience in the face of these stressors can be identified.

Combination of Stressors

Multiple stressors were more strongly associated with both observer-reported and self-reported mood than one stressor. However, unlike in the study by Hildon et al., there does not seem to be an additive effect of more stressors, as three or more stressors were not significantly more associated with the mood outcomes than two stressors (6). The combination of major life stressor and conflict had the strongest association with both mood outcomes. Overall, the prevalence of the combination of stressors and the association between the most common combinations and the mood outcomes were in line with the findings on single stressors.

Objective vs. Subjective Outcome

The associations between stressor and mood outcomes based on observer-report (objective) and self-report (subjective) in older LTCF residents were similar. Exceptions are the strength of the association with conflict as described above and the associations with hospital stay/inpatient acute care. People who were hospitalized had more self-reported depressive symptoms, although they tended to have less observer reported symptoms (DRS). A possible explanation for this contradiction may be that, in The Netherlands, the most (cognitively) frail residents are not always referred to hospital. Residents with cognitive impairment have higher scores on the DRS than the cognitively intact residents. The fact that the stressor occurs more often in the cognitively intact may have led to a lower DRS score in those who experienced hospitalization. As the residents who completed the SRM were more cognitively intact than the people without SRM scores, this effect may be less evident in the models with SRM.

Strengths and Limitations

This study gives a first insight into stressors for LTCF residents, using both objective and subjective outcome measures in a large representative cohort of LTCF residents in The Netherlands. The use of, nearly complete, routine care data minimizes selection bias.

There are also limitations to consider. As this is a cross-sectional study, we cannot make inferences on the directionality/causality of the associations between the stressors and mood symptoms. For example, in the case of conflict, it is conceivable that the relationship is bidirectional.

This information on the possible stressors is limited by the information available within the interRAI assessment. For example, the descriptions of major life stressor are quite broad, resulting in limited knowledge on the exact nature of the stressor experienced. Other studies have described similarly broad stressors (6). Research utilizes more detailed questionnaires of major life type stressors, such as the List of Threatening Experiences Questionnaire (LTE-Q), and qualitative methods are of added value when studying experienced life stressors as they allow for a more detailed exploration of number, nature, and complexity of the stressors (30).

The interRAI dataset uniquely allows for comparison of the association with both observer-reported and self-reported mood outcomes. The models with the outcome SRM only apply for those capable/willing to answer the self-report questions (missing data not at random). On average, this population was slightly older, less cognitively, and functionally impaired and had less diagnoses and a considerably lower score on the DRS. Although inherent to this outcome type, this should be considered when interpreting the results. An example is discussed in Section Objective vs. Subjective Outcome.

CONCLUSIONS

Major life stressor and conflict had the strongest association with both mood outcomes and are, therefore, particularly suited as stressors within psychological resilience research in older LTCF residents.

The association between conflict with other residents/care staff and mood symptoms was remarkably strong. Further (longitudinal) research is necessary to determine the directionality and relevance of this association for LTCF practice.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to privacy restrictions. Requests to access these datasets should be directed to HH (hpj.vanhout@amsterdamumc.nl).

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

MA, HH, MS, AB, CH, and KJ participated in the initial selection of stressors. MA performed the necessary data management, cleaning, and drafted the manuscript. MA and JT performed data analysis. All authors contributed to the conception and design of the article and finalization of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.811252/full#supplementary-material

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Disparities in Utilization of Psychiatry Services Among Home Care Clients: The Tale of Two Canadian Jurisdictions

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Publicly funded home care in Canada supports older adults in the community to delay institutional care, which results in complex care populations with multimorbidity that includes mental health problems. The purpose of this study is to examine prevalence of psychiatric diagnoses and other mental health symptoms among older clients in two publicly funded Home Care (HC) Programs and their psychiatry service utilization (psychiatrist visits) after being admitted to home care. This retrospective cohort study examines clients age 60 years and older in the two Canadian provinces of Manitoba (MB), specifically the Winnipeg Regional Health Authority (WRHA) ($n = 5{,}278$), and Nova Scotia (NS) ($n = 5{,}323$). Clients were admitted between 2011 and 2013 and followed up to 4 years. Linked data sources include the InterRAI Resident Assessment Instrument for Home Care (RAI-HC), physician visit/billing data and hospital admission data. Both regions had similar proportions (53%) of home care clients with one or more psychiatric diagnoses. However, we observed over 10 times the volume of psychiatry visits in the WRHA cohort (8,246 visits vs. 792 visits in NS); this translated into a 4-fold increased likelihood of receiving psychiatry visits (17.2% of WRHA clients vs. 4.2% of NS clients) and 2.5 times more visits on average per client (9.1 avg. visits in MB vs. 3.6 avg. visits in NS). The location of psychiatry services varied, with a greater number of psychiatry visits occurring while in hospital for WRHA HC clients compared to more visits in the community for NS HC clients. Younger age, psychotropic medication use, depressive symptoms, dementia, and having an unstable health condition were significantly associated with receipt of psychiatry visits in both cohorts. Access to psychiatric care differed between the cohorts despite little to no difference in need. We conclude that many home care clients who could have benefitted from psychiatrist visits did not receive them. This is particularly true for rural areas of NS. By linking the RAI-HC with other health data, our study raises important questions about differential access to psychiatry services by site of care (hospital vs. community), by geographical location (MB vs. NS and urban vs. rural) and by age. This has implications for staff training and mental health resources in home care to properly support the mental health needs of clients in care. Study results suggest the need for a mental health strategy within public home care services.

Keywords: home care, older adults, mental health, physician visits, psychiatry services

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INTRODUCTION

Publicly-funded home care in Canada provides personal support and home health services to older adults in the community with the aim to keep clients safely living at home and to reduce hospital or long-term care facility admissions (1). Efforts to shift institutional care for older adults to community care have resulted in complex care populations in home care programs (2). Older adults using home care live with high levels of frailty and multimorbidity, including high rates of mental health problems (3).

There is a substantial body of literature on mental health in older adults. First, the high prevalence of mental health illnesses in this population is well-established. Among persons over the age of 65 years, the prevalence of mental health illnesses range from 17 to 30%, or as high as 40–50% if sub-clinical depression, anxiety, or dementia-related problems are included (4, 5). More than one-quarter of long-stay home care clients have one or more psychiatric diagnoses, which was shown to be associated with higher rates of home care and long-term care use (5, 6). Older adults therefore experience higher rates of mental health problems than the general Canadian population, where one in five Canadians live with a mental health illness each year (7).

Second, there are substantial and unique barriers faced by these older adults to diagnose and treat their illnesses. These intrinsic (i.e., attitudes of care providers, personal/cultural stigma and confounding medical comorbidities) and extrinsic (i.e., cost, transportation and reliance on caregivers) barriers are summarized in a recent systematic review by Lavingia et al. (8). Older adults living with mental health illness are often subjected to a double burden preventing referral to psychiatry services. While more comorbidities and loss of social connections are related to higher rates of depression, anxiety and other mental health problems, these same problems are often underreported by patients and under diagnosed by clinicians (4, 9). Referral to psychiatry services is impeded by the stigma surrounding mental health, the belief that mental illness is a normal part of the aging process and the complexity of distinguishing symptoms of mental illness from multifaceted medical conditions (8).

Lastly, there is good evidence to suggest older adults who receive diagnoses and treatment for psychiatric conditions have better health outcomes and quality of life than those who are not diagnosed (10). Even for certain diagnoses that are expected to progress or relapse over time, seeing a specialist can provide options to manage symptoms, promote recovery and improve well-being for older adults and their caregivers (10). The Mental Health Commission of Canada identifies four unique populations of older adults who benefit from specialists with additional psychiatric training: (i) older adults with recurrent, persistent or chronic mental illness; (ii) older adults with late onset mental illnesses; (iii) older adults with behavioral and psychological symptoms associated with dementias, and (iv) older adults with chronic medical problems with known correlations with mental illnesses (e.g., cerebral vascular disease) (10). Additionally, substance misuse and suicidal ideation are highly prevalent in this population (10). Understanding and managing these unique presentations of mental health takes training and specialized knowledge.

What has not been systematically documented or explored is the magnitude of difference between need of psychiatry services and receipt of these services. Even in a country with universal health care such as Canada, it is generally purported that mental health services have been neglected (7, 11). Underfunding, narrow public insurance coverage, geography (urban vs. rural, provincial variation) and unavailability of primary care services have contributed to high rates of unmet needs and inaccessibility of specialized services (11–13). Of Canadians needing mental health care in 2018, 41.2–60.3% self-reported having unmet or only partially met needs, with particular deficits in finding counseling or therapy for psychiatric issues (13). Furthermore, there is even less evidence to compare unmet needs in older adults with mental health diagnoses, gaps which are hypothesized to be even greater than the general population. In one American study, only 5% of users of publicly funded mental health services were older adults despite comprising 20% of the study population. Other studies have shown a reluctance of older adults compared with younger adults to use psychiatry services after a mental health diagnosis (14, 15). Availability of specialized services can be particularly challenging for older adults with psychiatric diagnoses who live in rural areas. Overall, there are fewer psychiatrists and mental health services in rural areas of Canada, where healthcare resources including psychiatry services are clustered in the larger urban areas (16, 17). In rural areas, which represent the highest proportion of older people in their populations, responsibility for delivery of psychiatric care often falls to other services (e.g., emergency departments) in the absence of dedicated mental health facilities (18). To our knowledge, there is no evidence comparing need for mental health services and prevalence of seeing a psychiatrist in older adults in different areas in Canada. This research can help us better understand geographical and age-related differences in access to mental health care and guide areas for potential interventions to improve care for this population.

As the Canadian senior population grows, combined with the increased shift of older adult care to the community, home care services will increasingly be expected to help older adults with mental health conditions. Home care will need to collaborate with specialized mental health services to best care for this increasingly multi-morbid population. This study examines the prevalence of psychiatric diagnoses and other mental health symptoms among older clients in two publicly funded Home Care Programs in Canada: the province of Nova Scotia (NS) and the Winnipeg Regional Health Authority (WRHA) in the province of Manitoba (MB). In addition, we examine the psychiatry service utilization (psychiatrist visits) by home care clients.

MATERIALS AND METHODS

Study Setting and Population

This study is part of a larger research program examining the pathways of older adults with chronic and long term conditions through home care, in the large urban centre serviced by the

WRHA and the province of Nova Scotia as a whole (19). The study population included older adults, age 60 or older at time of admission to home care, who were long-stay clients (receiving service for 60 days or longer) in the publicly funded Home Care Programs in the WRHA or Nova Scotia. Including all of Nova Scotia in the study provided the opportunity to examine both urban and rural perspectives.

In both jurisdictions, a range of mental health services are provided in the community and in hospital. Home care clients usually have to be seen by another healthcare professional who makes a referral to psychiatry services, usually in the form of an outpatient clinic visit. Referrals can be made through a family physician, a nurse, an emergency physician, or allied health professionals who work with Home Care. Referral by a family physician or home care staff can be made to Community Mental Health Services for community follow up. Both settings have mental health and addictions crisis lines. Both provinces list directories of government, health and community resources online or through a telephone number. Telephone self-referrals, through a Central Intake service were available in the WRHA during the period of this study (20). In Nova Scotia, some in-patient mental health services operated only in the largest urban centre in the province, the city of Halifax. Notably, the only in-patient program for geriatric psychiatry is located in Halifax (21).

Older adults with mental illnesses may also be referred to a geriatrician or geriatric psychiatrist. Geriatric outreach teams are a cornerstone of specialized services for older adults in both provinces (4, 10), consisting of multidisciplinary team members who take a holistic approach to assessment, consultation, treatment and education for clients and their families with the goal of helping clients remain at home (4). These outreach teams, as well as geriatric day programs, often have access to specialized mental health professionals, illustrating another pathway by which home care clients can access psychiatry services.

Study Design and Data Sources

A retrospective cohort study was conducted to examine the mental health of home care clients and their use of psychiatry services. Several clinical and administrative data sources were utilized. Data sources from both WRHA and Nova Scotia jurisdictions were substantially the same, and included:

- Resident Assessment Instrument for Home Care (RAI-HC) (22) is mandated in both jurisdictions as part of regular clinical practice. The RAI-HC is a standardized, comprehensive assessment for use with adult and non-palliative home care clients. It is the data standard for the Canadian Institute for Health Information (CIHI) national reporting system for home care (23), and has acceptable reliability and validity (24, 25). Adult home care clients in both jurisdictions, expected to be on service at least 60 days, receive an initial assessment on referral to home care, and are expected to be re-assessed annually, or earlier in the case of a significant clinical change. The software for electronic completion of the assessment in both jurisdictions ensures that assessments are fully completed, thereby providing RAI-HC data without any missing values.
- Discharge Abstract Database (DAD) is the CIHI standard for acute care hospitalizations and is used here to inform mental health ICD-10 diagnoses assigned during a hospitalization within the home care episode.
- Vital statistics were provided to inform dates of death, as part of understanding discharge from home care.
- Physician administration records, either used for direct billing or as part of shadow-billing (where non-fee-for-service payment is in place) during the home care episode. Data included the physician specialty, date of service, location of service, and an ICD-9 diagnosis code.

Two cohorts were selected in an equivalent manner for each jurisdiction, the criteria being that a home care client age 60 or older received an initial RAI-HC assessment between January 1, 2011 and December 31, 2013, and at least one additional RAI-HC assessment in the following 4 years. They also had to have been active on home care for at least 60 days, and received some home support service (e.g., assistance with tasks such as bathing or dressing) in the first 120 days of their home care episode. The criterion that most greatly restricted cohort selection (∼30% of potential cases in NS and 20% in the WRHA) was the home support service requirement. Those selected, at the time of their initial assessment, were more likely to have had a recent decline in physical independence, not have a diagnosis of dementia or significant cognitive impairment, and have experienced a recent stay in hospital. Those not selected were more likely to have refused service or be deemed ineligible. The review period for this cohort was from the time of the initial assessment until discharge from home care, up to 4 years from the initial assessment.

For the analyses, the WRHA was treated as a single geographic area, containing no rural areas. Nova Scotia was further sub-divided into three zones based on the home care client's postal forward sortation area (FSA) at their initial assessment:

- Halifax and near-vicinity, based on FSA that mapped to Halifax or to an area with a strong or moderate metropolitan influence (26) of Halifax;
- Rural areas, denoted by a zero as the second digit of the FSA (27);
- Non-Halifax urban, all others.

Mental health diagnoses were assigned from a chosen list of ICD-9 and ICD-10 codes, listed in the **Supplementary Material**. Note that this comprised a broad range of mental health conditions but excluded those for Alzheimer's disease or a related dementia. Dementias were excluded as these are neurocognitive disorders and not mental illnesses *per se*. Excluding dementias from the list of diagnoses provided a better focus on mental illness in home care.

Client characteristics were drawn from the RAI-Home Care assessment items, and included demographic items, current psychotropic medications, a scale of depressive symptoms i.e., Depression Rating Scale (DRS) (28) and one for risk of long-term care facility placement i.e., Method for Assigning Priority Levels (MAPLe) (29), and other symptoms of anxiety or psychosis.

TABLE 1 | Psychiatry services, by province, and urban/rural.

	WRHA	Nova Scotia			
		All	Halifax	Urban non-Halifax	Rural
Home care clients in study (*N*)	5,278	5,323	1,306	1,755	2,262
#Clients with psychiatry service (%)	908 (17.2)	223 (4.2)	93 (7.1)	84 (4.8)	46 (2.0)
#Of psychiatry visits	8,246	793	338	330	125
Avg. #of visits among clients with psychiatry	9.1	3.6	3.6	3.9	2.7
#Of unique psychiatrists	107	58	35	17	14
#Of psychiatry visits provided in hospital (%)	6,478 (78.6)	222 (28.0)	143 (42.3)	45 (13.6)	34 (27.2)
#Of psychiatry visits provided in community (%)	1,768 (21.4)	571 (72.0)	195 (57.7)	285 (86.4)	91 (72.8)

Discharge status up to the 4-year period of follow-up was also assigned.

Physician visits with the specialty of psychiatry (i.e., psychiatry visits) from the physician administration records were identified that occurred within that client's home care episode.

Statistical testing across groups used chi-square tests for dichotomous variables, and *t*-tests for continuous variables.

Sensitivity analyses were conducted to shed light on how those in the cohorts with dementia who were more likely to exhibit neuropsychiatric symptoms differed in their likelihood of being seen by psychiatrist, or receiving psychotropic medications.

A multivariable logistic regression model was conducted, for each jurisdiction, on the likelihood of the home care client receiving one or more psychiatry visits, utilizing covariates used in the descriptive analysis. All variables were retained in the model, regardless of their significance.

Ethical approval for this study was obtained from Nova Scotia Health, Mount Saint Vincent University and the University of Manitoba. Research approval and data access was obtained from Manitoba Health, Seniors and Active Living's Health Information Privacy Committee (HIPC) and the WRHA's Research Access and Approval Committee. HIPC provided approval to access the physician administration data for the WRHA cohort from the National Physician Database at the Canadian Institute for Health Information.

All analyses were conducted with SAS v 9.4.

RESULTS

There were 5,278 cases in the WRHA cohort, and 5,323 in NS. Within the NS cohort, 1,306 (24.5%) were in the Halifax area, 1,755 (33.0%) were in urban areas outside of Halifax, and 2,262 (42.5%) were rural (**Table 1**).

Table 1 summarizes the psychiatry visit data for the two cohorts, with further stratification by location of the NS cohort. Across all years of service data following these cohorts (2011–2017) there were 107 different psychiatrists in the WRHA that provided 8,246 visits, and 58 different psychiatrists in NS that provided 793 visits. In the WRHA 79% of the visits were reported to have occurred in hospital, compared to 26% of those in NS.

In the WRHA, 908 (17.2%) received one or more visits by a psychiatrist during their home care episode, compared to 223 (4.2%) in the NS cohort. WRHA psychiatry recipients averaged 9.1 psychiatry visits, while those in NS averaged 3.6 visits.

Table 2 presents selected characteristics by provincial cohort, stratified by receipt of any psychiatry service. Consistently significant differences in both cohorts were found. Those receiving psychiatry services were younger in age, more likely to be receiving psychotropic medications, have a diagnosis of Alzheimer's disease or a related dementia, exhibit depressive symptoms, have a condition considered to be unstable, be at high risk for long-term care admission, not be at ease with others, and have hallucinations. In addition, within the WRHA cohort, clients receiving psychiatry services were more likely to not have an informal caregiver, to have made recent economic trade-off decisions because of limited funds, to have delusions, and to use tobacco daily. Discharge disposition groups differed significantly among the WRHA cohort only, with the clients who received psychiatry more likely to enter a long-term care facility.

Table 2 also summarizes differences *between* the two provincial cohorts among those who received psychiatry services. Here there are fewer differences found, although NS cases receiving psychiatry services were younger, more likely to receive anxiolytic or antidepressant medications, have more depressive symptoms, and were at greater risk of long-term care placement, compared to WRHA cases receiving psychiatry services.

Table 3 presents the same characteristics as **Table 1**, but stratified based on the presence of any mental health diagnosis while on home care. Remarkably, the prevalence of such a diagnosis did not differ across the cohorts, at 53%. Similar to receipt of psychiatry services, those with a diagnosis were consistently more likely in both cohorts to be younger, to be receiving psychotropic medications, have a diagnosis of Alzheimer's disease or related dementia, have depressive symptoms, an unstable condition, be at high risk of long-term care placement, be not at ease with others, exhibit hallucinations, and have daily tobacco use. In addition, those in NS with a mental health diagnosis were more likely to have made recent economic trade-off decisions due to limited funds, while those in the WRHA had significantly higher prevalence of delusions. In both cohorts, those with a mental health diagnosis were more likely to be discharged from home care to a long-term care facility.

TABLE 2 | Sample characteristics at latest RAI-HC assessment, those with and without psychiatry visit.

(%Of the column, unless indicated otherwise)	**WRHA**			**Nova Scotia**			***p* value WRHA vs. NS***
Received any psychiatry while on home care	**No**	**Yes**	***p***	**No**	**Yes**	***p***	
N	4,370	908		5,100	223		
(% of provincial cohort)	82.8	17.2		95.8	4.2		
Mean age in years (standard deviation)	84.3 (8.1)	80.6 (8.7)	**<0.0001**	83.1 (8.3)	79.2 (8.1)	**<0.0001**	**0.029**
Female	66.8	63.2	**0.036**	69.7	70.0	0.922	0.059
Married	31.8	34.8	0.077	30.2	33.2	0.345	0.207
No informal caregiver	1.1	2.2	**0.011**	1.7	3.1	0.093	0.412
Made economic trade-offs due to limited funds	2.8	4.9	**0.001**	4.0	4.0	0.955	0.608
Antipsychotics in the past 7 days	5.6	24.5	**<0.0001**	10.6	24.7	**<0.0001**	0.947
Anxiolytics in the past 7 days	9.1	21.2	**<0.0001**	17.7	31.4	**<0.0001**	**0.001**
Antidepressants in the past 7 days	16.3	39.5	**<0.0001**	33.1	54.3	**<0.0001**	**<0.0001**
Alzheimer's/related dementia	26.5	42.6	**<0.0001**	34.9	48.4	**<0.0001**	0.117
Depressive symptoms (DRS 3+)	8.9	23.7	**<0.0001**	26.4	42.2	**<0.0001**	**<0.0001**
Condition makes cognition, mood, ADL or behavior unstable	42.8	62.8	**<0.0001**	48.7	69.1	**<0.0001**	0.080
High risk of long-term care home entry (MAPLe 4 or 5)	40.8	56.0	**<0.0001**	54.6	67.7	**<0.0001**	**0.001**
Not at ease with others	4.8	11.8	**<0.0001**	8.8	13.0	**0.029**	0.616
Hallucinations	1.2	4.2	**<0.0001**	3.4	5.8	**0.050**	0.289
Delusions	1.5	4.6	**<0.0001**	5.4	7.2	0.252	0.122
Tobacco use daily	5.5	8.6	**0.001**	8.8	11.7	0.146	0.155
Discharge Disposition from Home Care			**<0.0001**			0.222	0.318
• Discharged deceased	19.6	14.8		18.4	16.6		
• Discharged to long-term care facility	30.1	43.7		43.1	49.3		
• Remain on home care after 4 years	39.4	32.3		30.0	28.3		

**Comparing those in the WRHA receiving any psychiatry with those in Nova Scotia receiving any psychiatry.*

DRS, Depression Rating Scale, sum of 7 depressive symptom items, range 0 to 14, higher scores are more severe; ADL, Activities of daily living; MAPLe, Method for Assigning Priority Level, algorithm assigning 1–5 range, with higher scores more at risk of long-term care placement and caregiver distress. Bolding denotes p values significant at the 0.05 (95% confidence) level.

Further, some differences between the provincial cohorts with a mental health diagnosis were evident: NS clients were younger, more likely to be taking an anxiolytic or antidepressant medication, have more depressive symptoms, be at higher risk of long-term care placement, and exhibit delusions.

Table 4 provides additional details regarding psychiatric diagnoses, including six mental health diagnoses, stratified by cohort and further in NS by Halifax/urban non-Halifax/rural. These groups were limited by the truncated values of ICD-9 codes, with some common groups like mood disorders impossible to aggregate. In NS, clients in or near Halifax were more likely to have seen a psychiatrist than in other urban areas. Those in rural NS areas were less likely than those in urban areas outside of Halifax, despite there being no difference overall in the prevalence of a mental health diagnosis.

In both sites, clients with a mental health diagnosis had a significantly higher rate of psychiatry visits than clients without a mental health diagnosis (**Table 4**). In the WRHA, 27.4% of clients with a mental health diagnosis had psychiatry services compared to only 5.7% of clients without a mental health diagnosis (nearly 5 times the rate). Similarly, in NS 7.4% of clients with a mental health diagnosis had psychiatry services compared to only 0.5% of clients without a mental health diagnosis (over 14 times the rate). However, in NS, among those with a mental health diagnosis, the likelihood of having received a psychiatry visit decreased significantly going from Halifax (13.2%) to urban non-Halifax (8.1%), to rural (3.6%). Among those without a mental health diagnosis there is no such pattern with rates below 1%.

Anxiety disorder was present in more than 20% of both cohorts, and more prevalent in the WRHA cases. Psychosis was diagnosed in at least 13% of cases, with prevalence higher in NS. Likelihood of receiving psychiatry service was consistently higher in the WRHA cohort regardless of diagnosis group. Patterns of lower likelihood of psychiatry service outside of Halifax were also evident among most of the selected diagnoses, except for some rarer groups where there is limited statistical power.

We investigated total days of care that were observable between and within the WRHA and NS cohorts, and there were no significant sources of bias that would result from differential observation periods as home care clients.

A sensitivity analysis applied 3-level stratification to the cohorts: those with a dementia diagnosis, with no dementia but with a psychiatric diagnosis, and others, as shown in **Appendix A**. All selected measures show significant differences, within cohorts, except for antipsychotics in NS with similar proportions comparing dementia and non-dementia with psychiatric diagnosis. Psychotic symptoms of hallucinations and delusions had the highest prevalence among those with dementia in both cohorts. Psychotropic medications are most often prescribed, and psychiatry is most often received by those

TABLE 3 | Sample characteristics at latest RAI-HC assessment, those with and without mental health diagnosis.

(%Of the column, unless indicated otherwise)	**WRHA**			**Nova Scotia**			**p value WRHA vs NS***
Any mental health diagnosis while on home care**	**No**	**Yes**	***p***	**No**	**Yes**	***p***	
N	2,483	2,795		2,495	2,828		
(% of provincial cohort)	47.0	53.0		46.9	53.1		
Mean age in years (standard deviation)	84.6 (8.2)	82.8 (8.4)	**<0.0001**	84.2 (8.2)	81.8 (8.3)	**<0.0001**	**<0.0001**
Female	65.2	67.1	0.142	68.7	70.5	0.151	0.340
Married	31.5	33.0	0.260	29.1	31.4	0.073	0.638
No informal caregiver	1.1	1.5	0.153	1.4	1.9	0.159	0.440
Made economic trade-offs due to limited funds	2.7	3.5	0.092	3.3	4.5	**0.025**	0.497
Antipsychotics in the past 7 days	3.3	13.7	**<0.0001**	6.5	15.4	**<0.0001**	0.539
Anxiolytics in the past 7 days	4.6	17.0	**<0.0001**	9.0	26.5	**<0.0001**	**0.001**
Antidepressants in the past 7 days	7.7	31.4	**<0.0001**	19.8	46.5	**<0.0001**	**<0.0001**
Alzheimer's/related dementia	21.8	36.0	**<0.0001**	29.3	41.0	**<0.0001**	0.184
Depressive symptoms (DRS 3+)	6.8	15.5	**<0.0001**	20.1	33.2	**<0.0001**	**<0.0001**
Condition makes cognition, mood, ADL or behavior unstable	37.4	54.2	**<0.0001**	41.9	56.2	**<0.0001**	0.616
High risk of long-term care home entry (MAPLe 4 or 5)	36.8	49.3	**<0.0001**	50.6	59.1	**<0.0001**	**0.008**
Not at ease with others	4.2	7.7	**<0.0001**	6.5	11.1	**<0.0001**	0.091
Hallucinations	0.8	2.5	**<0.0001**	2.4	4.4	**<0.0001**	0.121
Delusions	1.2	2.7	**<0.0001**	5.0	5.9	0.134	**0.022**
Tobacco use daily	4.2	7.8	**<0.0001**	6.7	10.9	**<0.0001**	0.156
Discharge Disposition from Home Care			**<0.0001**			**<0.0001**	0.131
• Discharged deceased	22.0	15.8		20.9	16.1		
• Discharged to long-term care facility	25.7	38.4		40.7	45.6		
• Remain on home care after 4 years	40.7	35.9		29.9	30.0		

**Comparing those in the WRHA receiving any psychiatry with those in Nova Scotia receiving any psychiatry.*

***Any of: psychiatric condition recorded on any RAI-HC assessment, selected ICD-9 diagnoses from physician visits while home care clients, selected ICD-10 diagnoses from hospital admissions while home care clients, excludes dementia and delirium.*

DRS, Depression Rating Scale, sum of 7 depressive symptom items, range 0 to 14, higher scores are more severe.

ADL, Activities of Daily Living.

MAPLe, Method for Assigning Priority Level, algorithm assigning 1–5 range, with higher scores more at risk of long-term care placement and caregiver distress. Bolding denotes p values significant at the 0.05 (95% confidence) level.

with a psychiatric diagnosis where dementia is absent, followed by those with dementia, and those with no dementia and no psychiatric diagnosis. Those with dementia in the WRHA and NS cohorts had a similar prevalence of comorbid psychiatric diagnosis (21%).

Results of the multivariable logistic models on the likelihood of the receipt of one or more psychiatry visits are provided as **Table 5**. Significance and direction of odds ratios may be compared, but the magnitudes of odds ratios are not comparable due to the large difference in the prevalence of the dependent variable between provincial cohorts. For five covariates that are significant in both models (three psychotropic medications, depressive symptoms, and unstable condition), the direction of the effect is consistent between the jurisdictions. In the WRHA sample, older age was protective and not being at ease with others was protective against psychiatry visits, while a dementia diagnosis, high MAPLe scores, and hallucinations were predictive. Model fit was stronger in the WRHA data.

DISCUSSION

This study provides important new information about mental health and illness among older home care clients and their receipt of psychiatry services. Information drawn from the RAI-Home Care along with administrative data including physician visits provide a powerful means for comparing and contrasting individuals receiving services in these two Canadian jurisdictions. Prevalence of mental health diagnoses was found to be equally high in both home care study cohorts, higher than found in previous reviews (6, 7). Yet overall, we observed over 10 times the volume of psychiatry visits in the WRHA cohort (8,246 visits vs. 792 visits in NS) which translated into a 4-fold increased likelihood of receipt of any psychiatry visits (17.2% of WRHA clients vs. 4.2% of NS clients), and 2.5 times more visits on average per client (9.1 avg. visits vs. 3.6 avg. visits in NS) among those home care recipients.

Client characteristics from the RAI-Home Care differed in ways that paints the NS cohort as having somewhat higher and more complex needs: higher prevalence of dementia, depressive symptoms, hallucinations, and delusions. The higher proportion of the NS cohort with elevated MAPLe scores is notable, since it brings together multiple factors related to caregiver burnout and risk of long-term care placement, including physical and cognitive impairment, history of falls, and responsive dementia behaviors (29).

TABLE 4 | Characteristics of HC clients having any psychiatry and/or mental health diagnoses, and by selected diagnostic groups, by province and urban/rural.

	WRHA	Nova Scotia				*p*		
		All	Halifax	Urban non-Halifax	Rural	WRHA vs. NS	Halifax vs. urban non-Halifax	Urban non-Halifax vs. Rural
Home care clients (*N*)	5,278	5,323	1,306	1,755	2,262			
Any psychiatry (%)	17.2	4.2	7.1	4.8	2.0	**<0.0001**	**0.012**	<0.0**001**
Any mental health diagnosis (%)	53.0	53.1	52.3	55.1	52.1	0.905	0.124	0.061
Any psychiatry among those with MH diagnosis (%)	27.4	7.4	13.2	8.1	3.6	**<0.0001**	**0.001**	**<0.0001**
Any psychiatry among those without MH diagnosis (%)	5.7	0.5	0.5	0.8	0.4	**<0.0001**	0.512	0.250
Anxiety disorder diagnosis								
Prevalence (%)	23.1	20.3	20.7	20.3	20.1	**0.0005**	0.792	**0.018**
Any psychiatry among those (%)	29.1	10.0	17.0	11.2	4.8	**<0.0001**	**0.037**	**0.001**
Psychoses diagnosis								
Prevalence (%)	13.4	15.8	19.6	17.9	12.0	**0.0005**	0.229	**<0.0001**
Any psychiatry among those (%)	49.4	12.0	21.5	10.8	4.4	**<0.0001**	**0.0005**	**0.004**
Acute reaction to stress or adjustment disorder Diagnosis								
Prevalence (%)	4.4	4.3	6.0	3.9	3.5	0.813	**0.007**	0.522
Any psychiatry among those (%)	41.4	21.2	33.3	18.8	11.3	**<0.0001**	0.053	0.191
Diagnosis related to special symptoms including sleep, pain disorder								
Prevalence (%)	1.9	5.6	6.1	6.1	5.0	**<0.0001**	0.974	0.128
Any psychiatry among those (%)	24.2	10.7	19.0	*	*	**0.001**	0.211	**0.017**
Diagnosis related to alcohol or drugs								
Prevalence (%)	1.0	2.6	2.6	2.4	2.8	**<0.0001**	0.712	0.440
Any psychiatry among those (%)	50.0	7.2	14.7	*	*	**<0.0001**	0.487	0.061
Personality disorder diagnosis								
Prevalence (%)	0.7	0.6	0.6	0.8	0.5	0.523	0.549	0.213
Any psychiatry among those (%)	62.9	29.4	*	35.7	*	**0.005**	0.512	0.122

**Cell suppressed due to fewer than 5 persons. These are p values significant at the 0.05 (95% confidence) level.*

As expected, patterns are similar whether the comparison is of those receiving psychiatry services, or those with a mental health diagnosis, since there is a strong relationship between any mental diagnosis and receiving a psychiatry visit. A client is nearly 5 times more likely to have a psychiatry visit in the WRHA when a mental health diagnosis is evident; and over 14 times more likely in NS. Similar to previous literature, this study found prevalence of psychiatry services was higher in urban than in rural settings (12, 14). In fact, psychiatry services were almost non-existent for rural Nova Scotians and leads to questions as to a higher burden on family physicians in these areas.

Both settings in this study have similar rates of psychiatrists available for their respective populations. According to the 2019 Canadian Medical Association Psychiatry Profile, the number of psychiatrists was 13.3 per 100,000 population in Manitoba and 14.5 per 100,000 population in Nova Scotia (30). In contrast, NS has 1.1 geriatricians per 100,000 persons and Manitoba has 0.4 per 100,000 persons. Some of the differences in psychiatry visits in our two populations may be due to geriatrician availability for specialty services among older home care clients with mental health issues in Nova Scotia. Future research is required to explore this relationship further. Research is also needed to assess the effect age has on the use of psychiatry services among home care clients. Nova Scotia has both a higher prevalence (21.1%) and higher numbers of older persons in its population (208,825 in 2020) (31) compared to WRHA (16.2 %; 127,032 in 2019) (32), yet cohort sizes were similar. We found, among other characteristics, younger home care users were more likely to use psychiatry services. With the higher level of needs and complexities among NS home care clients, one wonders whether referrals for scarce psychiatry services also suffer from age discrimination, stigma of mental health services or assumptions that mental illness is a normal part of the aging process. These are only speculations—but warrant further investigation.

A much larger proportion of the WRHA cohort accessed psychiatry services while hospitalized rather than in a community setting, while the opposite was found for the Nova Scotia cohort. An in-depth review of community mental health services and psychiatry services available in both sites was beyond the scope of the present study. Such a review may aid in identifying if there is differential focus on the care setting for mental health needs, and which mental health professionals are involved in the care. Previous systematic reviews found community mental health teams can have an impact on hospital admissions and lengths of stay. Similarly in-patient mental health bed supply can affect the amount of psychiatry services provided in hospital (33, 34).

The characteristics of the clients in both settings identified a high prevalence of dementia, ranging from 26.5% (WRHA) to

TABLE 5 | Multivariable logistic regression models of clients receiving any psychiatry visits within each provincial cohort.

	WRHA ($n = 5,278$ and 908 received psychiatry visit)			**Nova Scotia ($n = 5,323$ and 223 received psychiatry visit)**		
	Wald chi-square	***P***	**Odds ratio***	**Wald chi-square**	***P***	**Odds ratio***
Age group: 60–64	**Ref.**	**Ref.**	**Ref.**	**Ref.**	**Ref.**	**Ref.**
65–74	0.13	0.718	0.92	0.22	0.638	1.26
75– 84	5.02	0.025	**0.60**	0.21	0.648	0.80
85 and older	16.31	<0.0001	**0.40**	2.04	0.153	0.49
Female	3.57	0.059	0.85	0.34	0.560	1.10
Married	0.16	0.689	0.96	1.20	0.273	0.84
No informal caregiver	2.02	0.156	1.56	3.43	0.064	2.18
Made economic trade-offs due to limited funds	0.47	0.493	1.15	1.07	0.299	0.69
Antipsychotics in the past 7 days	110.94	<0.0001	**3.33**	11.88	0.001	**1.82**
Anxiolytics in the past 7 days	32.10	<0.0001	**1.79**	10.92	0.001	**1.68**
Antidepressants in the past 7 days	37.53	<0.0001	**1.96**	16.89	<0.0001	**1.80**
Alzheimer's/related dementia	110.26	<0.0001	**2.50**	2.43	0.119	1.31
Depressive symptoms (DRS 3+)	47.42	<0.0001	**2.10**	4.86	0.028	**1.40**
Condition makes cognition, mood, ADL or behavior unstable	13.74	0.000	**1.38**	8.40	0.004	**1.64**
High risk of long-term care home entry (MAPLe 4 or 5)	11.89	0.001	**1.40**	1.84	0.174	1.27
Not at ease with others	17.88	<0.0001	**0.59**	0.05	0.827	0.95
Hallucinations	6.41	0.011	**1.44**	0.02	0.888	1.05
Delusions	1.56	0.211	1.38	0.39	0.532	0.83
Tobacco use daily	2.74	0.098	1.50	0.05	0.823	1.05
C-Statistic (area under ROC Curve)	0.761			0.725		

**Caution to not directly compare odds ratios between WRHA and Nova Scotia, since the rate of receipt of psychiatry visits differs between the two jurisdictions. These are p values significant at the 0.05 (95% confidence) level.*

34.9% (Nova Scotia). For the purpose of this study a dementia diagnosis was not included in the mental health diagnostic areas of concern. As a cognitive disorder, individuals with Alzheimer's and related dementias are often referred to neurologists, geriatricians or serviced by primary care practitioners. However, it is recognized that there is a relationship between dementia and psychiatric disorders (35). Some of the psychiatry service results found in this study could be influenced by dementia diagnoses as opposed to other mental health issues, or if present, the comorbidity of mental illness and dementia.

This descriptive study is strengthened by population level data, high quality administrative data, and the availability of comparable measures and data in the different jurisdictions. Results identified that psychiatry visits represent a smaller proportion of medical service visits for older home care clients. Due to the study approach employed, the results are limited to their descriptive nature, that is, the observation of the very large difference in utilization of this specialized health service provider between two Canadian jurisdictions. However, the results cannot directly report on effective mental health services or outcomes.

In addition, the study is limited by looking at home care client characteristics at one point in time while reviewing receipt of psychiatry services over a time span up to 4-years in length. The characterization of the home care client may not be reflective of client status when visiting a psychiatrist, and the single point-in-time RAI-HC assessment results in symptom prevalence values that are under-estimates of what would be observed across the entire episode of home care. However, by using the client's most recent available assessment, it is more likely to capture any deterioration or changes in clinical status that may have prompted use of psychiatry services throughout the episode of home care.

CONCLUSION

In the current study, the prevalence of mental health diagnoses was high among older adult home care clients, and higher than found in the general population in Canada. Despite the higher prevalence, visits to a psychiatrist were low by comparison. The results from this study suggest the need for a mental health strategy within public home care services. Publicly-funded home care in Canada sits largely outside of the medical model, and psychiatry visits represent a small proportion of medical services visits for these clients—representing a thin edge when considering the overall picture. Nevertheless, our descriptive study has raised important questions about differential access to psychiatry services by site of care (hospital vs. community), by geographical location (MB vs. NS and urban vs. rural) and by age. We acknowledge our data only provide a snapshot and call for more research in this area.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: This study was conducted with data held by regional health and provincial authorities and the national body of the Canadian Institute for Health Information (CIHI). None of the data utilized are in the public domain. Access to the data is restricted to members of the research team based on strict data access and sharing agreements. From our Agreements with our Health administrative data sources, the following restrictions are applied to Publication of Data: The Applicant retains the right to publish research findings provided that results reported include only summary data and statistical analysis that preclude the identification, either alone or with other information, of subject individuals. For further information to access any data held by: WRHA, contact the WRHA Research Access and Approval Committee; Manitoba Health, contact the Manitoba Health, Seniors and Active Living Health Information Privacy Committee; hipc@gov.mb.ca; Health Data Nova Scotia (HDNS), contact HDNS@dal.ca; CIHI: https://www.cihi.ca/en/access-data-and-reports/make-a-data-request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Nova Scotia Health Research Ethics Board-Reference NSHA REB ROMEO FILE #: 1024323; Mount Saint Vincent Research Ethics Board Certificate of Research Clearances for NS-File #: 2018–202; Mount Saint Vincent Research Ethics Board Certificate of Research Clearances for MB-File #: 2018-087; University of Manitoba Health Research Ethics Board Certificate of Final Approval for New Studies Ethics #: HS22118 (H2018:349. The ethics committee waived the requirement of written informed consent for participation.

AUTHOR CONTRIBUTIONS

JP contributed to the study design, analysis and interpretation of the data, and drafting of the manuscript. LM contributed to the study design, interpretation of the data, and drafting of the manuscript. JM and JK contributed to interpretation of the data and drafting of the manuscript. JK is the Principal Applicant for the CIHR operational grant that funded this work. All authors were involved in critical revisions to the manuscript and approve of the submitted version to be published.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.712112/full#supplementary-material

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Author Disclaimer: The data used in this report were made available by Health Data Nova Scotia of Dalhousie University, the Winnipeg Regional Health Authority and the Canadian Institute for Health Information (with permission from Manitoba Health, Seniors and Active Living). Although this research is based on data obtained from the Nova Scotia Department of Health and Wellness, the Winnipeg Regional Health Authority, and the Canadian Institute for Health Information. The analyses, observations, conclusions, and opinions expressed are those of the authors and do not represent those of either Health Data Nova Scotia or the Department of Health and Wellness, Manitoba Health, Seniors and Active Living, the Winnipeg Regional Health Authority or the Canadian Institute for Health Information. We also thank the Geriatric Psychiatry Programs at the University of Manitoba and Dalhousie University for their contributions to the background of our paper.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX

Appendix A | Proportion of HC Clients with specific mental health characteristics by dementia diagnosis, and province.

	WRHA			Nova Scotia		
	Dementia	**No dementia, psych dx**	**No dementia, no psych dx**	**Dementia**	**No dementia, psych dx**	**No dementia, no psych dx**
n	1,654	682	2,942	1,888	744	2,691
Hallucinations	5.3%	1.9%	0.5%	11.1%	3.4%	2.1%
Delusions	4.2%	1.9%	0.3%	8.1%	2.2%	0.6%
Antipsychotics	17.6%	21.3%	2.0%	19.2%	19.6%	3.2%
Anxiolytics	9.6%	29.5%	7.8%	14.9%	43.4%	13.6%
Antidepressants	24.1%	62.2%	10.6%	40.4%	64.9%	20.9%
Any psychiatry visit	24.7%	39.4%	7.9%	5.7%	9.3%	1.7%
Psychiatric diagnosis	21.3%	100.0%	0.0%	20.7%	100.0%	0.0%

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ORIGINAL RESEARCH
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Linking the Scores of the Montreal Cognitive Assessment 5-min and the interRAI Cognitive Performance Scale in Older Adults With Mild Physical or Cognitive Impairment

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Background: Bridging scores generated from different cognitive assessment tools is necessary to efficiently track changes in cognition across the continuum of care. This study linked scores from the Montreal Cognitive Assessment-5 min (MoCA 5-min) to the interRAI cognitive Performance Scale (CPS), commonly adopted tools in clinical and long-term care settings, respectively.

Methods: We included individual-level data from persons who participated in a home- and community-based care program for older people with mild impairment in Hong Kong. The program used the interRAI-Check Up instrument for needs assessment and service matching between 2017 and 2020. Each participant's cognitive performance was assessed using CPS, CPS Version 2 (CPS2), and MoCA 5-min. We performed equipercentile linking with bivariate log-linear smoothing to establish equivalent scores between the two scales.

Results: 3,543 participants had valid data on both scales; 66% were female and their average age was 78.9 years (SD = 8.2). The mean scores for MoCA 5-min, CPS, and CPS2 were 18.5 (SD = 5.9), 0.7 (SD = 0.7), and 1.3 (SD = 1.1), respectively. A CPS or CPS2 score of 0 (intact cognition) corresponds to MoCA 5-min scores of 24 and 25, respectively. At the higher end, a CPS score of 3 (moderately impaired) and a CPS2 score of 5 (moderately impaired Level-2) corresponded to MoCA 5-min scores of 0 and 1, respectively. The linking functions revealed the floor and ceiling effects that exist for the different scales, with CPS and CPS2 measuring more-severe cognitive impairment while the MoCA 5-min was better suited to measure mild impairment.

Conclusions: We provided score conversions between MoCA 5-min and CPS/CPS2 within a large cohort of Hong Kong older adults with mild physical or cognitive impairment. This enabled continuity in repeated assessment with different tools and improved comparability of cognitive scores generated from different tools from diverse populations and research cohorts.

Keywords: crosswalk, cognitive screening, MoCA 5-min, cognitive performance scale, test equating

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INTRODUCTION

Assessing cognition in the aging population is necessary to understand the magnitude of loss in cognitive performance. In the long-term care system, the Cognitive Performance Scale (CPS), originally developed using data from the Minimum Data Set (MDS) assessment (1), is a widely used tool. CPS items were designed to assess the person's actual performance in remembering, thinking coherently, and organizing daily self-care activities as these are considered potentially crucial threats to personal independence and increase the risk for long-term care facility admission (2). The scale has been implemented in the MDS and interRAI assessment instruments that routinely collect data on vulnerable persons' clinical and functional status to improve their quality of life (3). In addition to providing a descriptive foundation of a person's cognition, CPS scores are used for triggering the cognitive loss Clinical Assessment Protocol (CAP) in the interRAI system. The interRAI system includes several CAPs designed to inform and guide care and service planning. Specifically, the cognitive loss CAP focuses on helping persons with intact cognitive ability or mild cognitive impairment to remain as independent as possible for as long as possible (4). The interRAI instruments have been widely adopted by home care and long-term care facilities, with assessments administered to over 50 million people worldwide (5–7). The CPS is also embedded in the Resident Assessment Instrument – Mental Health (RAI-MH), a valid screening measure of cognitive performance among adult psychiatric inpatients (8). In addition, the CPS has been extended to a new CPS Version 2 (CPS2) to improve its sensitivity to early cognitive impairment (9).

In the general health care environment, the Montreal Cognitive Assessment (MoCA) is a commonly used tool for screening cognitive impairment and dementia (10). The MoCA was designed to facilitate early and accurate detection of mild cognitive impairment by front-line physicians. It assesses multiple cognitive domains (including visuospatial/executive, naming, memory, attention, language, abstraction, delayed recall, and orientation) and was originally developed as a paper-and-pencil tool with 30 questions requiring the physical presence of the examinee and takes 10–20 min to administer. The validity of MoCA (including content, construct, and criteria validity) has been evaluated by studies of different populations and with different modeling frameworks. Although considerable variability in the sensitivity, specificity, and psychometric properties of the MoCA has been observed across populations with different characteristics, it demonstrates overall satisfactory performance in detecting mild cognitive impairment and dementia (11). Previous evidence also suggests that, compared to the Mini-Mental State Examination (MMSE), MoCA demonstrates superiority in detecting more subtle changes in cognition that may signal mild cognitive impairment caused by many illnesses (including Alzheimer's disease, Parkinson's disease, and stroke) (12). However, as reported by previous studies, the MoCA has a prominent floor effect and may not be suitable for measuring cognitive ability in people with severe impairment (e.g., those with MMSE scores of 10 or below) (13–15).

More recently, shorter versions of the MoCA have been developed to address the limited time available for cognitive assessment in many clinical settings (16–19). The MoCA 5-min protocol (MoCA 5-min), based on the Hong Kong version of the MoCA, has been developed as a very brief cognitive screening tool administered at the bedside or over the telephone to accommodate challenging face-to-face assessment situations (19). The MoCA 5-min has been validated in patients with stroke and transient ischemic attack (TIA), and score conversion between the MoCA 5-min and the full version of MoCA has been reported (15, 19). Owing to its shorter administration time, the MoCA 5-min has gained popularity recently in locations as diverse as Hong Kong, France, and Tanzania (20–22).

Older persons may move between care settings (e.g., home care, long-term care facilities, hospitals, and rehabilitation) as the levels of care they need change (3). Although cognitive assessments are often routinely carried out as part of the comprehensive assessment within the same setting, a person's cognitive status before entering the setting is often unknown. In situations where scores of previous cognitive assessments are available, establishing a valid trajectory of cognitive function remains difficult as the scores are unlikely to be from the same assessment tool. Consequently, determining any change in a person's cognitive status is particularly challenging if the person is newly admitted to the facility and no benchmark cognitive score is available. Linking the scores of different cognitive assessment tools allows continuous tracking of cognitive performance across the continuum of care, leverages existing records, and reduces the assessment burden. This also enables the identification of homogeneous groups of individuals with similar levels of cognitive impairment from different populations, which in turn allows further contextual-level enquiries. This study aimed to bridge scores from the MoCA 5-min to the CPS and CPS2 using assessment data from a large cohort of older adults in Hong Kong.

METHOD

Sample

We used baseline assessments of participants in a home and community-based care program for older people with mild impairment in Hong Kong. The program uses the Hong Kong Chinese version of the interRAI-Check Up (interRAI-CU) instrument for needs assessment and service matching (23). Additionally, participants' cognitive ability was assessed using the MoCA 5-min. All assessors received 2-day training and were accredited by the Social Welfare Department of the Hong Kong Government. Data collection was conducted between April 2017 and September 2020. Participants were assessed when they joined the program (the baseline assessment) for eligibility and service matching and were (and will be continuously) reassessed annually for care planning. All participants provided informed written consent. Ethical approval was obtained from the Review Board of the Human Research Ethics Committee for Non-Clinical Faculties at the University of Hong Kong (EA1709028).

Instruments and Measures

This interRAI-CU was recommended for use with two specific subgroups: (1) persons who could perform instrumental activities without the help of others, and (2) persons who required the help of others with meal preparation or housework only. The foundation reference of the interRAI-CU is the interRAI Home Care (HC), an assessment tool for persons in the community receiving home care services. The interRAI-CU is a shorter tool with about 100 items developed to support programs that address the needs of persons living independently in the community. It includes assessor-ratings on multiple domains, including cognition and communication, mood and psychosocial well-being, functional status, and health condition.

CPS

The CPS was generated using four interRAI items: short-term memory, cognitive decision-making, making oneself understood by others, and dependence in eating (1). Short-term memory was assessed by a binary item indicating whether the person could recall three unrelated items after 5 min. The cognitive decision-making item measures the person's cognitive skill for making decisions regarding daily living tasks. The person's cognitive skills were rated as 0 for independent, 1 for modified independence, 2 for minimally impaired, 3 for moderately impaired, 4 for severely impaired, and 5 for no discernible consciousness. Making oneself understood by others measured the person's ability to express information content (verbal and non-verbal). Expression ability was rated from 0 for understood (expresses ideas without difficulty) to 4 for rarely or never understood. The dependence in eating item was rated from 0 for independent to 6 for total dependence and was intended to anchor the most cognitively impaired category. Accredited assessors scored all items.

The total CPS score ranges from 0 for "cognitively intact" to 6 for "severe impairment," and is calculated according to a hierarchical structure designed to replicate the progressive nature of cognitive decline (9). The tool correlates substantially with the MMSE and other scales such as the MDS-cognition Scale, the Psychogeriatric Dependency Rating Scale (PGDRS), and the Activities of Daily Living Scale (ADL) in nursing home residents (1, 24) and people receiving home care services (25).

CPS2

CPS2 was developed to detect changes more sensitively in earlier stages of cognitive decline (9). It is based on six interRAI items: capacity to manage finances, capacity to manage medications, short-term memory, making oneself understood by others, decision-making, and walking. The managing finances and medications items measure the person's presumed ability to handle bills, credit cards, and household expenses and medication, respectively, both with ratings ranging from 0 for independent to 6 for total dependence. They are also standard items for assessing the person's ability in Instrumental Activities of Daily Living (IADL). The dependence in eating item in CPS was substituted by dependency level in walking in CPS2. The total score of CPS2 ranges from 0 for "cognitively intact Level one" to 8 for "very severe impairment." A previous study demonstrated a significant correlation between individual CPS2 items and MMSE, with correlation coefficients ranging from −0.44 (managing finances) to −0.69 (decision making). The total CPS2 score was highly correlated with CPS ($r = 0.93$), MMSE (−0.76), and external measures of dementia diagnosis, function, living status, and distress (9).

MoCA 5-min

The MoCA 5-min consists of four sub-tests extracted from the MoCA examining four cognitive domains: attention, verbal learning and memory, executive functions/language, and orientation (19). The attention domain is assessed by the immediate recall of five words, with scores ranging from 0 to 5 (1 point for each word correctly recalled). The executive functions/language domain is assessed by a 1-min verbal fluency test with scores ranging from 0 to 9. Orientation is measured by six items on data and geographic orientation, with 1 point for each correct answer. Memory is tested by delayed recall and recognition of five words learned in the first task (immediate recall), with scores ranging from 0 to 10. The total scores of the MoCA 5-min range between 0 and 30. Previous evidence suggested a high correlation between the MoCA 5-min protocol and the MoCA ($r = 0.87$). It also performed well in differentiating people with and without cognitive impairment in people with stroke or TIA (19).

Other measures obtained from interRAI-CU include age, sex, educational level, the ADL - Hierarchy Scale (ADL-H), and dementia diagnosis. The ADL-H is a summary scale measuring a person's functional status, with total scores ranging from 0 (independent) to 6 (total dependence). Earlier research suggested that individual ADL-H items can be classified into early loss, middle loss, and later loss components and a significant association between the scale score and external ADL criteria such as the time involved in formal and informal care (26, 27). Dementia diagnosis was measured by the diagnosis of Alzheimer's disease, other dementia, or dementia of unknown origin.

Statistical Analysis

The relationships between CPS, CPS2, and MoCA 5-min were initially assessed using Pearson correlations. As our sample was limited to older persons with mild physical or cognitive impairment, higher CPS values (i.e., severe cognitive impairment) may not be observed. A ceiling effect of CPS and CPS2 might be expected that may subsequently lead to a biased estimate of the Pearson correlation coefficient. Therefore, we further evaluated the association between CPS/CPS2 and MoCA 5-min using Kruskal-Wallis rank sum tests, a non-parametric method for testing the association between two variables (28). For each CPS and CPS2 score, we also compared and tested the mean age and ADL-H scores using Kruskal-Wallis rank sum tests. We fitted three simple logistic regression models to assess the predictive accuracy of the CPS, CPS2, and MoCA 5-min for detecting dementia. It is important to note that this predictive accuracy evaluation is mainly exploratory as the dementia diagnostic rate is very low in Hong Kong (29).

To establish the score conversions, we utilized equipercentile linking (30, 31), a method that matches two scales' cumulative distributions and computes equivalent scores from one scale to the other. Log-linear presmoothing of the raw score frequencies was undertaken to reduce random error in the linking process (32). We applied a model selection based on the Bayesian Information Criterion to select the univariate and bivariate models (33), where we considered up to eight univariate moments and three bivariate moments. The model fit was evaluated graphically by comparing the predicted and observed conditional means and variances.

Previous studies have identified a significant association between MoCA sum scores and age and educational level, while item properties of the MoCA varied with education (10, 34, 35). Age- and education-corrected cutoff scores were also proposed to identify people with significant and mild neurocognitive disorders and mild cognitive impairment (35, 36). Therefore, we further evaluated population invariance (37) by estimating linking functions in groups defined by (1) educational level (no formal education, 1–6 years of education, and >6 years of education) and (2) age group (<75 years and ≥75 years). We estimated the linking function from CPS and CPS2 to MoCA 5-min with the R package kequate (38) and obtained equivalent scores and standard errors.

RESULTS

A total of 4,099 individuals participated in the home and community-based care program.

Values in either MoCA or CPS/CPS2 items were missing for 556 (13.5%) individuals who were excluded from the analysis. The final sample included 3,543 participants with valid data on both the MoCA 5-min and CPS. Two-thirds (66.24%) were female, and the average age was 78.86 years (SD = 8.19). The mean score of MoCA 5-min was 18.51 (SD = 5.93). The mean ADL-H score was 0.28 (SD = 0.91), between independent and supervision required, suggesting the sample's low functional impairment. Less than 4% of the sample had a diagnosis of dementia. The mean CPS and CPS2 scores were 0.65 (SD = 0.69) and 1.34 (1.09), respectively, corresponding to a cognitive performance level between intact and borderline intact. The highest scores observed were 3 for CPS and 5 for CPS2. **Table 1** summarizes the mean MoCA 5-min, CPS, and CPS2 scores by age group and educational level. A considerable difference in mean MoCA 5-min scores was evident between people younger than 75 and people aged 75 years or older.

The Pearson correlation was −0.42 ($p < 0.001$) between CPS and MoCA 5-min, −0.43 ($p < 0.001$) between CPS2 and MoCA 5-min, and 0.92 ($p < 0.001$) between CPS and CPS2. Kruskal-Wallis tests confirmed significant associations between MoCA 5-min and CPS/CPS2. **Table 2** shows that the mean ages, ADL-H, and MoCA 5-min scores differed significantly and substantially by the level of CPS and CPS2. Higher CPS and CPS2 scores are associated with older age, more severe functional impairment as measured by ADL-H, lower MoCA 5-min scores, and higher proportions of people with a dementia diagnosis. We further explored the diagnostic performance of the three scales for dementia using logistic regressions. The receiver operating characteristic curve (ROC) curves are plotted in **Figure 1**. All three scales detected dementia diagnosis with reasonable accuracy. The area under curve (AUC) was 0.69 for CPS, 0.71 for CPS2, and 0.74 for MoCA 5-min.

For the log-linear models used in the equipercentile linking with the full sample, we selected models with five univariate moments for the MoCA 5-min, two univariate moments for the CPS and four univariate moments for the CPS2. Meanwhile, both selected bivariate models (one for CPS and MoCA 5-min and one for CPS2 and MoCA 5-min) had one bivariate moment. In a single group linking design, we used equipercentile linking in the kernel equating framework with a uniform kernel (31, 39). This approach provides linking functions that closely match traditional linking with percentile ranks while enabling the estimation of random linking error. We selected models that included between four and six univariate moments for the MoCA 5-min for the education- and age-based sub-analyses. All selected models had two and four univariate moments for the CPS and CPS2, respectively, and one bivariate moment for all cases considered. **Supplementary Table 1** provides detailed descriptions of the selected models. The relationships between each MoCA score and the conditional mean and variance of the CPS/CPS2 score for the total sample and subgroups are plotted in **Supplementary Figures 1–12**. Model evaluation based on the fitted and observed conditional means and variances indicated acceptable fit for all models. Discrepancies between the fitted and observed values were only observed at the highest and lowest values of MoCA, which can be expected due to the small number of observations available at the extremes.

Figure 2 shows the linking functions from CPS and CPS2 to MoCA 5-min for the full sample, where an approximately linear function existed for the CPS to MoCA 5-min conversion but not for the CPS2 to MoCA 5-min conversion. The random error, low in general, was larger for higher CPS and CPS2 score values, reflecting the lower number of participants with high CPS and CPS2 scores.

Table 3 shows equivalent MoCA scores for each CPS and CPS2 score, for the total sample and by age and education groups. The scores displayed are rounded values to facilitate direct clinical usage. **Supplementary Table 2** documents the more accurate estimates of the equivalent MoCA scores and their confidence intervals. The total sample analysis implies that a CPS of 0 corresponds to a MoCA 5-min score of 23.8 (95% CI, 23.5–24.0), and a CPS2 score of 0 corresponds to a MoCA 5-min score of 24.8 (24.6–25.0). At the higher end, a CPS score of 3 and a CPS2 score of 5, the highest scores observed for each of the scales in the sample, correspond to MoCA 5-min scores approximately equal to 0.4 (−0.08 to 0.89) and 0.6 (0.01–1.10), respectively. The linking functions revealed the floor and ceiling effects for the different scales, with CPS and CPS2 capable of measuring more severe cases of cognitive impairment than MoCA 5-min while the MoCA 5-min can measure less severe impairment more accurately than CPS and CPS2. **Figure 3** shows that the score conversions did not differ by age groups but differed by educational levels. Participants with no formal education had lower linked MoCA 5-min scores than their counterparts with higher levels of education, although the differences were not

TABLE 1 | Sample characteristics.

	Total Sample ***N* = 3,543**	**<75 years** ***N* = 1,074**	**≥75 years** ***N* = 2,469**	**No education** ***N* = 1,026**	**1–6 years education** ***N* = 1,489**	**>6 years education** ***N* = 957**
Age (years) (mean, SD)	78.86 (8.19)	68.70 (3.83)	83.28 (5.04)	79.07 (8.12)	78.86 (8.04)	78.64 (8.49)
Female (%)	66.24	67.69	65.61	68.32	66.25	64.01
ADL-H (mean, SD)	0.28 (0.91)	0.28 (0.94)	0.28 (0.90)	0.29 (0.90)	0.28 (0.92)	0.27 (0.91)
Dementia diagnosis (%)	3.90	2.14	4.66	5.06	3.43	3.37
MoCA 5-min (mean, SD)	18.51 (5.93)	21.16 (5.15)	17.36 (5.87)	18.23 (5.87)	18.49 (5.88)	18.85 (6.05)
CPS (mean, SD)	0.65 (0.69)	0.53 (0.65)	0.70 (0.70)	0.68 (0.70)	0.64 (0.69)	0.63 (0.68)
CPS2 (mean, SD)	1.34 (1.09)	1.13 (1.07)	1.42 (1.08)	1.38 (1.08)	1.33 (1.09)	1.29 (1.09)

TABLE 2 | Age, functional assessment scores, MoCA 5-min scores, and dementia diagnosis by level of the CPS and CPS2.

	CPS score						**Kruskal-Wallis**
	0	**1**	**2**	**3**	**4**	**5**	**test *p*-value**
Sample size	*N* = 1,656	*N* = 1,474	*N* = 395	*N* = 14	-	-	
Age, years	77.64 (8.19)	79.77 (7.93)	80.34 (8.38)	84.50 (8.08)	-	-	0.000
ADL-H	0.22 (0.79)	0.27 (0.90)	0.51 (1.25)	1.93 (2.13)	-	-	0.000
MoCA 5-min	20.83 (4.96)	17.30 (5.63)	13.66 (6.03)	9.86 (8.22)	-	-	0.000
Dementia diagnosis, *n* (%)	34 (2.1%)	49 (3.3%)	51 (12.9%)	3 (21.4%)	-	-	0.000
	CPS2 score						
	0	**1**	**2**	**3**	**4**	**5**	
Sample size	*N* = 1,138	*N* = 518	*N* = 1,545	*N* = 244	*N* = 85	*N* = 9	
Age, years	77.07 (7.84)	78.87 (8.81)	79.78 (7.92)	80.58 (8.61)	80.25 (8.18)	83.89 (9.79)	0.000
ADL-H	0.12 (0.57)	0.45 (1.09)	0.29 (0.93)	0.56 (1.33)	0.38 (0.95)	1.89 (2.26)	0.000
MoCA 5-min	21.60 (4.72)	19.15 (5.06)	17.17 (5.67)	13.76 (6.05)	12.38 (6.21)	11.33 (9.25)	0.000
Dementia diagnosis, *n* (%)	11 (1.0%)	23 (4.4%)	56 (3.6%)	32 (13.1%)	13 (15.3%)	2 (22.2%)	0.000

substantial. The largest difference (1.87) was observed in linked MoCA 5-min scores between the no education group and >6 years education group.

DISCUSSION

This study provides score conversions between MoCA 5-min and CPS/CPS2 in a large cohort of Hong Kong older adults with mild physical or cognitive impairment. This crosswalk enabled uninterrupted assessments of cognitive performance and record-linkage across care settings. We also provide score conversions specific to various age groups and educational levels when more fine-grained conversion is preferred for the study population.

Score conversions among various cognitive assessment tools have been made available to (1) enable continuity in repeated assessments with different tools, (2) improve comparability of cognitive scores generated from different measures in different populations and research settings, and/or (3) facilitate the adoption of newly proposed assessment tools. For example, one study used clinical cohorts with and without neurologic conditions to bridge scores of the short MoCA (s-MoCA) and MMSE (40). A Hong Kong study converted MMSE scores to both MoCA and MoCA 5-min using another clinical sample of patients with stroke or TIA (15). However, previous work is limited to assessment tools within the clinical setting. Large-scale cognitive assessments performed in long-term care settings have long been treated as an independent domain although many people living with dementia receive care in the long-term care system. From a person-centered perspective, longitudinal records that can be viewed, understood, and compared irrespective of care setting are important to ensure the quality of care while controlling the cost. Linking scores of widely adopted tools in healthcare and social care settings are hence needed.

We recruited a sample of older adults who applied to a pilot home care and support for elderly persons with mild impairment program. People with severe cognitive impairment were excluded because of their eligibility for other subsidized services such as enhanced home and community care services and integrated home care services. Consequently, we observed a ceiling effect of CPS and CPS2 attributable to the study sample's unique characteristics. Score conversions between the two scales derived from this study were hence limited to lower values of CPS. However, it is arguable that this range of CPS scores is the most relevant score interval that requires linking as it represents a critical transitional period from independent to needing care or from community to long-term care facilities. Specifically, when MoCA tests have been performed before a nursing home placement, score conversions can be used to understand whether

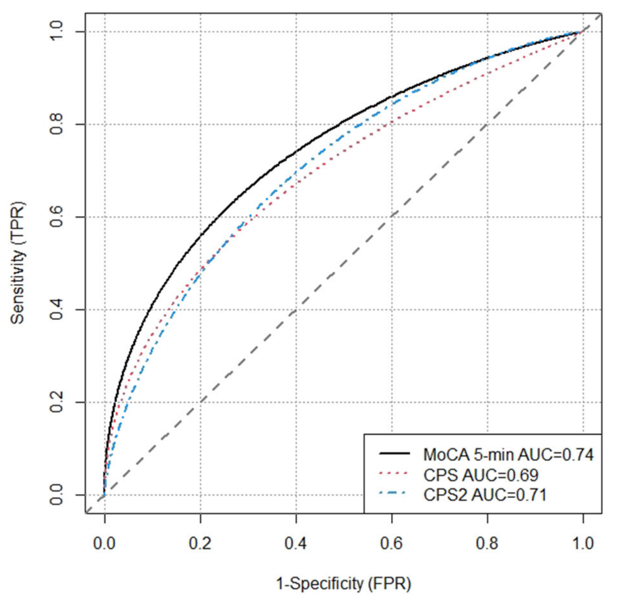

FIGURE 1 | Receiver operating characteristic (ROC) curves for CPS, CPS2, and MoCA 5-min.

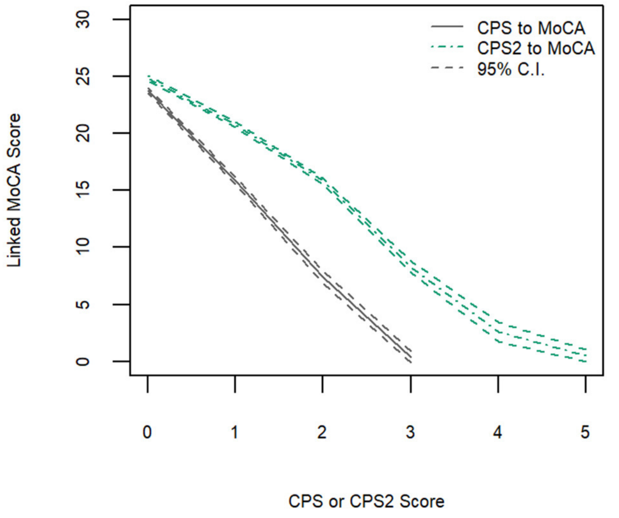

FIGURE 2 | Equipercentile linking function from CPS and CPS2 to MoCA-5 min with 95% confidence intervals.

a substantial change in cognition occurred before and after the placement. This may further aid the development of a more personalized care plan or intervention. Alternatively, a nursing home resident or a person receiving home care may also receive a MoCA assessment outside the long-term care setting. Then, placing the MoCA and CPS scores on a common scale enables more frequent monitoring of the trajectory of cognitive decline, which may help detect subtle changes and changes occurring over a short time. For people in long-term care with a moderate to severe level of cognitive impairment, the MoCA may not have been used in the first place as it was designed to screen for mild cognitive impairment and because floor effects of MoCA items have been reported in previous studies (15, 41). Future work on bridging MMSE scores to CPS and CPS2 scores are needed to enable the continued assessment of cognitive performance in people with severe cognitive impairment.

Score conversions between MoCA 5-min and CPS can also benefit research that aims to estimate the monetary cost and societal impact of dementia. These kinds of cost-of-illness studies typically aim to estimate total costs of care for all people with cognitive impairment or dementia in three categories: health, social, and unpaid care. All three cost categories need to be estimated separately by the severity of cognitive impairment or dementia (e.g., mild, moderate, and severe) and then be summed together, which requires a consistent measure to approximate the severity (42).

This study is also the first to explore the criterion validity of CPS in a mild impairment population in an Asian society. The criterion validity was explored using the ROC analysis, and the large AUC values demonstrated that the interRAI CPS and CPS2 can distinguish dementia diagnosis well.

We found differences in linking functions between people with different educational levels. This may be explained by possible differences in characteristics of specific MoCA 5-min items in people with diverse educational backgrounds. An earlier Hong Kong study of MoCA found that the functioning of some items was superior in people without formal education (34). Item-level analysis of the MoCA 5-min was beyond the scope of this investigation. However, future studies are needed to investigate measurement invariance of MoCA 5-min items in more diverse subpopulations.

This study has several limitations. First, our data were collected from community-dwelling older adults with mild functional impairment, excluding people with severe cognitive impairment. Consequently, our highest observed scores were 3 for CPS and 5 for CPS2 scores. Linked MoCA 5-min scores for CPS scores of 4 (moderate for severe impairment) and above, and CPS2 scores of 6 (severe impairment Level 1) and above could not be estimated. However, our results showed that the linked MoCA 5-min score for a CPS score of 3 was already as low as 0, suggesting that higher CPS scores may correspond to a MoCA 5-min score of 0 or a missing value due to severe impairment. Second, although interRAI assessments collect information on the diagnosis of Alzheimer's disease and dementia, only 4% of the participants reported having a diagnosis of dementia, suggesting that dementia is under-diagnosed in community samples in Hong Kong. We hence did not further explore the classification accuracy of the linked scores of MoCA 5-min. The results of the ROC analysis should also be interpreted with caution. Third, the Pearson correlation coefficients between MoCA 5-min and CPS/CPS2 were relatively low. Possible explanations for this are that (1) the CPS/CPS2 suffered from a ceiling effect and only a few values were available for estimation; (2) both CPS/CPS2 and MoCA 5-min are subject to measurement errors that weaken the correlation observed, and (3) the relationships between CPS/CPS2 and MoCA 5-min were not strictly linear as shown in **Figures 2–4**. It is worth noting here that we aimed

TABLE 3 | Equivalent MoCA scores for each CPS and CPS2 score in three education groups and two age groups.

	Total Sample	**<75 years**	**≥75 years**	**No education**	**1–6 years education**	**>6 years education**
CPS score						
0 Intact	24	24	24	23	24	24
1 Borderline intact	16	16	16	15	16	16
2 Mild impairment	7	7	8	7	8	8
3 Moderate impairment	0	1	1	1	0	0
CPS2 score						
0 Intact 1	25	25	25	24	25	25
1 Intact 2	21	21	21	20	21	21
2 Borderline intact 1	16	16	16	15	16	16
3 Borderline intact 2	8	8	8	7	9	9
4 Moderately impaired 1	3	3	3	2	2	4
5 Moderately impaired 2	1	1	1	1	0	0

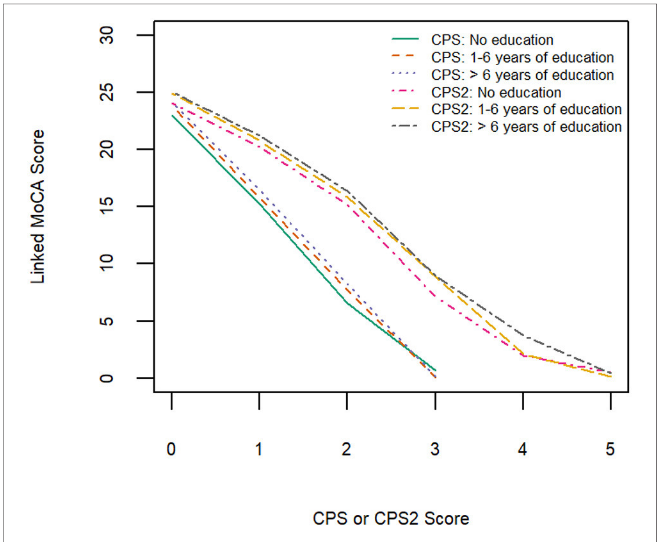

FIGURE 3 | Equipercentile linking function from CPS and CPS2 to MoCA-5 min in three education groups.

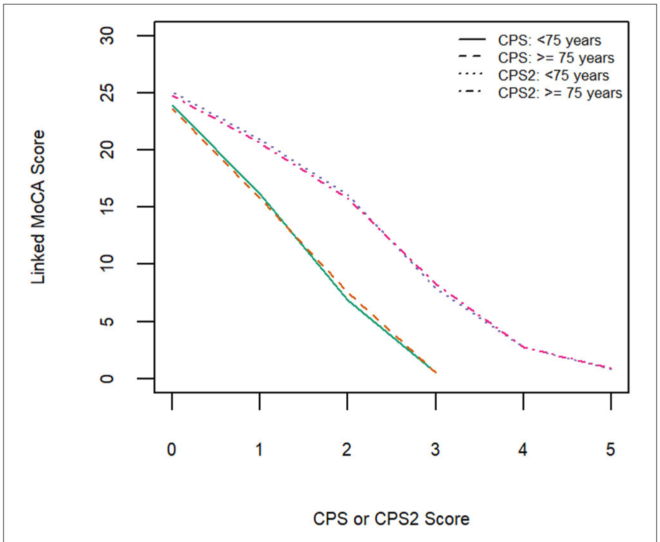

FIGURE 4 | Equipercentile linking function from CPS and CPS2 to MoCA-5 min in two age groups (<75 years old and ≥75 years old).

to achieve comparability of scores obtained from the two scales using linking rather than equating. Linking can be conducted when two distinct tests measure similar constructs for a common population, while equating requires the more specific condition that tests measure the same (not similar) construct and have equal reliability. To conduct a linking, a high correlation is preferred but not required (43). Fourth, our data were collected from applicants for public-funded home care services in Hong Kong who possibly had lower socioeconomic status. The results may not generalize to other populations.

CONCLUSIONS AND IMPLICATIONS

This study represents one of the first attempts to bridge scores generated from cognitive assessment tools commonly used in clinical populations and among older adults in the long-term care system. Cross-sectionally, it bridges scores from cognitive scales used in diverse settings and different research cohorts. Longitudinally, it allows continuous tracking of cognitive performances across the continuum of care. Subject to the unique characteristics of the study sample, score conversions were limited to CPS scores between 0 tand 3, CPS2 scores between 0 and 5, and MoCA 5-min scores between 0 and 24, corresponding to older adults who were cognitively intact or had mild cognitive impairment. Future research bridging scores from a wider range of cognitive assessment tools is warranted to realize continuous tracking of cognitive performance across the continuum of care.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the ethical approvals do not allow sharing of raw data of this project. De-identified data may be shared separately with qualifying researchers after reviewing the research proposal. The proposal needs to comply with legislation and within the scope of the ethical approval. Requests to access the datasets should be directed to Terry Y. S. Lum, tlum@hku.hk.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Review Board of the Human Research Ethics Committee for Non-Clinical Faculties at the University of Hong Kong (EA1709028). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HL, BA, GW, and TL: study concept and design and critical revision of the manuscript for important intellectual content. GW and TL: acquisition of data. BA: analysis and interpretation of data. HL: conducted the analysis and all authors contributed to the interpretation of data. HL and BA: drafting of the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.705188/full#supplementary-material

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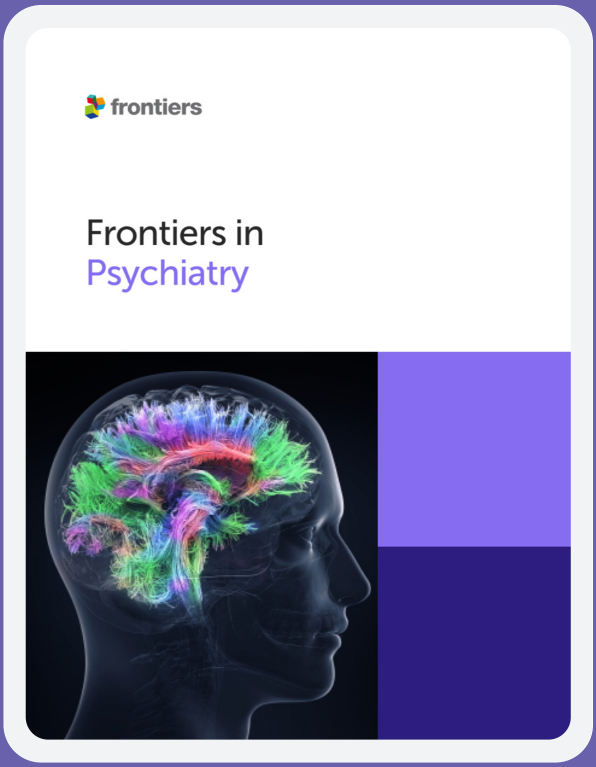

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