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EDITED BY
Ineke Marshall,
Northeastern University,
United States

REVIEWED BY
Susana Mendive,
Pontificia Universidad Católica de Chile,
Chile
Kelly M. Purtell,
The Ohio State University,
United States

*CORRESPONDENCE
MaryCatherine Arbour
✉ marbour@bwh.harvard.edu

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Absenteeism prevention in preschools in Chile: Impact from a quasi-experimental evaluation of 2011–2017 Ministry of Education data

MaryCatherine Arbour[1]*, Carolina Soto[2], Yanira Alée[2], Sidney Atwood[1], Pablo Muñoz[2] and Marcela Marzolo[2]

[1]Brigham and Women's Hospital and Harvard Medical School, Boston, MA, United States, [2]Fundación Educacional Oportunidad, Santiago, Chile

Introduction: In 2007, to promote social equity, Chile expanded coverage and subsidies for early childhood education (ECE). Fundación Educacional Oportunidad (OFE) aimed to improve ECE quality through its professional development program for teachers and school leaders, Un Buen Comienzo (UBC). An experimental evaluation showed that high levels of absenteeism moderated UBC's impact: despite moderate to large positive impacts on preschool quality, only children who attended most frequently experienced positive impacts on targeted language and literacy skills. In 2012, OFE began prioritizing attendance promotion and chronic absenteeism prevention.

Methods: Using a Breakthrough Series Collaborative (BTS) that combines continuous quality improvement methods and networked peer learning, OFE tested a theory of change and several innovations, including Absenteeism Committees comprised of school teams and families; a new real-time data platform; and a set of universal and targeted strategies to apply with families at risk for chronic absenteeism. In 2014-2015, OFE expanded the UBC program to nineteen schools in Chile's VI Region, five of which prioritized attendance promotion. This study describes the intervention strategies and BTS implementation approach, and we use publicly available Ministry of Education databases to analyze rates of absences and chronic absenteeism in public preschools in Chile's VI region from 2011 to 2017 (n=1,218 children per year; 63,689 child-months of data), comparing rates between UBC schools that prioritized attendance (n=5), UBC schools that did not prioritize attendance (n=14), and non-UBC schools (n=27).

Results: Children missed, on average, 14.0%–14.4% of schooldays. Rates of chronic absenteeism were 50.9%–54.2%. Statistical Process Control charts show an initial increase in the percentage of days absent per child each month (13.4% to 16.3%) in UBC Schools prioritizing attendance, followed by a decrease to 12.9%. The percentage of children with chronic absenteeism decreased from 54.2% to 35%. Interrupted time series analyses suggest that these reductions can be attributed to UBC participation.

Discussion: This study (1) replicates findings from prior research indicating that absenteeism rates are sufficiently high among Chilean preschoolers to diminish ECE's potential benefits, and (2) demonstrates the effectiveness of multi-level

strategies implemented using continuous improvement methods and networked peer learning to promote attendance and reduce chronic absenteeism.

KEYWORDS

chronic absenteeism, school attendance, preschool education, Chile, absenteeism intervention, interrupted time series analysis, statistical process control, quality improvement

1. Introduction

High-quality early childhood education can improve children's development and learning in the short and long term and reduce inequality in society (Cunha and Heckman, 2007). Globally, many countries are making significant investments in early childhood education with high expectations of their academic, economic and social return (Myers, 2005; Britto et al., 2011; Engle et al., 2011; Yoshikawa and Kabay, 2014). Multiple factors affect the impact of early childhood education. The quality of services — including dimensions of structure and process — is key to obtaining the expected results (Camilli et al., 2010; Sachs and Weiland, 2010; Yoshikawa and Kabay, 2014; OECD, 2018). The United Nations included in Sustainable Development Goal 4.2: by 2030, ensure that all girls and boys have access to early childhood care and development services and quality preschool education (UN General Assembly, 2015). However, high-quality services may not have the expected impact if exposure to the program is low. In this context, preschool attendance has emerged as an important issue.

Decades of research across multiple disciplines illustrate the importance of school attendance and describe associations between absenteeism and poor child outcomes, including cognitive, academic, behavioral, health, judicial and economic outcomes (Monk and Ibrahim, 1984; Hibbett and Fogelman, 1990; Levine, 1992; Wang et al., 2005; Henry et al., 2012; Marchbanks III et al., 2014; Monahan et al., 2014; Latif et al., 2015; Lansford et al., 2016; Rocque et al., 2017; Mauro and Machell, 2019). The prevalence of absenteeism varies predictably by age and grade (Balfanz and Byrnes, 2012; Díaz et al., 2020). Absenteeism in preschool is often high and can reduce the effects of early education and reduce the return on investments in it (Balfanz and Byrnes, 2012; Ehrlich et al., 2014). An absenteeism rate of 10% or more of school days in kindergarten is defined as "early chronic absenteeism" and is associated with poor language and math skills in first and fifth grades (Chang and Romero, 2008).

Factors associated with absenteeism span child, family, school, and community–level characteristics (Baker et al., 2001; Epstein and Sheldon, 2002; Gottfried and Gee, 2017). Child characteristics associated with absenteeism include poor child health, behavioral issues, learning difficulties, negative attitudes toward school, higher internalizing behavior, and, among kindergarten children, no prior experience with non-kinship care (Fowler et al., 1985; Allensworth and Easton, 2007; Chang and Romero, 2008; Gottfried and Gee, 2017; Gubbels et al., 2019). In low- and middle-income countries, children with disabilities are significantly more likely to exhibit chronic absenteeism (Mizunoya et al., 2018).

Family characteristics associated with higher absenteeism include poverty, single motherhood and teen motherhood, low maternal education, maternal unemployment, food insecurity, poor health, multiple siblings, non-nuclear family structure (e.g., parental divorce), and child abuse (Chang and Romero, 2008; Romero and Lee, 2008; Gubbels et al., 2019). A systematic review found that there was greater evidence of socioeconomic status's impact on absenteeism when measured at the family level, rather than the school level (Sosu et al., 2021). Lack of access to reliable transportation can also impede regular school attendance (Allen et al., 2018). In low- and middle-income countries, children may miss school if they have to earn income or participate in household chores and childcare (Evans and Acosta, 2021).

Schools with low quality education or facilities, poor pupil-teacher relationships, higher grade levels, inadequate attendance monitoring, and poor parent outreach experience higher absenteeism (Chang and Romero, 2008; Gubbels et al., 2019). Community factors associated with higher absenteeism include poverty, violence, and air pollution (Chen et al., 2000; Allensworth and Easton, 2007; Gottfried, 2011).

Less is known about how best to promote attendance and reduce absenteeism, especially across diverse contexts. Solutions have traditionally focused on student, family, school and community-level interventions separately, rather than in a systemic, coordinated manner (Eklund et al., 2022; Kearney and Gonzálvez, 2022). Most studies examine single intervention strategies, for example, text-based and mail-based interventions to motivate parents to improve their child's attendance (Robinson et al., 2018; Díaz et al., 2020; Kalil et al., 2021) or interventions addressing specific child health problems, like asthma (Guevara et al., 2003; Clark et al., 2004; Kim et al., 2020). A recent meta-analysis of 17 studies of evidence-based interventions targeting absenteeism within pre-K-12 public schools in the United States showed positive yet small effects [$g = 0.25$ (95% CI, 0.14–0.36)]. The meta-analysis also examined effect sizes by the type of intervention, each of which demonstrated small positive effects as well [behavioral, $g = 0.26$ (95% CI, 0.14–0.38); academic, $g = 0.25$ (95% CI, 0.04–0.45); parental involvement, $g = 0.09$ (95% CI,

−0.03 to 0.21)]. Just one study focused on preschool-aged children, and only four involved collaboration across students, families, and schools (Eklund et al., 2022). Two of these interventions also included community partners: one study of an intervention for truant students included police (Mazerolle et al., 2017); another study of Ohio elementary schools showed that schools that implemented school-family-community partnerships to increase student engagement (specifically, school outreach to families) improved attendance by an average of 0.5%, which was statistically significant (Sheldon, 2007).

Research suggests that multi-tiered, team-based strategies may address absenteeism more effectively (Reid, 2013; Kearney, 2016; Kearney and Graczyk, 2020), particularly when informed by data (Mandinach, 2012; Chu et al., 2019; Keppens et al., 2019). Attendance Works, a national leader in absenteeism prevention in the United States, recommends universal, prevention-oriented supports (Tier 1), more personalized outreach (Tier 2), and intensive individualized intervention (Tier 3). One example of a three-tiered intervention ("Positive Family Support") to reduce middle school absenteeism implemented multiple supports across Tier 1 (e.g., publicized clear expectations around attendance), Tier 2 (e.g., emails and text messages home), and Tier 3 (parent support sessions, community referrals). The randomized control trial ($n = 41$ schools) demonstrated small positive effects, though implementation challenges (e.g., funding cuts, turnover) were prevalent (Smolkowski et al., 2017). Another three-tiered intervention ("ATI-UP") tested in 27 Oregon middle schools communicated the importance of attendance to students, school staff, and parents; established attendance goals, student incentives, and a "problem-solving team" which reviewed attendance data every 2 months; and engaged parents early on in problem solving their child's absenteeism. The cluster randomized control trial showed some increase on average daily attendance and some reduction on chronic absenteeism; however, these differences were not statistically significant (Berg, 2018).

This study contributes to this literature by examining the effect of a multi-tiered strategy to promote attendance and prevent absenteeism in Chilean preschools that (a) included multiple interventions (child, family, school) and (b) was implemented using a Breakthrough Series Collaborative that combines continuous quality improvement methods and networked peer learning.

1.1. Study context and aim

Chile is a country in the western part of South America with a population of approximately 17.5 million people. In 2007, the Government of Chile established early childhood development (ECD) policy as a key priority: it created a national integrated system for early childhood protection (Chile Grows with You) and expanded free ECE opportunities for the poorest 40% of the population by increasing funding for public ECE centers and for vouchers to private subsidized centers (Memoria de la Instalación del Sistema de Protección Integral a la Infancia, n.d.; Vegas and Santibanez, 2009; Peralta, 2011). By 2012, 73% of 4-year-olds and 93% of 5-year-olds were enrolled in preschool; most of this growth occurred in the poorest quintiles of the population that enrolled in prekindergarten and kindergarten classrooms within public and subsidized voucher primary schools (Ministerio de Educación, 2014).

While educational access in Chile is high, educational quality – although higher than other Latin American countries – is similar to low or average levels when compared to the other 36 member countries of the Organization for Economic Cooperation and Development (OECD) (Leyva et al., 2015; Schady et al., 2015; Adlerstein et al., 2016). Since 2007, Fundación Educacional Oportunidad (OFE) has worked to improve the quality of early childhood education through its professional development program for public school teachers, teachers' aides, and school leaders, *Un Buen Comienzo* (UBC). UBC is a two-year intervention that combines didactic training with twice-monthly in-classroom coaching; a full description of the intervention has been published elsewhere (Yoshikawa et al., 2015). Results from the experimental evaluation of UBC showed moderate to large positive impacts on preschool classroom quality, null effects on the targeted child language and literacy skills on average for the full sample (Yoshikawa et al., 2015), and positive impact on two of four language outcomes among children who attended most frequently (Arbour et al., 2016).

Evidence that UBC was an effective intervention whose potential impact could be attained only if children received sufficient dosage – that is, if they attended school regularly – galvanized OFE to establish attendance promotion and absenteeism reduction as a new strategic priority and an area of intervention within UBC.

To raise awareness of the importance of preschool attendance and the prevalence of early chronic absenteeism in Chile, OFE sponsored large national seminars where they disseminated international research that defined and established the importance of early chronic absenteeism, along with its local findings: over 2 years, children enrolled in prekindergarten and kindergarten in 64 public preschools in the Metropolitan Region missed 21.7% of schooldays, on average. The prevalence of chronic absenteeism in the sample was 67%. Of children who were chronically absent in prekindergarten, 76% were chronically absent again in kindergarten (Arbour et al., 2016). In addition, OFE launched a publicity campaign (FunOportunidad, dir, 2015) and convened a working group of more than 10 public and private institutions to generate new proposals to combat chronic absenteeism in early education in Chile.

In addition to raising awareness, OFE engaged preschool leaders, teachers, and teachers' aides to identify, develop, and test strategies to promote regular attendance and decrease chronic absenteeism in an expansion of the UBC program, using a Breakthrough Series Collaborative (BTS). This commonly used continuous quality improvement (CQI) model was designed to facilitate the uptake of innovations (Nolan et al., 2004). It recruits

teams of direct service providers and stakeholders to pursue one shared, specific aim during a defined period of time, typically 9 to 18 months, and creates a structure within which interested organizations can learn from each other and recognized experts. BTS has been applied successfully across a diverse array of topics in healthcare settings (Flamm et al., 1998; Kilo, 1998; Leape et al., 2000; Glasgow et al., 2002), public health (Ebert et al., 2012; Singh et al., 2016; Arbour et al., 2019; Tandon et al., 2020; Arbour et al., 2021), and more recently in education as "Networked Improvement Communities" (Bryk et al., 2011; Arbour et al., 2015; LeMahieu et al., 2017; Proger et al., 2017). One attendance-focused BTS collaborative increased the median attendance from 44.9 to 59.2% at seven early childhood education centers in New Zealand (Tyler et al., 2018). This study represents the first test of the BTS model in reducing absenteeism in Chilean preschools.

Following the BTS model, OFE began by developing a theory of change to reduce chronic absenteeism in the Chilean context for the 2014 school year (visualized in the Key Driver Diagram, see Figure 1). The theory of change aimed to address factors associated with absenteeism in the academic literature and from OFE's own experience and research on absenteeism in Chilean preschools. UBC's impact evaluation highlighted factors associated with absenteeism in this study population, corroborating some of the child, family, school, and community-level factors seen in the literature. For example, children experiencing respiratory illness and those with no prior participation in center-based childcare were more likely to be absent. Family-level characteristics included lack of childcare for siblings, a depressed caretaker, low maternal education, maternal unemployment, and parents who felt unwelcome in their child's classroom. Parents of children with high absenteeism were more likely to report that their children missed school due to oversleeping, cold and rain, or lack of transportation. These parents were also more likely to state that they preferred to keep the child at home sometimes, and that they believed the school's main role was to keep their child safe and healthy, rather than encourage social or school skills. Finally, at the community level, municipalities with more socioeconomic vulnerability, colder weather, or worse air pollution predicted higher absenteeism (Arbour et al., 2016).

Drawing from Attendance Works, OFE adopted a multi-tiered approach and translated and adapted intervention resources available on the Attendance Works website that curated contributions from schools' experiences in New York City, Los

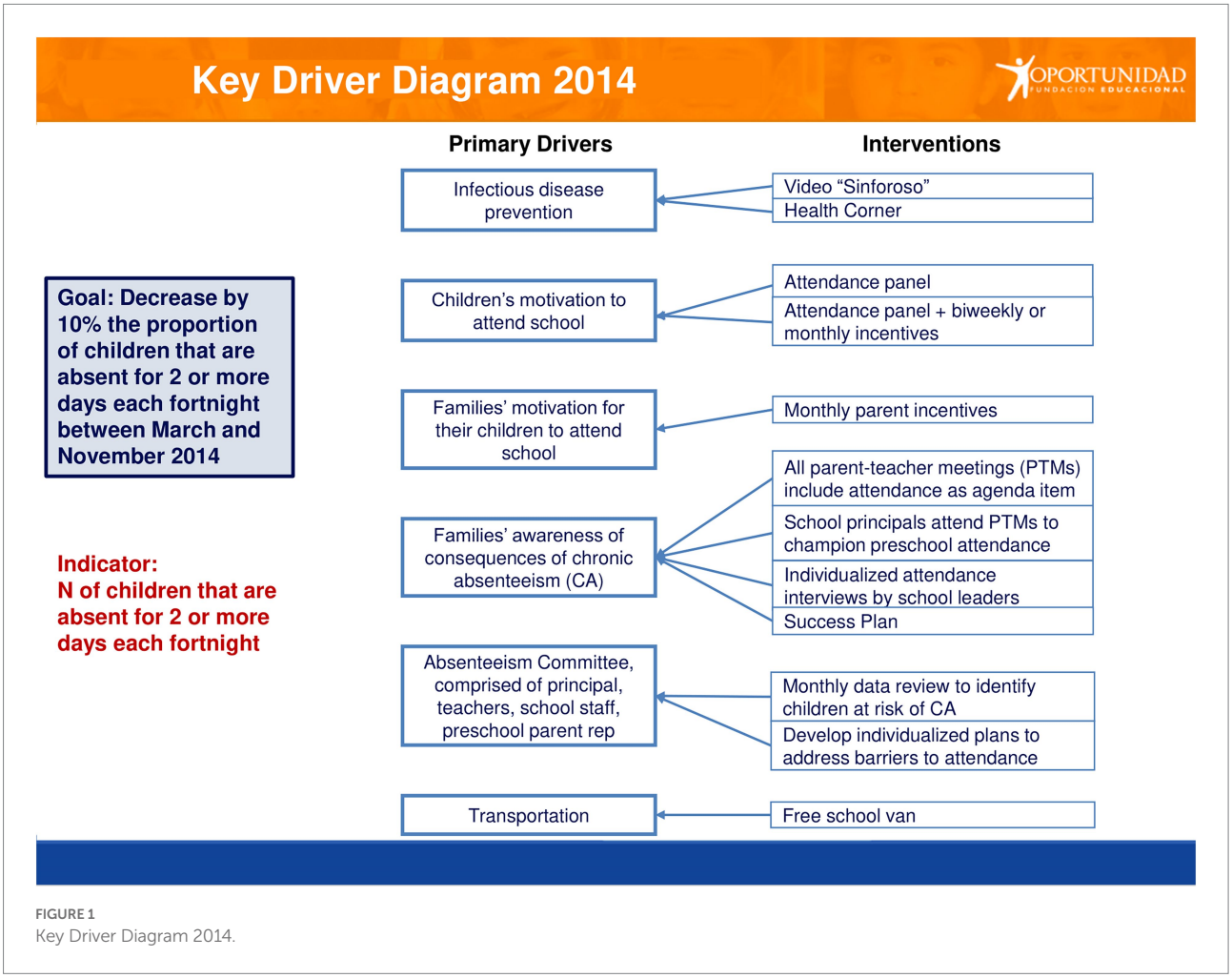

FIGURE 1
Key Driver Diagram 2014.

Angeles, Rhode Island and beyond. Prior to the 2014 school year and as part of BTS model, OFE convened international, Chilean national and local experts (including school leaders, teachers, teachers' aides, and parents) to review the tiered model and translated intervention resources; to draft a driver diagram that summarized the factors driving absenteeism in Chilean preschools; to select interventions from among the translated resources; and to contribute additional intervention ideas to test with school-based teams in practice.

In 2014–2015, OFE expanded the UBC program to 19 schools in the VI Region of Chile. All participating schools received training in CQI methods and UBC's three main areas of intervention: Instructional Time, Effective Interactions, and Attendance. Participating schools selected one area to prioritize at their school; a subset of five schools with six preschool classrooms prioritized attendance promotion.

UBC program data and experience suggest that consistently applied strategies work: for example, programmatic data from one of the UBC schools showed that the percentage of children who missed more than 2 days in each fortnight fell from 28% during 2014 to 24.2% during the first semester of 2015 and to 13.1% during the second semester of 2015. However, these analyses have limitations, as official daily attendance data at the child level were not available.

In 2018, for the first time, the Ministry of Education made publicly available databases with individual-level daily attendance of all children enrolled in all public schools from 2011 to 2017 (MINEDUC, n.d.). This research uses this administrative data to answer two fundamental questions:

1. What were the rates of absences and chronic absenteeism in preschools in the VI region of Chile between 2011 and 2017?
2. Is there a difference in the evolution of absences and chronic absenteeism between three groups of schools?

a. Schools that did not participate in UBC (27 Comparison Schools),
b. Schools that participated in UBC in 2014 and 2015, but did not choose attendance as their priority intervention area (14 UBC Schools that did not prioritize attendance), and.
c. Schools that participated in UBC in 2014 and 2015 and chose attendance as their priority intervention area (5 UBC Schools that prioritized attendance).

This study contributes to the rapidly changing field of school attendance and absenteeism by examining the effect of *Un Buen Comienzo* (UBC) – a 2-year preschool professional development intervention that included a multi-tiered attendance promotion and absenteeism prevention strategy – on preschool attendance in Chile. By describing the BTS model that supported school teams to test and implement those attendance strategies, it also contributes to the literature on implementation science in education, which is a field of extreme relevance that still needs to be developed in countries like Chile (Meneses et al., 2017). In addition, the analytic approach responds to the discourse on the importance of a robust and effective assessment of quality improvement initiatives in education and provides a model that combines methods that facilitate practice-based data-driven decision-making and methods with causal inference (Fretheim and Tomic, 2015; Gessa et al., 2022).

2. Materials and methods

2.1. Intervention

The UBC program's theory of change for improving attendance is visualized in a driver diagram with six primary drivers – that is, key determinants – that contribute to reaching the goal of reducing absenteeism (see Figure 1).

Primary Driver 1: Infectious Disease Prevention and its associated interventions aimed to prevent child illness – particularly respiratory illnesses – which were one of the most frequently reported reason for missing school (Arbour et al., 2016).

> Strategy 1.1 "Health corner": Teachers designated a physical space in the classroom with tissues, alcohol gel, and a waste basket for children to use as needed.
>
> Strategy 1.2 "*Video Sinforoso*": UBC provided and teachers used age-appropriate educational materials about the importance of personal hygiene for avoiding illness and attending school. Materials included a puppet show about "*Sinforoso*," a bacterium that hates handwashing, and series of postcards that *Sinforoso* sent to the classroom periodically throughout the year about his misadventures and failures as children around the country used regular handwashing and other infection prevention strategies.

Primary Driver 2: Children's Motivation to Attend School addressed this child-level factor. Positive attitudes toward school are positively associated with school attendance (Gubbels et al., 2019), and Chilean parents reported that children oversleeping contributed to problematic absenteeism, which suggests this factor was relevant to the study context (Arbour et al., 2016).

> Strategy 2.1 "Attendance panel": UBC provided materials and classroom teams (i.e., teachers and aides) assembled and displayed on the classroom wall an attendance panel that contained the names of each child in the class and the dates for every day of class in the month. Every day, each child recorded his or her own attendance on the panel.
>
> Strategy 2.2 "Attendance panel plus incentives": Each class or school defined an attendance goal for each fortnight or month. In addition to having children register their daily attendance on the classroom wall, classrooms celebrated and gave prizes

> to children who met the goal. For example, some classrooms gave children a crown to wear for the day or displayed a photograph of children who attended 100% of class days in the month in the school entryway. Some classrooms defined individual goals (e.g., attend 9 of 10 days in the fortnight, or 100% of class days in a month) and presented prizes to each child who met the goal. Others set a classroom goal (e.g., in a class of 16 children, the whole class would have no more than 5 days absent).

Parental attitudes toward education and their child's classroom contributed to absenteeism in UBC's impact evaluation, specifically their report that they sometimes kept them home out of personal preference, and they believed school's main role was to keep children safe and healthy, rather than encouraging social or school skills (Arbour et al., 2016). Therefore, Primary Drivers 3 and 4 aimed to increase parents' motivation to send their children to school (PD3) and raise awareness of the value of preschool education and consequences of chronic absenteeism (PD4), while also strengthening the parent-school relationship (Chang and Romero, 2008).

Primary Driver 3: Families' Motivation for their Children to Attend School.

> Strategy 3.1 "Incentives for families": This strategy aimed to acknowledge and positively reinforce families whose children met the class's attendance goal. At customary monthly group meetings between the classroom teachers and parents, school leaders presented certificates to parents whose child attended 100% of the days of school during a month.

Primary Driver 4: Families' Knowledge and Understanding of Consequences of Absenteeism.

> Strategy 4.1 "All parent-teacher meetings include attendance": Schools established attendance as a standing agenda item for all parent-teacher meetings and used a set of UBC-provided resources for teaching about the importance of attending classes and the effects of absenteeism on children's development.
>
> Strategy 4.2 "School leaders champion preschool attendance": School principals attended the parent-teacher meetings to reinforce the importance of attending preschool, as well as his or her wish to see each of their children in school every day and willingness to help problem-solve barriers to regular attendance.
>
> Strategy 4.3 "Individualized 'attendance interviews' by school leaders": School leaders met with families of children with repeated school absences, expressed his or her wish to see their child in school every day, and used a series of scripted questions to engage families in shared problem-solving.
>
> Strategy 4.4 "Success Plan": Adapted from United States non-profit AttendanceWorks (Attendance Works, n.d.), the Success Plan was a rubric that contained historical information on a child's absences and the number of days that would result in chronic absenteeism, should he or she miss them in the future. Schools used this approach in an individual or group interview with the parents of children at risk of chronic absenteeism to generate awareness and invite families to commit to a plan for overcoming common causes of their child's absences.

Primary Driver 5: Absenteeism Committee fostered schools' capacity to monitor attendance, a key tool in preventing absenteeism (Chang and Romero, 2008; Keppens et al., 2019).

> Strategy 5.1 "Absenteeism Committee": Schools formed a team comprised of the principal, preschool teacher and teacher's aide, school staff (e.g., social worker, cafeteria worker, school administrator, etc.), and a preschool parent representative. The team met monthly to analyze attendance data, identify children at risk of chronic absenteeism, and develop an individualized approach for engaging each child and family in overcoming barriers to regular school attendance.

Primary Driver 6: Transportation provided children with school transportation *via* a free school van, addressing a parent-reported barrier to regular attendance (Arbour et al., 2016).

> Strategy 6.1 "School van": School sponsored transportation for children with absences due to lack of transportation.

Table 1 lists the UBC schools that prioritized attendance and the strategies they tested each month. Table 2 shows the number of times each strategy was used per month in the UBC schools that prioritized attendance.

2.2. Implementation strategy

OFE delivered UBC using the Breakthrough Series Collaborative Model (BTS), a commonly used continuous quality improvement (CQI) model that recruits teams of direct service providers and stakeholders to pursue one shared, specific aim during a defined period of time, and creates a structure wherein interested organizations learn from each other and recognized experts (The Breakthrough Series: IHI's Collaborative Model for Achieving Breakthrough Improvement, 2003). The model has three core elements: (1) learning sessions that bring teams together periodically for training and collaboration, separated by (2) 'action periods' during which teams test what they have learned in practice, using (3) Plan-Do-Study-Act cycles – a structured approach to rapid-cycle testing of innovations in practice (Figure 2).

Participating schools formed school-based teams comprised of school leadership (principals or curriculum directors), teachers, teachers' aides, and preschool parents. OFE convened

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TABLE 1 UBC Schools that prioritized attendance and the strategies they tested each month.

UBC Schools that prioritized attendance	Mar 2014	Apr 2014	May 2014	Jun 2014	Jul 2014	Aug 2014	Sept 2014	Oct 2014	Nov 2014	Dec 2014	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sept 2015	Oct 2015	Nov 2015	Dec 2015
School 1			1	1	1	1	1	1			1		1							
		2			2		2	2	2		2	2	2	2		2				
			3									3	3	3		3		3	3	
				4		4		4	4				4							
													5							
																6				
		7			7						7									
School 2			1	1	1				1		1		1							
		2			2			2	2		2	2								
			3									3	3			3	3	3	3	
				4								4	4							
					5											5	5	5		
																6				
						7					7									
School 3		1	1	1	1	1					1		1							
		2			2		2		2		2	2			2					
			3									3	3		3	3		3	3	
				4		4			4				4							
												5					5			
													6		6	6				
		7			7						7									
School 4			1	1	1	1			1			1	1	1	1	1			1	
		2			2		2					2	2	2						
			3									3	3	3	3	3		3	3	
						4						4	4	4	4	4			4	
																	5	5		
															6		6			
		7			7						7									
School 5			1	1	1	1		1	1			1	1							
		2			2	2		2	2			2			2		2			
			3									3	3		3		3			
				4					4			4	4							
																6				
		7			7						7									

Key to Table 1.

Number	Strategy
1	Attendance panel
2	Inclusion of the attendance issue in all parent-teacher meetings
3	Absenteeism Committee
4	Incentives for children
5	Incentives for families
6	Success Plan
7	Health Corner

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TABLE 2 Number of times each strategy was used per month in the UBC Schools that prioritized attendance.

	March 2014	April 2014	May 2014	June 2014	July 2014	August 2014	September 2014	October 2014	November 2014	December 2014	March 2015	April 2015	May 2015	June 2015	July 2015	August 2015	September 2015	October 2015	November 2015	December 2015
Attendance panel		1	5	5	5	4	1	2	3		3	2	5	1	1	1			1	
Parent–teacher meetings		5			5	1	2	4	4		2	5	2	2	2	1	1			
Absenteeism Committee			5									8	5	2	3	4	2	4	4	
Incentives for children						4		1	3			3	7	1	1	1			1	
Incentives for families				4	1							5	1			1	3	2		
Success plan													6	1	1	6				
Health corner					5						5									

school-based teams at Learning Sessions three times during each school year to learn UBC's theory of change and to form a peer Learning Network, where UBC Schools shared their learning, data, successes, and failures. In total, school teams met six times over 24 months. Three times in 2 years, OFE organized cross-school visits, in which 3–5 school-based teams visited a peer school selected by the OFE team to model their application of the intervention strategies, observed their work, and engaged in a reflection and feedback discussion. Each month, teams tested interventions using Plan-Do-Study-Act (PDSA) cycles, reported measures, and participated in UBC coaching.

Each UBC school received three on-site coaching sessions per month (April–June and August–November 2014 and 2015). Two coaching sessions focused on implementation of UBC language strategies; these 2-h sessions included a "pre" classroom session (Plan implementation of a UBC activity), followed by in-classroom observed activity implementation (Do), then a "post" classroom session where the teacher and coach reflected on what worked well and what to change the next time the teacher implemented that UBC strategy (Study and Act). The third coaching session each month focused on applying CQI methods to support implementation of each school's priority area of intervention: coaches reviewed with teachers the interventions tested and supported data analysis —for example, examining graphs of daily attendance over time, noting when certain interventions were implemented, and observing trends and shifts in the data and their relationship to interventions tested.

UBC Field Coordinators delivered the coaching sessions. These were trained preschool teachers with Master's degrees in Educational Leadership. Every 2 or 3 months, UBC Area Coordinators accompanied the Field Coordinators in coaching sessions to provide content expertise on the UBC strategies that schools were testing in their priority area of intervention. The Attendance Coordinator focused mostly on completion of PDSA cycles and data review to detect improvements in attendance and adjust implementation for individual children who were at risk for chronic absenteeism. The Attendance Coordinator was a social worker with a Master's degree in Family Sciences and a certificate in CQI Methods. Field Coordinators and Area Coordinators used a modeling-to-scaffolding approach – for example, in the first coaching session of the month, a Field Coordinator might lead an intervention with support from the teacher and the teachers' aide; then, during the second coaching session, the teacher or teachers' aide would lead with support from the coach. Thus, the role of the UBC team evolved, as the school-based team practiced and developed greater comfort and capacity implementing the UBC intervention strategies.

To support data-driven decision-making in implementation, OFE developed an online attendance data platform. Recognizing that all schools in Chile are required to submit individual-level attendance data each month to the Ministry of Education *via* an online portal (described below, see Procedures and Definition of Variables), OFE contracted a software engineer to develop a digital platform that could read

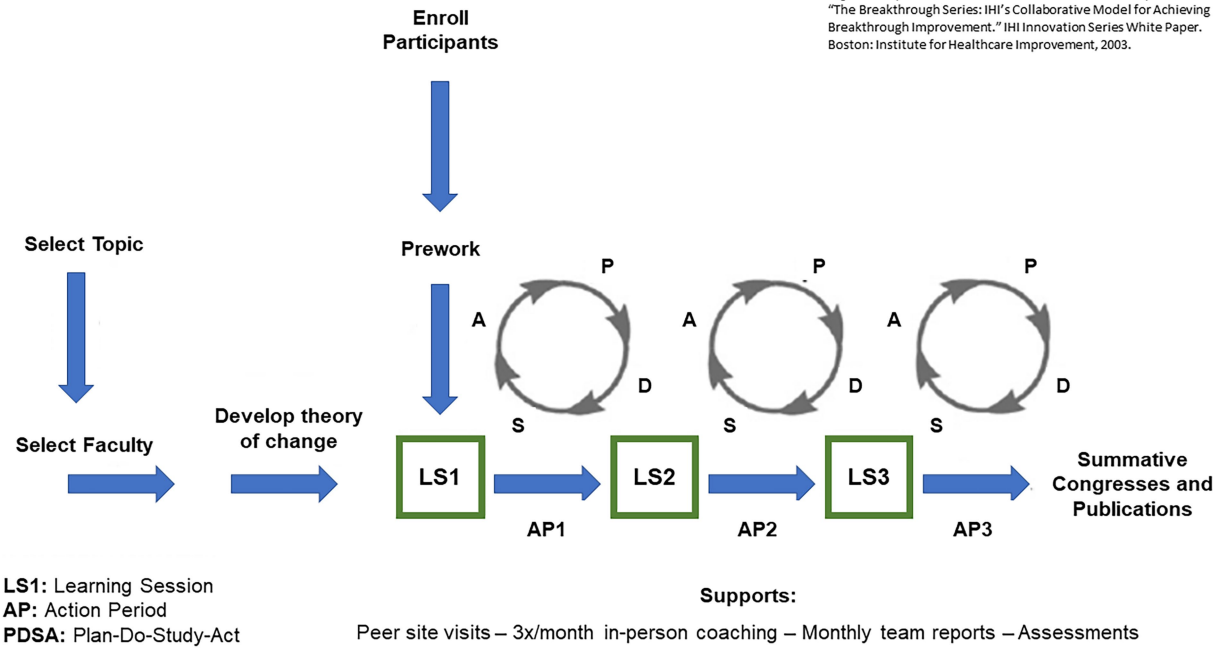

FIGURE 2
The Breakthrough Series Collaborative model adapted by Fundación Educacional Oportunidad to implement their professional development program in UBC Schools that prioritized attendance.

the schools' MINEDUC attendance data reports and create a database that calculated the percent of schooldays attended to date for each child, marking in yellow the children who attended less than 90% of school days to date. OFE's CQI Coordinator, a sociologist with a Master in Social Research methodologies, defined the platform's capabilities and supervised the software engineer's work; the Attendance Coordinator tested the platform and refined its use cases. At first, the CQI Coordinator collected all the schools' MINEDUC reports from schools and uploaded them. In coaching sessions, the Attendance Coordinator supported school-based Attendance Committees in viewing and using the data to identify students in need of individualized intervention. Over time, schools saw that uploading the MINEDUC data was easy and useful, and they became responsible for managing their own data independently, with training and technical documents provided by OFE's CQI Coordinator.

OFE's Director of Implementation led UBC program implementation, including coordination between OFE staff and stakeholders from municipalities and schools. She is a former history teacher with a Masters in Educational Management and certificate in CQI methods. Beginning in 2013, she visited the Director of Educational Administration (*Director de Administracion Educacional Municipal,* DAEM) of every municipality in the VI Region. She offered UBC participation to all schools and explained that the UBC program is free of cost for municipalities and school leaders who committed to (a) provide classroom coverage so that teachers and teachers' aides can participate in Learning Sessions and coaching sessions, and (b) apply measurement instruments and report data for CQI and program evaluation. Prior to UBC implementation, every DAEM with schools interested in participating in UBC signed an agreement committing to those conditions. During UBC implementation, every month, OFE's Director of Implementation met with each DAEM to monitor implementation and discuss any concerns – concerns raised by schools, challenges the Director of Implementation noted herself (e.g., regarding school-based teams not attending Learning Sessions or not submitting data), or feedback from UBC coaches. UBC Field Coordinators communicated directly with DAEMs to coordinate month-to-month activities with schools, including coaching sessions.

2.3. Intervention study

During the second half of 2013, all schools in the VI Region were offered the choice of receiving UBC professional development in 2014–2015. Twenty-seven schools did not participate.

Nineteen schools opted to participate in UBC; a subset of five schools with six preschool classrooms prioritized attendance. Thus, these schools paid special attention to the regular and rigorous application of the attendance-promoting strategies, and they received more intensive coaching in this area – for example, their third coaching session focused on applying CQI methods to implement attendance strategies and included support from the Attendance Coordinator every other month.

TABLE 3 Characteristics of the analytical sample.

2011–2017	UBC schools that prioritized attendance	UBC schools that did not prioritize attendance	Comparison schools	Total	*p*-Value[d]
N schools	5	14	27	46	
N rural schools	5	14	20	39	
N municipal schools	5	13	27	37	
N voucher schools	0	1	0	10	
N classrooms	6	19	42	67	
Average N preschool children[a], total (range)	104 (83–126)	300 (274–317)	814 (742–865)	1,218 (1,099–1,308)	
Average N children per preschool classroom (range)	18 (5–39)	16 (4–45)	19 (1–44)	18 (1–45)	0.01
Average N matriculated children per school (range)	156 (77–254)	159 (72–363)	195 (16–825)	180 (16–825)	0.64
Average N students living in poverty[b] (range)	112 (44–166)	123 (59–252)	147 (11–565)	120 (11–565)	0.62
Average % students living in poverty[b] (range)	71.4 (57.1–80.6)	78.4 (64.0–92.2)	75.1 (58.1–86.1)	75.7 (57.1–92.2)	0.22
Average N students living in extreme poverty[c] (range)	65 (25–79)	80 (36–127)	94 (4–369)	87 (4–369)	0.57
Average % students living in extreme poverty[c] (range)	42.4 (29.9–52.3)	52.3 (34.8–72.9)	46.9 (24.1–65.0)	48.1 (24.1–72.9)	0.19
Pre-intervention (2011–2012) average % schooldays absent (range)	12.0 (0–86.7)	10.8 (0–90.3)	13.2 (0–82.5)	12.5 (0–90.3)	<0.001
Pre-intervention (2011–2012) average % of CA children	46.2	38.6	53.9	49.6	<0.001

IQR, interquartile range; %, Percentage; CA, chronically absent. [a]These represent individual children in each year; the evolution of an individual child's attendance across the years cannot be examined. [b]Students from families within the 20% most vulnerable. [c]Students from families within the 5% most vulnerable. Citation: JUNAEB: Ministerio de Educación. "IVE." Government Website. Accessed September 13, 2022. https://www.junaeb.cl/ive?lang=en. [d]Differences tested using ANOVA for all variables, except for the pre-intervention average percent of chronically absent children, which was tested using a Chi-square test.

2.4. Procedures and definition of variables

In Chile, data on attendance and absences for all students matriculated in public schools for preschool (prekindergarten and kindergarten), primary and secondary education are registered by teachers once a day. Schools submit individual student-level daily attendance data to a centralized database each month (the Ministry of Education's General Information System for Students; *Sistema de Informacion General de Estudiantes*, SIGE). The Ministry of Education's Study Center processes and compiles attendance data into national monthly databases that are available to the public (MINEDUC, n.d.) Each database contains individual, student-level data, including a unique identification number, gender, birthdate, and daily attendance, as well as the following variables: number of schooldays in the month, classroom, school, year, region, rurality, and administration (municipal, voucher, cooperative administration). Chile can be considered one of the forerunners in the world in systematically collecting individual-level school attendance and absenteeism data among all students who attend public schools. This innovation is consistent with a broader commitment to open data: MINEDUC's open data website offers the greatest access to disaggregated data in education among all OECD countries, with individual, de-identified data for students from prekindergarten through doctoral studies (MINEDUC, n.d.).

For this study, the attendance databases were downloaded for all months from March 2011 to December 2017 (MINEDUC, n.d.). It is important to note that, in Chile, the school year begins in March and ends in December. Monthly databases were reduced to include only schools in the VI Region with preschool classrooms and then merged to form a single database with individual-level daily attendance for all children matriculated in preschool in the VI Region between 2011 and 2017.

For each child, the percentage of days absent in each month and year was calculated by dividing the number of days absent by the number of school days in that month and year, respectively. The total number of school days was not an approximation; each school reported the exact number of school days monthly to MINEDUC *via* SIGE. The number of school days per year varied by school ($M = 162$ days, SD = 23.7), and there was a small (1–2 days) but significant difference between the average number of school days by group ($p = 0.04$, see Table 3). A child was classified with chronic absenteeism if he or she missed more than 10% of days in the year. For each child, days were counted from the first month the child attended until the child withdrew from school. A child was considered withdrawn if (a) he or she appeared with attendance at another school and did not return to the original school, or (b) he or she was absent four consecutive months and did not return. Thus, the population of children varies from month to month, incorporating children when they enter school and eliminating children when they leave, and the percentage of days absent is

based only on school days that occurred while the child was still enrolled. It was not possible to follow the behavior of the children from one year to another since each child's unique identifier is not retained from year to year.

For each school, the average of the percentage of days absent per child each month and for the year was calculated by dividing the sum of the number of days absent by the sum of the number of schooldays for all enrolled children. Children were classified as chronically absent if they were absent for more than 10% of the schooldays for which they were enrolled. The percentage of children with chronic absenteeism was calculated for each year.

2.5. Definition of the sample

All children were included in the analyses except 90 children who appeared to attend more than one school in the same month. Children who were enrolled for less than 4 months were examined to determine whether their limited data caused extreme values; they were included because they were not outliers and there were very few of them (e.g., out of 1,485 children with data in 2011, 8 children were enrolled for fewer than 80 days).

Schools were included that had preschool classrooms with pre-intervention data (from 2011 and/or 2012), intervention period data (2014–2015), and post-intervention data (2016–2017). Data from 2013 were not considered, as the MINEDUC databases lacked data for the first 5 months of the school year. There were no other exclusion criteria. All schools were from Chile's VI region and were classified according to their exposure to the UBC Program implemented in 2014–2015: "UBC schools that prioritized attendance" participated in UBC and selected attendance as their priority area. "UBC schools that did not prioritize attendance" participated in UBC but selected other UBC areas as their priority area, and "Comparison schools" did not participate in UBC. Eight schools that had some classrooms that participated in UBC and other classrooms that did not participate in UBC were excluded from the analyses, for a cleaner comparison.

To examine how similar the three groups of schools were before the intervention, we compared data from the beginning of 2014 for the average number of students per preschool classroom, the number and proportion of students living in poverty (20% most vulnerable), and the number and proportion of students living in extreme poverty (5% most vulnerable; IVE, n.d.). These data are from the National System of Assignment with Equity (*Sistema Nacional de Asignación con Equidad*, SINAE), which measures a vulnerability index for every household using data from public social support programs that the government provides to families with limited income, such as public health insurance and cash assistance (i.e., "the Ethical Family Income"; ¿Cómo Funciona El Sinae?, n.d.). These data are matched to the student body of each classroom at the beginning of each school year and are published by September each year; they approximate pre-intervention time. Moreover, school-level vulnerability indices vary very little (less than two percentage points) between 2013 and 2014 (IVE, n.d.). We also compare the average number of schooldays per year, and the pre-intervention (2011–2012) absenteeism rate and percent of children with chronic absenteeism.

Table 3 describes the characteristics of the analytical sample, which includes attendance data for an average of 1,218 children per year; the exact number varied between 1,099 and 1,308 children per year between 2011 and 2017. These children attended 46 schools: 5 UBC Schools that prioritized attendance, 14 UBC Schools that did not prioritize attendance, and 27 Comparison Schools.

Most of the schools were rural (39 of 46 schools, or 83%). All UBC Schools that prioritized attendance were rural, and all but one of the UBC Schools that did not prioritize attendance were rural. All UBC schools that prioritized attendance and Comparison Schools were municipal public schools, as well as 13 of the 14 UBC Schools that did not prioritize attendance. The one remaining UBC School that did not prioritize attendance was a voucher school (see Table 3).

There were no differences between groups in the number of matriculated students, the proportion of students living in extreme poverty, nor the proportion of students living in poverty. Of note, in all three groups, approximately half of students were living in extreme poverty and three quarters were living in poverty.

There were small but significant differences between the groups' average number of children per classroom (range = 16–19 children) and the average number of school days per year (range = 162.4–164.2 days). There were also differences between groups' pre-intervention absenteeism and chronic absenteeism. On average, for UBC Schools that prioritized attendance, UBC Schools that did not prioritize attendance, and Comparison Schools, absenteeism rates were 12.0, 10.8, and 13.2%, respectively, and the percent of children with chronic absenteeism rates was 46.2, 38.6 and 53.9%, respectively.

2.6. Analysis

To answer the first research question – what was the rate of absences and chronic absenteeism in preschools in the VI region between 2011 and 2017? – we calculated the average days absent per child and the proportion of children with chronic absenteeism for all schools together and for each subgroup separately: Comparison Schools, UBC Schools that did not prioritize attendance, and UBC Schools that prioritized attendance. We tested for differences in averages across groups using ANOVA and Chi-square tests.

To examine differences in the evolution of absences and chronic absenteeism between UBC Schools that prioritized attendance, UBC Schools that did not prioritize attendance, and Comparison Schools (research question 2), data were analyzed in time series using two methods: Statistical Process Control charts and Interrupted Time Series Analysis.

Statistical Process Control (SPC) chart (also called Shewhart charts) are well-established methods that can identify changes that are unlikely due to chance alone and allow inferences to be drawn from the temporal relationships of interventions and results (Shewhart, 1930; Deming, 1986; Provost, 2011; Provost and Murray, 2011b; Green et al., 2012; Gessa et al., 2022; Sivena and Nikolaidis, 2022). SPC charts plot time series data with three lines: a central line representing the expected mean value, and regression-based control limits (CLs) that bound expected variation, typically set at 3 standard deviations (SDs) above and below the mean. The central line is based on data before the intervention; in this case, mean baseline absenteeism was calculated from 18 datapoints from 2011 and 2012. The standard deviation is calculated from the baseline mean and the denominator, using the formula appropriate to the type of data and its distribution – in this case, child-schooldays in each month and the binomial distribution (for each day, each child is either present or absent). Thus, the CLs are stepped because they reflect changes in the sample sizes, and they control for differences in sample size between groups and over time. The CLs are set 3SDs above and below the mean so that standard rules can be applied to identify changes in the data that have a less than 5% probability of occurring by chance alone: one or more point outside the CL, eight or more points in a row above or below the mean ("shift"), five consecutive points increasing or decreasing ("trend"), and two of three points outside 2SDs (Perla et al., 2011). Following best practices, when shifts occurred, we calculated the average of the eight points and extended that new mean absenteeism central line into the future to be used for identification of any further changes.

SPC chart interpretation involves comparing changes in the data with timing of UBC attendance promotion and absenteeism prevention strategies from Tables 1, 2, which allows inferences to be drawn about which strategies or combination of strategies are associated with changes in absenteeism, as well as inferences about how long the UBC intervention needs to be implemented before an effect may be seen. In addition, creating separate SPC charts for UBC Schools that prioritized attendance, UBC Schools that did not prioritize attendance, and Comparison Schools facilitates comparison of the evolution of absences and chronic absenteeism across groups and consideration of whether detected changes might be due to secular changes that occurred simultaneous, but not related, to the intervention. However, SPC methods lack causal inference.

Therefore, as a secondary approach to assess UBC's impact on absenteeism, we also conducted Interrupted Time Series (ITS) analysis for multiple group comparisons. ITS is a strong quasi-experimental design that accounts for pre-existing and secular trends in the outcome (EPOC, n.d.; Penfold and Zhang, 2013; Bernal et al., 2017). ITS uses statistical models to estimate and compare the preintervention to postintervention intercepts (i.e., comparison of levels) and preintervention to postintervention slopes (i.e., comparison of trends). A change in level (a jump or drop in the outcome after the intervention) represents an abrupt intervention effect; a change in trend (an increase or decrease in the slope of the segment after the intervention) represents a gradual change in the value of the outcome (Linden, 2015). ITS can estimate the effects of multiple treatment periods (Linden, 2015, 2017).

We estimated an ordinary least squares (OLS) regression model with percent absent as the dependent variable and time, intervention period (pre versus post), and the time-by-period interaction as the independent variables. Calendar month was used as the unit of time. Because UBC was implemented over 2 years with some intervention strategies deployed in year one (2014) and different intervention strategies added in year two (2015) and considering that the SPC charts demonstrated an upward shift in 2014 for UBC schools that did not prioritize attendance and a downward shift in 2015 for UBC schools that did prioritize attendance, we used an ITS model to estimate the effects of two treatment periods. We compared 18 months of pre-intervention data (2011–2012) with 9 months of year 1 intervention data (March–November 2014) and 27 months of post-year-two intervention data (2015–2017). To account for autocorrelation, we used Newey–West standard errors, and we set lag to 9 (inclusive of all data in a school year, March through November) because attendance data within a school year is known to be correlated (Balfanz and Byrnes, 2012). A Cumby-Huizinga test suggested that this model could correctly account for autocorrelation structure (Cumby and Huizinga, 1992).

To analyze the effect of UBC on chronic absenteeism (CA), neither SPC charts nor ITS analysis could be applied due to the limited number of datapoints: since CA is defined based on a full school year's data, there are only six CA datapoints in this sample. ITS typically requires 8 pre-intervention and 8 post-intervention datapoints (Penfold and Zhang, 2013); SPC charts calculate baseline mean from 12 to 20 datapoints (Provost and Murray, 2011a). Therefore, chronic absenteeism was analyzed using time series run charts with a central line only, and they are interpreted using visual analysis alone (Provost and Murray, 2011a).

Database preparation, descriptive analyses and ITS analyses were performed using the software package STATA SE, version 14.2 (StataCorp, College Station, TX). All tests were two-tailed, and alpha was set at 0.05. SPC charts were constructed using QIMacros (Arthur, n.d.).

3. Results

Research question 1: What were the rates of absences and chronic absenteeism in preschools in the VI region between 2011 and 2017?

Table 4 shows that between 2011 and 2017, children enrolled in Region VI preschools were absent for 14.2% of school days, on average. Average rates for that period were similar across the three subgroups: children were absent for 14.4% of school days in Comparison Schools, 14.0% in UBC Schools that did not prioritize attendance, and 14.2% in UBC Schools that prioritized attendance. There was more variation among the UBC Schools that prioritized attendance: in the school with the lowest absenteeism, the children were absent for 10.4% of the school days, while in the school with

TABLE 4 Average percent of days absent per child and the percent of children with chronic absenteeism in preschools in the VI Region.

Average, 2011–2017	Total	Comparison schools	UBC schools that did not prioritize attendance	UBC schools that prioritized attendance
Percent of days absent per child	14.2 (10.4–17.3)	14.4 (12.1–16.3)	14.0 (10.8–15.3)	14.2 (10.4–17.3)
Percent of children with chronic absenteeism	52.1 (33.5–68.9)	50.9 (33.5–68.9)	51.2 (40.3–57.1)	54.2 (35.3–62.0)

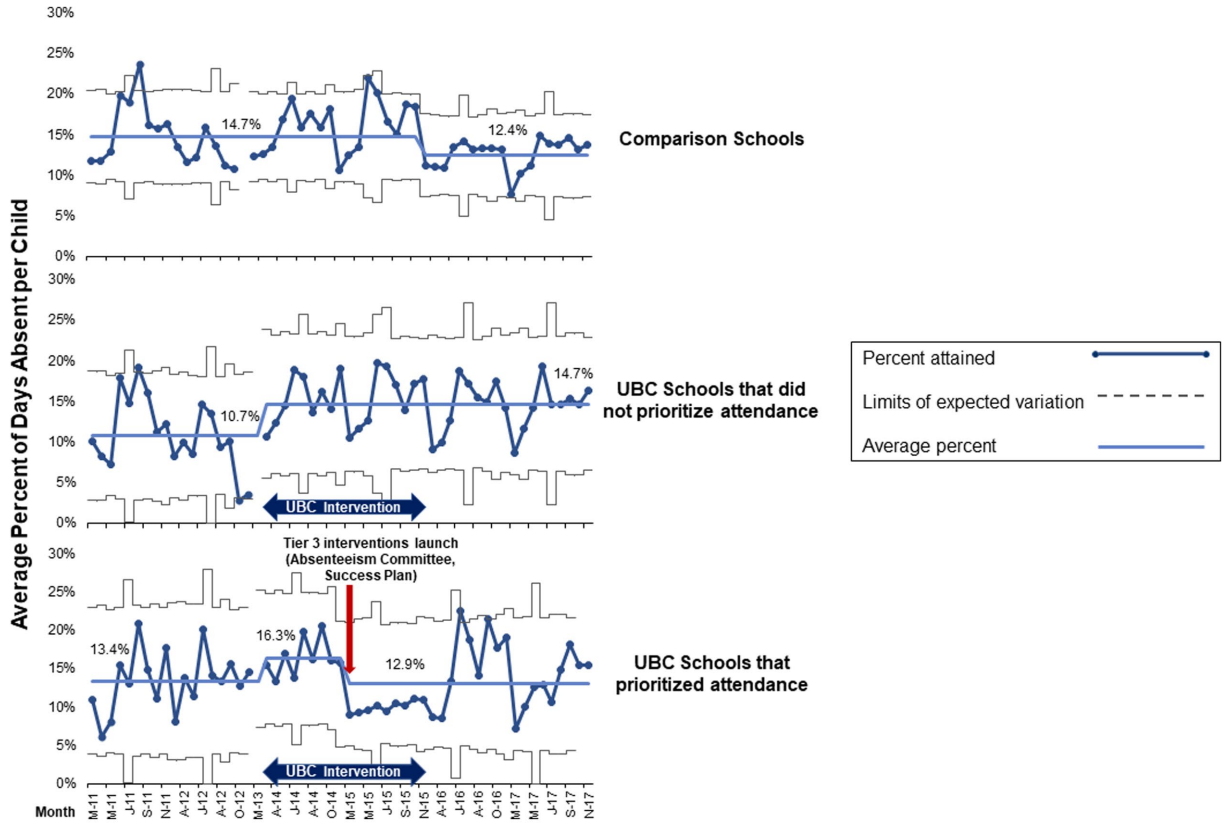

FIGURE 3
Evolution of the average percent of days absent per month per child, for the Comparison Schools, UBC Schools that did not prioritize attendance and UBC Schools that prioritized attendance.

the highest absenteeism, the children were absent for 17.3% of the school days.

On average between 2011 and 2017, the percentage of children with chronic absenteeism – those who missed more than 10% of school days – was 52.1% for the whole sample. In Comparison Schools, 50.9% of children were chronically absent. In UBC Schools that did not prioritize attendance, 51.2% of children were chronically absent, and in UBC Schools that prioritized attendance, 54.2% of children were chronically absent (see Table 4).

Research question 2: Is there a difference in the evolution of absences and chronic absenteeism between these three groups of schools?

a. Schools that did not participate in *Un Buen Comienzo* (27 Comparison Schools),
b. Schools that participated in *Un Buen Comienzo* in 2014 and 2015 but did not choose attendance as their priority area (14 UBC Schools that did not prioritize attendance), and.
c. Schools that participated in *Un Buen Comienzo* in 2014 and 2015 and chose attendance as their priority area (5 UBC Schools that prioritized attendance).

Figure 3 illustrates the evolution of the average percentage of days absent per child each month from 2011 through 2017 using Statistical Process Control charts.

In the Comparison Schools, children were absent an average of 14.7% of school days between 2011 and 2012 (baseline) and throughout 2014–2015. Beginning in April 2016, there is a downward shift– i.e., a series of eight points in a row below the

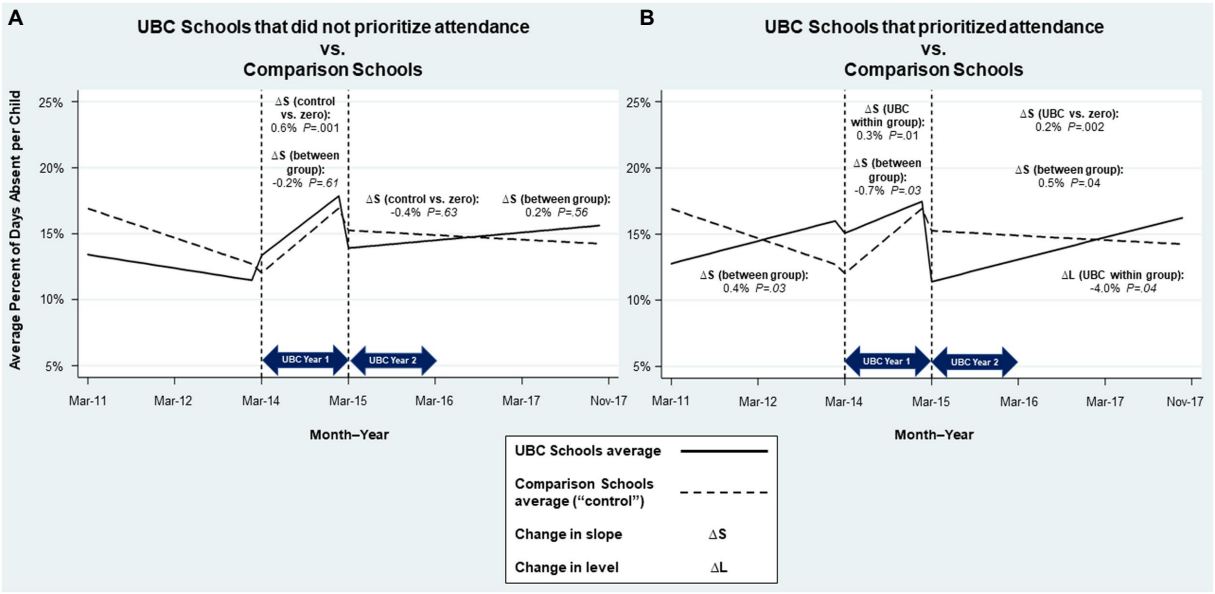

FIGURE 4
Interrupted time series analysis of the average percent of days absent per month per child, for (A) UBC Schools that did not prioritize attendance vs. Comparison Schools and (B) UBC Schools that prioritized attendance vs. Comparison Schools.

baseline – with a new average value of 12.4% that was sustained through the end of the study period (2017).

In UBC Schools that did not prioritize attendance, children were absent for an average of 10.7% of school days between 2011 and 2012. Beginning in March 2014, there is an upward shift to 14.7% that remained stable through the end of 2017.

In UBC Schools that prioritized attendance, children were absent for an average of 13.4% of school days between 2011 and 2012. Beginning in March 2014, there is an upward shift to 16.3% that lasts through November 2014. Beginning in March 2015, there is a downward shift to 12.9% that is sustained through the end of 2017.

Figure 4 presents the results of Interrupted Time Series analyses. Comparison schools (Figures 4A,B) prior to the intervention had baseline absence level of approximately 16.9% and a downward slope that was not statistically significant (−0.035, $p = 0.13$). At the first year of intervention, Comparison Schools had no change in absence level (−0.004, $p = 0.75$) but demonstrated an upward change in slope that was statistically significantly different from pre-intervention slope (0.009, $p = 0.003$) and different from zero (0.006, $p = 0.001$). This means that during 2014, Comparison schools' absence rates were rising by 0.6% each month. At the second year of intervention, Comparison Schools again exhibit no change in absence level (−0.023, $p = 0.18$). There is a decrease in slope that was statistically significantly different from their own 2014 slope (−0.007, $p = 0.002$) but indistinguishable from zero (−0.004, $p = 0.63$).

Comparing UBC Schools that did not prioritize attendance to Comparison Schools (Figure 4A), there were no differences in baseline level of absence (−0.035, $p = 0.16$) nor pre-intervention slope (0.001, $p = 0.55$). There were no differences in change in absence levels nor slopes between these two groups at the first year of intervention (0.024, $p = 0.19$ and −0.002, $p = 0.61$, respectively) nor at the second year of intervention (−0.022, $p = 0.26$ and 0.002, $p = 0.56$, respectively). Like the Comparison Schools, at the first year of intervention, UBC Schools that did not prioritize attendance had no change in absence level (−0.0044, $p = 0.75$) and a statistically significant upward slope (0.006, $p < 0.001$) that reversed at the second year of intervention and was not different from zero (0.001, $p = 0.18$).

In other words, Comparison Schools and UBC Schools that did not prioritize attendance had similar and stable absence rates before 2014 and again 2015–2017. In 2014, absence rates rose for both groups by approximately 0.6 percentage points each month ($p < 0.01$ for both).

Figure 4B presents the ITS comparison of UBC Schools that prioritized attendance versus Comparison Schools. There was no difference in baseline level of absence (0.023, $p = 0.07$). There is a small, statistically significant difference in pre-intervention slope (0.004, $p = 0.03$), indicating that absences were rising over time in the UBC Schools that prioritized attendance by roughly 0.4 percentage points per month. In the first year of intervention, UBC Schools that prioritized attendance had no change in absence level (−0.007, $p = 0.70$), but there is a change in slope that represents a small increase compared to their own pre-intervention rising trend (0.003, $p = 0.01$) but is negative when compared to the Comparison Schools' change in slope (−0.007, $p = 0.03$). In other words, during the first year of the intervention, absence rates in the UBC Schools that prioritized attendance were rising more quickly than they had been prior to 2014, but significantly less quickly than the rise in absence rates in Comparison Schools. In the second year of intervention, UBC schools that prioritized attendance experienced a statistically significant drop in absence

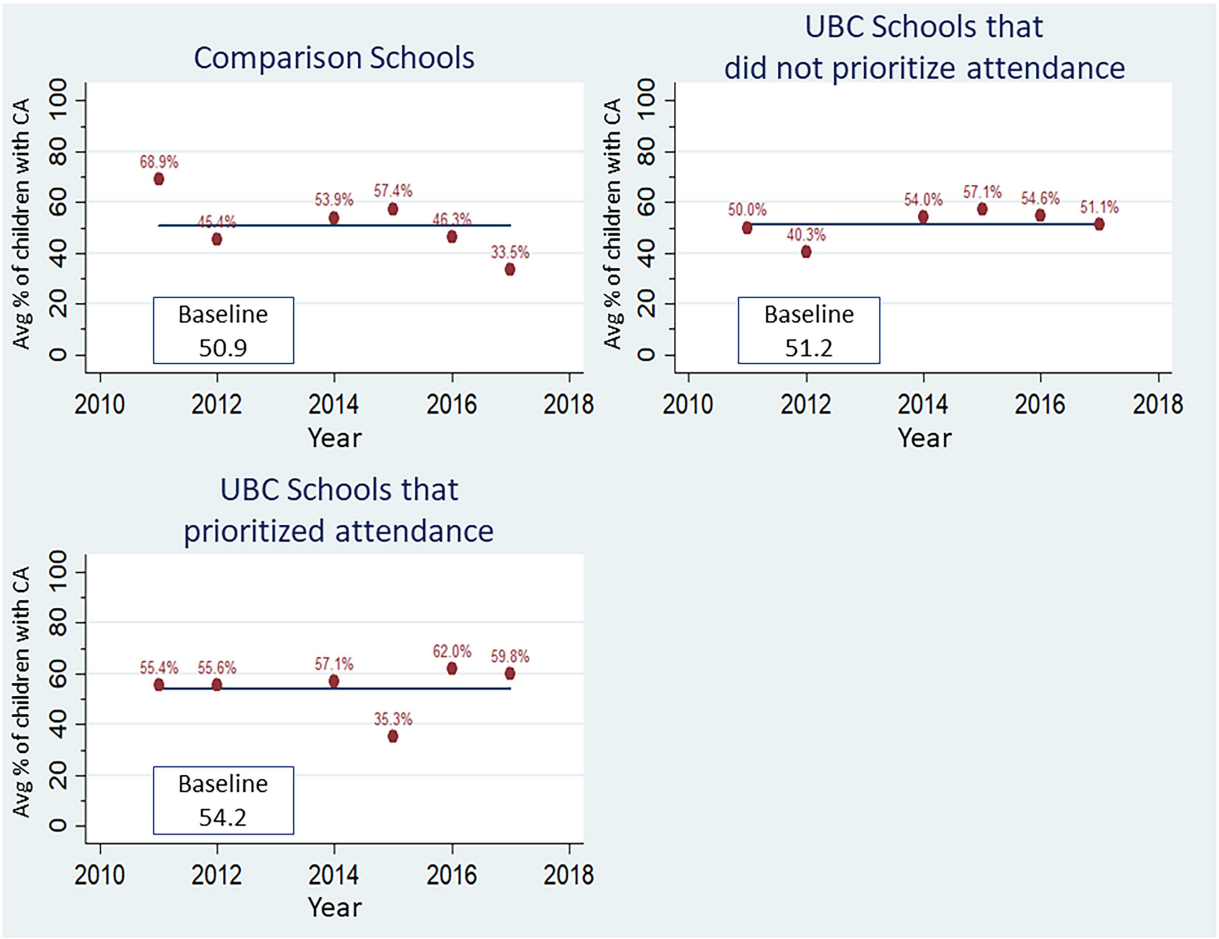

FIGURE 5
Evolution of the percentage of children with chronic absenteeism (CA) per year, for the Comparison Schools, UBC Schools that did not prioritize attendance and UBC Schools that prioritized attendance.

level (−0.041, $p = 0.04$). They continued to demonstrate positive slope that was different from zero (0.002, $p = 0.002$) and different from the Comparison Schools' 2015–2017 slope (0.005, $p = 0.04$).

In summary, before 2014, absence rates in UBC Schools that prioritized attendance were similar in level to the other two groups, but they were rising. In 2014 (UBC's first year), absence rates rose less quickly in UBC schools that prioritized attendance than the other schools, and in 2015 (UBC's second year), absence rates dropped by 4 percentage points. However, from 2015 to 2017, absence rates in UBC schools that prioritized attendance were rising again, while those of the other two groups stabilized.

Figure 5 shows the evolution of the average percentage of children with chronic absenteeism in each group of schools. From 2011 to 2017, the average percentage of children with chronic absenteeism was 50.9% in Comparison Schools and 51.2% in UBC Schools that did not prioritize attendance. The evolution over time has a similar shape in these two groups: lower in 2012 than 2011, higher in 2014, rising in 2015 and lower in 2016 and 2017. The UBC Schools that prioritized attendance had an average of 54.2% of children with chronic absenteeism from 2011 to 2017, and the evolution over time is quite stable, except for 2015, when the percentage of children with chronic absenteeism was 35.0%.

4. Discussion

Since discovering high rates of chronic absenteeism among Chilean preschool children and the moderating effect of absenteeism on the UBC program's impact, Fundación Educacional Oportunidad has played a leading role in raising awareness in Chile's early childhood community about the importance of regular attendance, and in developing and testing strategies to promote attendance and prevent absences and chronic absenteeism. This study is the first to analyze the effects of these innovations using national Ministry of Education data of 7,310 children enrolled in public preschool in Region VI over 7 years (totaling 63,689 child-months of data). It replicated two important findings from earlier UBC-related research (Arbour et al., 2016) and reports two new findings. First, the percentage of school days missed by children enrolled in prekindergarten and kindergarten in Chilean municipal schools is,

on average, higher than the threshold that affects skill development in the medium term and that can reduce or eliminate the impact of high-quality early childhood education. Second, more than half of the children enrolled in prekindergarten and kindergarten are absent for more than 10% of school days. Third, these analyses provide, for the first time, evidence that it is possible to reduce the school days lost to absences and reduce the percentage of children with chronic absenteeism with rigorous and systematic application of strategies that, on one hand, promote regular attendance by all children and, on the other, address the specific causes of absences of individual children at risk of chronic absenteeism. Finally, obtaining and sustaining improvements in attendance can be supported using networked peer learning and continuous improvement methodology (i.e., Breakthrough Series Collaborative).

Between 2011 and 2017, children enrolled in preschools in Region VI were absent, on average, for 14% of school days – more than the 10% associated with poorer school performance in first and fifth grade (Chang and Romero, 2008), and higher than the level that hindered the positive impact that UBC can have on children's learning (Arbour et al., 2016). The magnitude of absences and chronic absenteeism across all schools (Comparison Schools, UBC Schools that did not prioritize attendance, and UBC Schools that prioritized assistance) indicates that this problem is widespread and enduring. These findings are consistent with one study from Uruguay that reported that one third of children enrolled in preschool were absent for more than 15% of school days (Díaz et al., 2020). Data from around the world about daily attendance by preschoolers is scant (most studies have focused on preschool attendance as a binary variable, more reflective of preschool access and uptake; Gong et al., 2015; Boo, 2016; Delprato et al., 2016; Woldehanna, 2016; Sun et al., 2018; Su et al., 2020). This study and emergent literature suggest that levels of absences among children enrolled in early childhood education in the global majority may be high and reinforces that efforts to achieve the United Nation's Sustainable Development Goal 4.2 (i.e., by 2030, ensure that all children have access to quality early childhood development, care and pre-primary education so they are prepared for primary education) should include attention to attendance promotion and absenteeism prevention (UN General Assembly, 2015).

The results of this study also offer insights into how to promote attendance and address absenteeism, given the differences in the evolution of the percentage of days absent per child. Prior to and throughout UBC implementation, Comparison schools demonstrated stably high absenteeism levels (14.7% with no shift on SPC charts, 16.9% with no change in level by ITS). UBC Schools that did not prioritize attendance—despite lower baseline absence rates (10.7% in 2011 and 2012)—experienced a shift and subsequently matched Comparison school rates (14.7% from 2014 to 2017 on SPC charts, no differences identified by ITS).

In contrast, the UBC Schools that prioritized attendance show a favorable evolution of the percentage of days absent per child. They began with an intermediate level of absenteeism (13.4%), which rose to 16.3% in March 2014 and then dropped to12.9% in March 2015 and continues through the end of 2017. ITS analyses identified a similar reduction (four percentage points) and suggest that it can be attributed to UBC participation. This represents an average of 7 fewer days absent per child during that year. The percentage of children with chronic absenteeism in UBC Schools that prioritized attendance also decreased in 2015 to 35.0% of children, from more than 50% of children who were chronically absent in 2011 and 2012. This means that 16 additional children (of the 104 children enrolled in UBC Schools that prioritized attendance) reached the attendance threshold at which the UBC Program was shown to confer a positive impact on language development (Arbour et al., 2016).

These effects are larger than those of some other promising interventions in the emergent early absenteeism literature that apply a single strategy. Text-based interventions have been shown to reduce chronic absenteeism from 63 to 55.3% of children enrolled in Head Start classrooms in Chicago (Kalil et al., 2021), and from 26 to 13% of children enrolled in kindergarten in Pittsburgh (Smythe-Leistico and Page, 2018). A text-based intervention for parents of children enrolled in prekindergarten and kindergarten in Uruguay increased attendance by 0.32–0.68 days over the 13-week period among children whose baseline attendance was in the 25th, 50th and 75th quantiles (Díaz et al., 2020). A mail-based intervention decreased chronic absenteeism from 5.5 to 4.6% of children in 10 preschools in California (Robinson et al., 2018). Although these interventions had smaller impacts than those of UBC, they are significantly less costly than the set of interventions described in this study and may prove more feasible for certain contexts.

The reductions in absences and chronically absent children occurred in the second year of UBC implementation and coincide with an increase in the number and types of attendance strategies that were applied. As seen in Tables 1, 2, during 2014, 65 of the 70 tests focused on raising awareness or motivating all children and guardians through the application of the Attendance Panel, the parent-teacher meetings, the Health Corner, and incentives for children and/or families.

During 2015, UBC Schools that prioritized attendance continued applying these strategies and added 46 tests of two strategies focused on children at risk of chronic absenteeism: the Success Plan and the Attendance Committee. The Success Plan, adapted from Attendance Works in the United States (Attendance Works, n.d.), was an instrument that showed families their child's absences and the number of absences that remained before they developed "chronic absenteeism," and then asked the family to outline a plan with goals and strategies to prevent chronic absenteeism. The Attendance Committee, a school-level, multidisciplinary team, aimed to accompany children at risk of chronic absenteeism in a personalized way. Attendance Committees met monthly to review data, identify children at risk for chronic absenteeism, discuss suspected causes of those absences, and design specific strategies for working with each child and family.

Both of these strategies incorporated several best practices reported in the literature (Reid, 2013; Kearney, 2016; Chu et al., 2019): they analyzed and made use of their collected attendance data, identified causes of absenteeism, and provided attendance feedback to key stakeholders, including principals, counselors and

parents. Prior research has described that the extent to which schools maximize the potential of attendance data depends on certain preconditions, including data literacy (Mandinach, 2012; Keppens et al., 2019). UBC coaches supported teams to develop data literacy skills and processes for effective cross-hierarchical teamwork: they modeled facilitation of the first meetings, provided resources such as sample meeting agendas and slide decks, and gradually transitioned responsibilities to local school leaders. The standing agenda provided structure for the Committee to review data, identify children at-risk for chronic absenteeism and ask, "what happened?": for each child, the Committee sought to identify the root cause(s) of his or her absences and select an intervention strategy to address the root cause(s). Regular monthly meeting times facilitated the use of evaluative and iterative strategies, including setting clear goals for individual families, testing a specific strategy with that family to overcome a specific barrier to attendance, and soliciting feedback from families about what worked or why something failed. By including parents and other school staff who were often members of the child and family's community (e.g., cafeteria worker), discussions in Attendance Committee meetings often surfaced information that teachers and principals might not know was instrumental in shaping the approach to working with the family – in one case, one parent worked nights during specific seasons; in another, intrafamilial violence contributed to a child's absences. The Attendance Committee exemplifies an incremental, iterative, data-driven, and family-centered approach to attendance promotion and absenteeism prevention that has been proposed in the past (Cook et al., 2019; Lyon et al., 2019).

In addition to increasing and diversifying strategies, the UBC Learning Network, modeled after the Breakthrough Series Collaborative, provided a forum where UBC Schools that prioritized attendance supported one another and shared their learning, data, successes, and failures. The opportunities for collaborative work provided through the network were intended to advance their common goal: "to promote school attendance and reduce chronic absenteeism. In the years after participating in the UBC intervention, in UBC Schools that prioritized attendance, chronic absenteeism returned to levels similar to other schools and to their own pre-intervention rates, and absence rates demonstrated less stability (greater variation on SPC charts and continued trend to rise by 0.2 percentage points per month, according to the ITS analysis). These findings – that the reductions in absenteeism observed in 2015 do not persist over time – suggest that the BTS implementation strategy played an important role in supporting the teams to achieve improvements. It is well-established in the literature that coaching in addition to didactic professional development is more effective than didactic instruction alone (Landry et al., 2009; Neuman and Cunningham, 2009; Zaslow et al., 2010; Egert et al., 2018; Kraft et al., 2018). This initiative integrated UBC's coaching-based professional development with BTS' continuous quality improvement and collaborative learning: it is doubtful that the same results would be attained if these same multi-tiered intervention components were introduced without the structured implementation strategy.

Two unexpected findings warrant comment. First, UBC Schools that did not prioritize attendance demonstrated an upward shift in absence from 10.7% in 2011–2012 to 16.7% 2014–2017. ITS analyses suggest that this is secular trend, not related to UBC implementation: all three groups' absence rates had a positive slope during 2014, and there was no difference between this group and the Comparison schools. It is possible that this represents regression toward the mean: this group of schools had the lowest absenteeism among schools in our sample prior to UBC implementation in the VI Region, and perhaps relatedly, they prioritized one of the other two UBC intervention areas (Effective Interactions or Instructional Time). A related hypothesis is that asking school teams to identify a single priority area within the UBC intervention unintentionally causes a 'trade off' – a deprioritization of attendance that resulted in increased absenteeism in schools that focused on effective interactions or instructional time. In fact, data from the UBC Program show that UBC Schools that did not prioritize attendance applied few attendance strategies, and with less frequency and intensity than the UBC Schools that prioritized attendance.

The second unexpected finding was that Comparison schools experienced a downward shift in absenteeism that began in April 2016 and continued through 2017. The present analyses cannot elucidate causes of this observed decrease, nor speculate about why UBC schools were not affected similarly.

4.1. Future learnings and innovations

Based on the achievements obtained by the UBC Schools that prioritized attendance, at the end of 2015, Fundación Educacional Oportunidad refined the driver diagram to incorporate the key learnings for new schools in an ongoing expansion in 2016–2017 (see Figure 6). First, they made explicit that it is essential to work on "Universal" strategies that aim to improve the attendance of all children and "Individual" strategies that aim to work with children at risk of chronic absenteeism – identifying the causes and designing with the family specific strategies to support them (Kearney et al., 2019). This modification aligns with a multi-tiered system of support model that has been used in education for many years, an adaptation of which was developed and proposed for school attendance and absenteeism in 2019. Second, the diagram was simplified to include only the most proven and effective strategies, resulting in a set of five successful strategies known to promote preschool attendance and reduce chronic absenteeism in Chile. UBC teams also added interventions for future testing, which emerged from the literature or frontline teams. Third, although all the schools that participated in UBC worked to promote attendance, previous studies and the present analyses confirm that reducing chronic absenteeism requires the rigorous and systematic application of attendance strategies reinforced by regular monitoring of real-time data and team-based problem-solving, and that hard-won improvements will disappear over time without intentional support for implementation (Chu et al., 2019; Cook et al., 2019; Lyon et al., 2019). Moreover, even the lower absenteeism rates among UBC Schools that did not prioritize attendance exceeded the levels associated with poorer academic performance. Therefore, beginning in 2016, OFE revised its

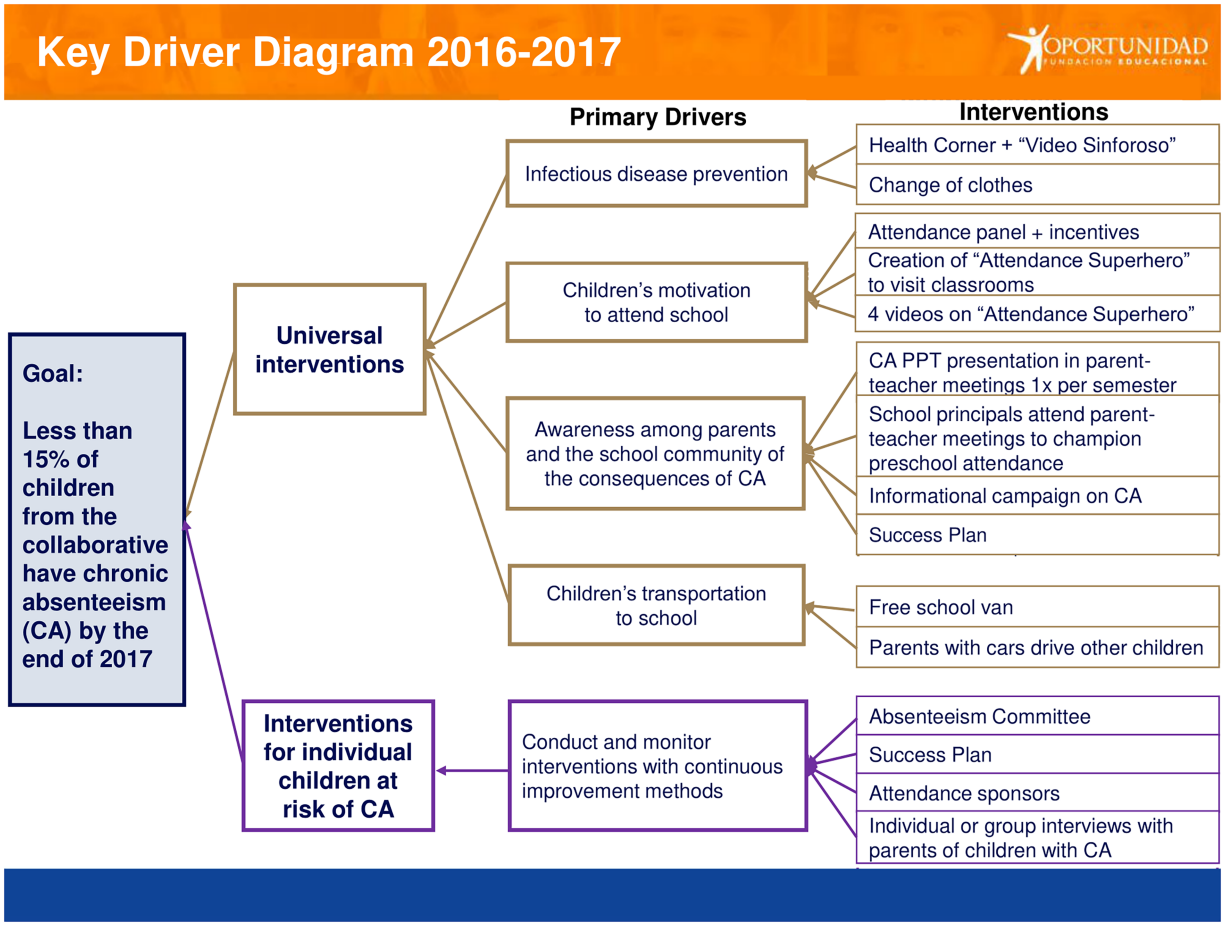

FIGURE 6
Key Driver Diagram 2016.

implementation strategy so that all participants of the UBC Program must work on attendance using the continuous improvement methodology as an integral and essential part of the intervention. Lastly, in 2017, OFE partnered with municipal leadership to create and administer the UBC Learning Network which invites all schools that graduate from 2 years of intensive intervention in the UBC Program to participate in an ongoing community of schools that aims to maintain gains and foster a spirit of continuous and collaborative learning.

4.2. Limitations

The selection of volunteer sites to implement UBC limits generalizability. Differences in baseline absence rates is controlled for by SPC and ITS methods, but there was a difference in the pre-intervention slope of absence rates of UBC Schools that prioritized attendance and Comparison Schools. This likely contributed to the choice these schools made to prioritize attendance; it also raises concern for selection bias. There were no known simultaneous attendance interventions for preschools in the VI Region at the time of the UBC intervention, and in their absence, we would expect rising absence rates to bias our findings toward the null. Nonetheless, differences in baseline trends in absence rates introduces some uncertainty in the causal inference provided by ITS. Another study limitation is the inability to tease apart which intervention strategies were most responsible for the decreased absenteeism. From SPC charts and ITS models with two intervention periods, it appears that the interventions added in 2015 have a greater impact on attendance; however, it is not possible to know how much of the 2015 impact is due to added interventions versus lagged impact of the intervention strategies introduced in 2014. The implementation strategy, as applied in this case, represents a high-intensity and higher-cost intervention than many single-tier attendance interventions in the literature. It is important to recognize that UBC aims to improve other outcomes alongside attendance (i.e., instructional time and effective interactions), and that its infrastructure supports other intervention elements as well. Nonetheless, this approach may not be affordable in all contexts.

5. Conclusion

UBC's innovations demonstrate what can happen when key leaders – from an early childhood education foundation and its partners in national and local government and within schools – commit to discovering new ways to promote attendance and prevent problematic absences. OFE curated a theory of change with universal and targeted strategies and developed a data platform that used data the schools already collected to create an early detection system, analyzing individual-level attendance data in real-time. School-based attendance committees brought together school leaders, teachers, and families to review data together monthly, to activate universal strategies and deploy targeted strategies with individual families at-risk for chronic absenteeism, which began with identifying root causes of student absences — i.e., beginning with 'what happened?' All of this led to measurable improvements in attendance among children enrolled in public preschools that participated in UBC and applied continuous quality improvement methods to improve children's attendance and maximize their opportunities for learning.

In addition, through its Learning Network, OFE created a community and a movement focused on improving presence and participation in preschool that persists. The Learning Network not only invited schools to pursue a shared goal using a common theory of change and measures, but importantly, it facilitated learning between peers and across traditional hierarchies. At Learning Network convenings, school-based teams shared failures and successes with other teams and with local and national Chilean stakeholders, they encouraged one another, and they contributed to refinement and further dissemination of the theory of change. The ongoing UBC Learning Network, co-administered by OFE and its municipal partners, supports a community of schools to maintain gains and foster continuous and collaborative learning. It may serve as an example for others who seek to partner with parents and other stakeholders to support student engagement in their education.

Data availability statement

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

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 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

MA, SA, PM, and MM designed and planned the study. MA, SA, CS, YA, and PM structured and analyzed the data. MA wrote the manuscript. All authors interpreted the data, took responsibility for the integrity and accuracy of the data analysis and the decision to submit this manuscript for publication, read and approved 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.

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