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Depression and stress are associated with latent profiles of problematic social media use among college students

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Background: The previous literature has demonstrated that depression, anxiety, and stress are significant predictors of problematic social media use. However, the manifestation of problematic social media use varies, and the predictive relationship between depression, anxiety, and stress with different subgroups of problematic social media use remains unclear. The aim of this research was to evaluate latent subgroups of problematic social media use among college students and to investigate the impact of depression, anxiety, and stress on these latent subgroups.

Methods: A survey was carried out among college students in China using a cross-sectional approach. A total of 955 participants were included, with a mean age of 19.50 ± 1.22 years. Participants completed questionnaires containing the Bergen Social Media Addiction Scale (BSMAS) and the Depression, Anxiety, and Stress Scale-21 (DASS-21). The study employed latent profile analysis (LPA) to investigate latent subgroups of Chinese college students with problematic social media use, and a robust three-step approach was used to develop predictive regression mixed models of depression, anxiety, and stress on latent subgroups.

Results: Problematic social media use of Chinese college students can be categorized into four latent subgroups, namely, the high-risk group, the moderate-risk with pleasure group, the moderate-risk with compulsion group, and the low-risk group. The regression model showed that there was a significant difference between the high-risk group and the low-risk group on the stress scale. There was a significant difference between the moderate-risk with pleasure group and the moderate-risk with compulsion group on the depression scale.

Conclusion: Problematic social media use is heterogeneous, with depression and stress being potentially key factors influencing problematic social media use. Depression would make college students more likely to be moderate-risk with compulsion problematic social media users than moderate-risk with pleasure problematic social media users, and stress would make college students more likely to be high-risk problematic social media users than low-risk problematic social media users.

KEYWORDS

problematic social media use, college students, depression, anxiety, stress, latent profile analysis

1 Introduction

1.1 Problematic social media use

The use of social media has become increasingly prevalent among college students, making it one of the most popular mobile applications today. It refers to a communication platform that enables users to engage with a broad or specific audience in real-time or delayed interactions, through which information can be created, commented and shared (1). QQ, WeChat, Weibo, and TikTok are the social media platforms that college students in China frequently utilize. College students can utilize social media anytime and anywhere without limitations due to the convenience and instant accessibility of smartphones (2, 3), which fulfills their spiritual desires and enhancing their overall life contentment and happiness (4–6). Nevertheless, problematic social media use can likewise result in various negative consequences (7–12). A previous study showed that problematic social media use was more prevalent among college students in mainland China (44.9%) compared to college students in other regions (the United States, Singapore, South Korea, and Japan) (13). Problematic social media use refers to an excessive preoccupation with social media, a strong drive to engage with it, and a significant expenditure of time and effort on social media at the expense of other social engagements, educational pursuits, professional commitments, interpersonal connections, as well as mental health and overall wellbeing (14, 15), and it belongs to a specific type of problematic Internet use (16). Although problematic social media use has numerous detrimental consequences like other addictive behaviors, the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) and the 11th revision of *International Classification of Diseases* (ICD-11) do not officially define problematic social media use as an addictive disorder. Presently, the prevailing consensus among scholars is that, although lacking formal recognition as an addictive disorder, the specific criteria pertaining to problematic social media use, namely clinical relevance, empirical evidence, and theoretical embedding, are congruent with the classification of "other specific addictive behavioral disorders" (code: 6C5Y) in the ICD-11 (17). Consequently, it is deemed appropriate to investigate this phenomenon within the framework of addiction (18, 19). The notion that problematic social media use may constitute a potential addictive disorder has been proposed by numerous scholars, and future versions of the DSM and ICD may be influenced by evidence-based discussions to potentially incorporate problematic social media use (20–22).

1.2 Classification of problematic social media use

The classification of problematic social media use has varied in previous studies. Some studies identified problematic and non-problematic users by setting clear boundaries (22). Some studies categorized problematic social media use into a non-addictive group, a problematic use group, and an addictive group by means (*M*) ± standard deviation (*SD*) (18). However, there is heterogeneity in social media use among college students, and previous variable-oriented methods have not taken into account a wide range of individual differences (21). Therefore, comprehending the simultaneous functioning of multidimensional personal characteristics

within individuals and their role in creating diverse subgroups with different levels of problematic social media use is crucial (23). Person-oriented methods gather data at the personal level and have the ability to identify significant patterns of traits within subgroups (21). Latent profile analysis (LPA), as a person-oriented method, explains associations between exogenous variables in terms of the number of latent profiles. It can reveal latent subgroups with similar symptom profiles from the observed data, ensuring that between-group heterogeneity is maximized versus within-group heterogeneity is minimized, which will help researchers to understand the specific characteristics of each subgroup in a way that is unmatched by variable-oriented methods (24). The person-oriented method is especially suitable for categorizing diseases with diverse symptoms, as it can achieve a highly reliable classification by accurately discerning various characteristics. The application of latent profile analysis (LPA) has been utilized in studying problematic social media use and can provide an estimation of the percentage of individuals at varying degrees of vulnerability (24).

Many studies have found in latent profile analysis (LPA) that problematic social media use can be categorized into three latent subgroups, high-risk, moderate-risk, and low-risk, and what these studies have in common is that each of the latent subgroups scored roughly the same on each item (24–27). The aforementioned categorization results are similar to those of the variable-oriented method. However, it is flawed in its failure to highlight potential incongruous responses that certain groups may exhibit across different items. Some studies have found that some latent subgroups differ in their scores on each item. Luo et al. (28) distinguished between five latent subgroups, casual users and regular users who scored all six items on the Bergen Social Media Addiction Scale (BSMAS) as "very rarely" or "rarely," and disordered users who scored all six items as "very often" or "often." Although low-risk high-engagement users and at-risk high-engagement users scored similarly higher on the salience and tolerance criteria, low-risk high-engagement users scored much lower than at-risk high-engagement users on the mood modification, relapse, withdrawal, and conflict criteria. The results of this categorization reveal varying responses of certain group on different items. However, caution should be exercised due to the fact that one of the profiles represents less than 5% of the total population. The study also found that although the salience (the dominance of social media engagement in a person's thoughts and everyday existence) and tolerance (the inclination to allocate increasing time on social media to attain the same level of enjoyment) criteria were highly endorsed, they were weak in distinguishing whether social media use was compulsive or not. Conflict (negative impact on work or school caused by inappropriate social media use), withdrawal (psychological distress when unable to access social media), and relapse (attempts to quit or control excessive social media use but failing to curb it) criteria provided considerable discriminatory power in identifying whether or not social media use was compulsive, and were strong independent predictors of problematic social media use (28, 29). From this, we hypothesized that some subgroups may have large differences in scores on conflict, withdrawal, and relapse indicators versus scores on salience and tolerance indicators. Therefore, an attempt can be made to classify problematic social media use into four latent subgroups. The first subgroup exhibited high scores on all items. The second subgroup displayed high scores on salience and tolerance items, with low scores on other items. The third subgroup demonstrated high

scores on conflict, withdrawal, and relapse items, while scoring low on the remaining items. Lastly, the fourth subgroup obtained low scores across all items. This categorization avoids excessive classification while emphasizing the potential differential responses of these groups toward different aspects.

The Interaction of Person-Affect-Cognition-Execution (I-PACE) model proposed by Brand et al. provides a theoretical foundation for categorizing problematic social media use into four latent subgroups. It suggests that gratification is the primary, but not the only, driver of changes in affective and cognitive responses to Internet-related stimuli during the early stages of the process of specific problematic Internet use. Furthermore, it suggests that the degree of gratification diminishes as the addictive process advances, while the impact of compensation effects intensifies. Decreasing control over specific Internet applications can lead to an increase in negative experiences and emotions. The detrimental effects are worsened by the fact that the significance of gratification diminishes while the significance of compensation increases in the decision to repeatedly utilize Internet applications. The addictive process involves a transition from a voluntary and pleasurable to a habitual or compulsive pattern (16). Thus, there are two driving paths in the progression of problematic Internet use: "feels better" and "must do." The path of "feels better" encompasses both positive (such as enjoyment and reward) and negative (such as decreased anxiety and unfavorable emotions) reinforcing experiences and related cravings and desires, which is the path linked to gratification. The path of "must do" might manifest at a later stage of the addictive process and encompasses habitual behaviors and even obsessive behaviors, which refer to maladaptive actions that persist despite being aware of their detrimental outcomes, and this path is linked to compensation (19). Therefore, the present study hypothesized that problematic social media users motivated by the "feels better" path are more likely to be "moderate-risk with pleasure" users with higher scores on salience and tolerance; that problematic social media users motivated by the "must do" path are more likely to be "moderate-risk with compulsion" users with higher scores on conflict, withdrawal, and relapse; and that high-risk problematic social media users with high scores on all six items are likely to be motivated by both paths. This leads us to propose the first hypothesis of the study, that as a specific type of problematic Internet use, problematic social media use may comprise four latent subgroups: high-risk, moderate-risk with pleasure, moderate-risk with compulsion, and low-risk.

1.3 Relationship between depression, anxiety, and stress and problematic social media use

Due to the negative impacts of problematic social media use, there is a great need to explore the risk factors of problematic social media use and their formation mechanisms. According to the I-PACE model, specific predisposing factors may be associated with different types of problematic Internet use (30). In the case of problematic social media use, mental distress (i.e., depression, anxiety and stress) emerges as a significant predisposing factor. Moreover, numerous studies have consistently reported a high prevalence of mental distress among college students (31). College students experiencing mental distress are more prone to developing problematic social media use. Mental

distress has been indicated as a potential predictor of increased levels of problematic social media use (32–34). The reason why mental distress is related to problematic social media use may lie in the Internet's compensatory function for the absence of reality, as suggested by Kardefelt-Winther's compensation Internet use theory (CIUT) (35). According to this theory, people may turn to the Internet to alleviate their negative life situations and relieve their mental distress (36). Thus, mental distress can be viewed as an antecedent to Internet use, and excessive or heightened Internet use is perceived as a compensatory action to regulate mental distress, which, if uncontrolled, can lead to unregulated behaviors (37). Consequently, individuals experiencing depression, anxiety, or stress may allocate an imbalanced amount of time on social media as a means of managing their mental distress, despite the fact that this approach may not be beneficial for their wellbeing (38–40). Thus, mental distress may be a predictor of problematic social media use, and individuals experiencing depression, anxiety, and stress might favor virtual encounters over in-person interactions (34). However, previous research assessing the relationship between mental distress and problematic social media use has predominantly used total scores from measurement instruments (e.g., calculating total scores for the six addiction criteria and interpreting the severity of problematic social media use in terms of the total score) (41). As previously mentioned, problematic social media use among college students is heterogeneous, and there may be differences in the prediction of problematic social media use by depression, anxiety, or stress for different latent subgroups (42). Additionally, previous approaches might have concealed the potential diversity of these symptoms (41). Meanwhile, Billieux's integrative pathway model (43) proposes that there are three main pathways that can lead to problematic smartphone use, a pathway of excessive reassurance, a pathway of impulsivity-antisocial, and a pathway of extraversion. Each of these pathways is linked to distinct risk factors. As a subtype of problematic smartphone use, exploring the distinct connections between the six addiction criteria of problematic social media use and the three forms of mental distress (depression, anxiety, and stress) can enhance comprehension of their correlation. The present study hypothesized that the pathways in which individuals experiencing depression, anxiety, or stress employ social media to manage mental distress, along with the resulting forms of problematic social media use, might vary.

Several research studies have indicated notable correlations between symptoms of depression and problematic social media use (26, 44). One study confirmed that depressive character can significantly and positively predict Facebook addiction (45). Another study using cluster analysis found that a cluster of adolescents with borderline personality adolescents disorder focused on depressive symptoms scored higher on problematic social media use than the normal group, and that depressive symptoms were found to be a valid predictive variable for problematic social media use (46). Depressed individuals often experience a diminished interest or enjoyment in nearly all activities (47). It has been suggested that these individuals typically engage in passive social media use, for example, scrolling through social media news, in an attempt to alleviate the depressive symptoms. However, they often express feelings of boredom and a lack of pleasure while using social media. This repetitive and joyless social media use can develop into a habitual or even compulsive behavior, where depressive symptoms automatically trigger passive social media use. Unfortunately, inhibiting this impulsive behavior becomes

challenging (48). This is consistent with Brand's description of the "must do" path (19), and thus, individuals with depression might have a higher tendency to develop "high compulsion" problematic social media use. Thus, we propose the second hypothesis of the study, that depression positively predicts moderate-risk with compulsion problematic social media use.

Research based on empirical studies has indicated that anxiety serves as a contributing factor to the development of problematic social media use (42, 49). Heightened levels of anxiety have been linked to excessive utilization of smartphones and a proclivity for sending an abundance of text messages (50). According to a study, individuals with anxiety may develop an overreliance on social media to promptly satisfy their psychological requirement for social solace. Their anxiety levels decrease when they utilize their smartphones to check notifications from family, friends, and loved ones (51). Experiencing prolonged anxiety generates a profound feeling of discomfort, prompting individuals to turn to social media as a means of compensating for their self-esteem, confronting their fears, and ensuring self-preservation. This strengthens the behavior of using social media, and ultimately, it leads to the development of problematic social media use (52). Some studies have confirmed that anxiety and fear of missing out are significantly correlated with problematic social media use, and that fear of missing out leads to the need to stay in frequent contact with social networks for comfort, therefore, the need for socialization is a key mechanism to explain problematic social media use and its association with anxiety (53). Anxious individuals attempt to relieve anxiety and gain pleasure through social media use, which is consistent with Brand's description of the "feels better" path (19). Some researchers have also demonstrated that of the three subtypes of mental distress, only anxiety predicts low-risk high-engagement problematic social media use (as evidenced by high scores on salience and tolerance, and low scores on the other criteria) (41). Consequently, individuals experiencing anxiety might have a higher propensity to "high pleasure" problematic social media use. Therefore, we propose the third hypothesis of the study, that anxiety positively predicts moderate-risk with pleasure problematic social media use.

Numerous studies have indicated that stress is a positive predictor of problematic social media use (6, 54). According to Kardefelt-Winther's findings, stress emerged as the sole influential factor for problematic Internet use when analyzing various psychological traits. The significance of loneliness and social anxiety in relation to excessive online gaming diminished when stress was taken into account, suggesting a greater stability of stress compared to other psychological traits (55). When college students perceive stress, they are inclined to seek out intense excitement and novel sensations and experiences, even if the situation contains danger and risk factors (56). It's no wonder that individuals who are inclined toward excitement and enticed by incentives will frequently gravitate toward social media, considering its highly engaging nature and abundant options for amusement and enjoyment (23). Research consistently indicates that a propensity for sensation-seeking is linked to problematic social media use among late adolescents and adults (57). Additionally, a study proposed that social media attributes, such as socialization and entertainment services, enhance the perceived pleasure in a manner that reinforces uncontrolled social media use (58). In brief, it seems that the impact of stress on problematic social media use appear to be driven by both the "feels better" and "must do" paths. Some

researchers have confirmed that stress only predicts high-risk problematic social media use (as evidenced by high scores on all six addiction criteria), and is not predictive of other subgroups of problematic social media use (41). Therefore, we propose the fourth hypothesis of the study, that stress positively predicts high-risk problematic social media use.

The study focused on college students and utilized the latent profile analysis technique to classify the problematic social media use among this group. It aimed to identify the various latent profiles of problematic social media use among college students and examine the connections between depression, anxiety, and stress with these different profiles.

2 Methods

2.1 Participants and procedure

A total of 1,188 college students were invited to participate in an online questionnaire at a university. However, 233 college students were excluded due to non-compliant responses on the polygraph questions, resulting in a receipt of 955 valid questionnaires. Of the 955 participants, 236 (24.70%) were male and 719 (75.30%) were female, aged 17–26 years old ($M \pm SD = 19.50 \pm 1.22$). Every participant willingly volunteered to take part in this research study and each participant duly signed a form indicating their informed consent. Participants were given the necessary emotional or psychological assistance when required. Ethical approval was granted by the Ethics Committee of Tianjin Normal University. This study adhered to the principles of the Declaration of Helsinki in its procedures.

2.2 Measures

2.2.1 The Depression, Anxiety, and Stress Scale-21

The Depression, Anxiety, and Stress Scale-21 (DASS-21) is a revision by Antony et al. (59) of the Depression, Anxiety, and Stress Scale-42 (DASS-42) scale revised by Lovibond et al. (60). The measurement includes three subscales for measuring depression, anxiety, and stress, which eliminates the need for redundant assessments of these three conditions. Each subscale comprises 7 items, resulting in a total of 21 items for the entire measurement. Participants were asked to recall whether the corresponding symptoms had occurred within the previous week. They were then evaluated using a Likert scale with four points (0 representing non-compliance and 3 representing the highest level of compliance). Higher scores on the scale indicated a greater degree of mental distress. Multiple research studies have verified that the DASS-21 in its Chinese version exhibits a strong level of reliability and validity (31, 61–63).

2.2.2 The Bergen Social Media Addiction Scale

In the field of addictive behaviors, while only gambling disorder and Internet gaming disorder have been officially recognized as addictive disorders so far, an increasing body of research also acknowledges problematic social media use as a potential addictive disorder. Therefore, it can be identified based on the six criteria of addiction (22). The Bergen Social Media Addiction Scale (BSMAS) (64) was derived from the Bergen Facebook Addiction Scale (BFAS)

(22) by substituting the term "Facebook" with "Social Media." The BSMAS is a commonly measurement for evaluating the symptoms and prevalence of problematic social media use in a population (64). The scale encompasses the six addiction criteria proposed by Griffiths, namely salience, tolerance, mood modification, withdrawal, conflict, and relapse, with each criterion being represented by one item, resulting in a six-item scale (29). Participants rated each item from 1 (rarely) to 5 (often) based on their personal encounters in the previous year. In the Chinese version of the BSMAS, social media is defined as "QQ, WeChat, Weibo, TikTok, etc." (28), and the Chinese version of the BSMAS has been shown to have high reliability and validity (65).

2.3 Statistical analysis

Descriptive statistics were analyzed using SPSS 26.0 and common method bias was tested using Harman's one-way test, if the maximum factor variance explained was <40%, it indicated the absence of serious common method bias (66).

A latent profile analysis (LPA) was conducted using M*plus* 8.3 (23), identifying subgroups of participants (latent profiles) who exhibited comparable responses on the Bergen Social Media Addiction Scale (BSMAS) items (i.e., similar levels of risk for developing problematic social media use). Fit indices of 1–6 profiles were extracted for model comparison using the robust maximum likelihood (RML) estimation.

To establish the number of latent profiles (ranging from 1 to 6), various criteria were employed, including information-theoretic methods, likelihood ratio statistical test methods, and the entropy-based criterion known as the Entropy index. The first method includes Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample size-adjusted BIC (aBIC), where lower values indicate a leaner model and better model fit (67). The second method uses the Lo–Mendell–Rubin Likelihood Ratio Test (LMR-LRT) and the Bootstrap-based Likelihood Ratio Test (BLRT), and the $p < 0.05$ for both the LMR-LRT and BLRT indexes suggests that the model with k profiles fits better than the model with k-1 profiles (68). The third method comprises the last standard entropy value, ranging from 0 to 1. Higher values suggest improved distinction among profiles, and values above 0.8 indicate a classification accuracy exceeding 90%, with greater accuracy in classification (69). To avoid unrealistic solutions and overfitting, it is recommended that all latent profiles identified by the LPA consist of a minimum of 5% of the sample (25).

Regression mixed models were developed using a robust three-step approach based on M*plus*' R3STEP program. Depression, anxiety, and stress were considered as independent variables, while the dependent variables were the latent profiles obtained in the initial stage. The aim was to account for the effects of these independent variables on the latent profiles and to validate the predictive role of depression, anxiety and stress on profile membership (70, 71).

3 Results

3.1 Common method bias test

In this study, the data was examined for common method bias using Harman's one-way test. The unrotated exploratory factor analysis revealed five factors with a characteristic root greater than 1, and the maximum factor variance explained was 36.61% (<40%), so there was no serious common method bias in this study (66).

3.2 Latent profiles of problematic social media use

To explore latent patterns of social media use among college students, latent profiles were modeled based on participants' means on each dimension of the Bergen Social Media Addiction Scale (BSMAS) (see Table 1).

The fitting indices AIC, BIC, and aBIC decelerated with increasing number of profiles. The deceleration of the fitting indices slowed down for the 3-profile model, but Entropy was equal to 0.77 (<0.80), with significant ($p < 0.05$) LMR-LRT and BLRT values; Entropy was equal to 0.84 (>0.80) for the 4-profile model, with significant ($p < 0.05$) LMR-LRT and BLRT values; Entropy was equal to 0.85 (>0.80) for the 5-profile model, with LMR-LRT and BLRT values were significant ($p < 0.001$), but one of the profiles accounted for 5.2% and the characteristics of the population in that profile were similar to the other profile. Considering the streamlining treatment of the model, this study proposed to categorize the participants into 4 profiles.

The mean values of the 4-profile model on the six dimensions are shown in Figure 1. Based on Figure 1, it can be seen that profile 1 (31.3%) exhibited high mean values on the six dimensions of the Bergen Social Media Addiction Scale (BSMAS), all of which were greater than 3. This aligns with the criteria for addiction suggested by a previous study, which stated that at least four out of the six items should score 3 or higher (22). Therefore, profile 1 was named the "high-risk group" for problematic social media use. Profile 4 had a lower mean score of less than 2, so it was named the "low-risk group" for problematic social media use. Profile 2 had high means (>3) on the salience and tolerance dimensions and low means (<3) on the other dimensions. Salience and tolerance indicate the significant time and effort individuals dedicate to social media activities to derive pleasure, reflecting the important role of gratification in the early stages of addiction as described in the I-PACE model (16). Therefore, profile 2 was named as a "moderate-risk with pleasure group." profile 3 had a high mean on the relapse dimension (>3) and a low mean on the other dimensions (<3). Relapse, in this context, refers to the unsuccessful attempt to quit or control the excessive use of social media, reflecting what is described in the I-PACE model, where compensation becomes increasingly important in the later stages of addiction and gradually changes from pleasure to compulsion to use. Profile 3 was therefore named the "moderate-risk with compulsion group."

The scores on the Bergen Social Media Addiction Scale (BSMAS) showed significant differences among profile 1 ($M = 22.28$, $SD = 3.00$), profile 2 ($M = 16.61$, $SD = 2.32$), profile 3 ($M = 16.27$, $SD = 2.30$), and profile 4 ($M = 10.85$, $SD = 2.70$), $F(3, 951) = 878.55$, $p < 0.001$, $\eta_p^2 = 0.74$. Multiple comparisons indicated significant differences between profiles ($p < 0.001$), except for profiles 2 and profiles 3 which were not statistically significant ($p = 0.154$). Although there was no statistically significant difference in the total score of the BSMAS between profiles 2 and profiles 3, profile 2 exhibited significantly higher scores than profile 3 on the salience and tolerance dimensions ($p < 0.001$), while significantly lower scores were observed for profile

TABLE 1 Summary of latent profile analysis.

No. of profiles	AIC	BIC	aBIC	Entropy	LMR-LRT	BLRT	Smallest profiles%
1	18246.16	18304.50	18266.39				
2	16938.98	17031.35	16971.00	0.82	<0.001	<0.001	49.6%
3	16703.23	16829.63	16747.06	0.77	0.017	<0.001	14.1%
4	16502.88	16663.32	16558.51	0.84	0.035	<0.001	18.1%
5	16347.85	16542.32	16415.28	0.85	<0.001	<0.001	5.2%
6	16223.21	16451.71	16302.44	0.84	<0.001	<0.001	7.0%

AIC, Akaike information criterion; BIC, Bayesian information criterion; aBIC, sample size-adjusted Bayesian information criterion; LMR-LRT, Lo–Mendell–Rubin Likelihood Ratio Test; BLRT, Bootstrap-based Likelihood Ratio Test.
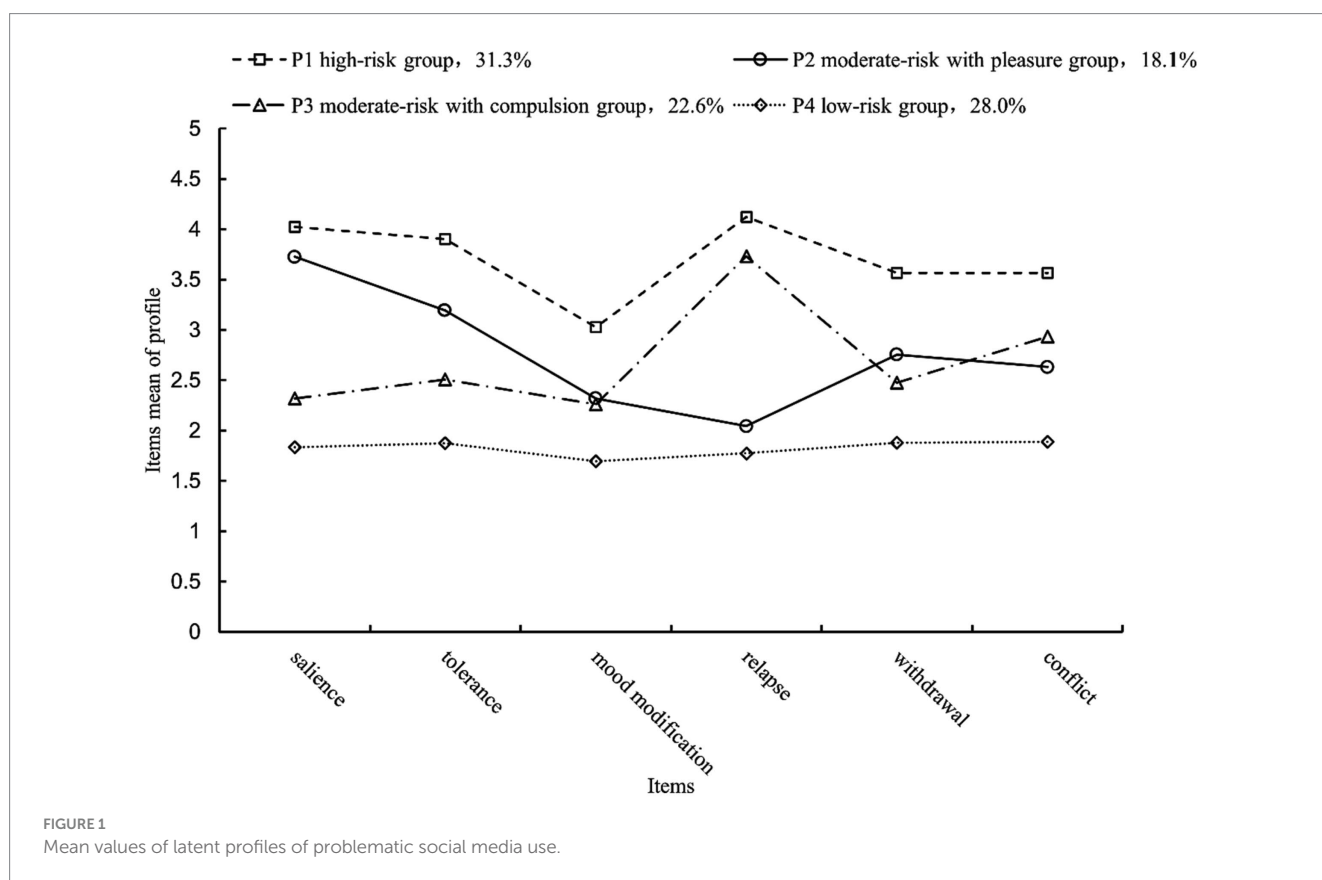

FIGURE 1
Mean values of latent profiles of problematic social media use.

2 compared to profile 3 on the relapse dimension ($p < 0.001$). The results suggest heterogeneity in problematic social media use.

3.3 Depression, anxiety, and stress in relation to problematic social media use

To examine the correlation between depression, anxiety, stress, and problematic social media use, we utilized latent profile analysis (LPA) results as the dependent variable. The independent variables consisted of the three subscales: depression, anxiety, and stress. By assessing the Odds Ratio (OR) values and their significance, we determined that the independent variables were predictive of the dependent variables when the OR values were significant. In this study, the low-risk group was used as the reference group, and there

was a significant difference between the high-risk group and the low-risk group on the stress scale ($p < 0.001$). Furthermore, as participants' stress scale scores increased, so did their likelihood of being part of the high-risk group (1.19 times). There were no significant differences between the moderate-risk with pleasure group and low-risk groups on any of the depression, anxiety, or stress scales, and there were no significant differences between the moderate-risk with compulsion group and low-risk groups on any of the depression, anxiety, or stress scales. Interestingly, there was a significant difference between the moderate-risk with pleasure group and the moderate-risk with compulsion group on the depression scale ($p = 0.031$), and the higher a participant's score on depression, the lower the probability of belonging to the moderate-risk with pleasure group than to the moderate-risk with compulsion group (0.89 times lower). The results suggest that depression and stress can

TABLE 2 Odds ratio of problematic social media use among individuals with different levels of depression, anxiety, and stress.

Variables	P1 vs. P4		P2 vs. P4		P3 vs. P4		P2 vs. P3	
	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)
Depression	1.03	0.95–1.12	0.98	0.88–1.08	1.09	1.00–1.20	0.89*	0.82–0.98
Anxiety	1.06	0.97–1.15	1.03	0.93–1.15	0.96	0.87–1.06	1.08	0.97–1.20
Stress	1.19***	1.10–1.30	1.10	1.00–1.21	1.09	0.99–1.19	1.01	0.92–1.10

P1, High-risk group; P2, Moderate-risk with pleasure group; P3, Moderate-risk with compulsion group; P4, Low-risk group; OR, odds ratio; CI, confidence interval. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

predict problematic social media use across different latent profiles (see Table 2).

4 Discussion

4.1 Latent profiles of problematic social media use

By employing latent profile analysis, the research examined four subgroups of college students' problematic social media use: high-risk group (31.3%), moderate-risk with pleasure group (18.1%), moderate-risk with compulsion group (22.6%), and low-risk group (28.0%). Hypothesis 1 was supported. The study confirms previous research that college students are heterogeneous in their problematic social media use (24, 26). Previous research has classified individuals into three subgroups (high-risk, moderate-risk, and low-risk) (25, 27). The present study found that different subgroups could be separated from the moderate-risk group, i.e., the moderate-risk with pleasure group and the moderate-risk with compulsion group. It was also observed that the moderate-risk with pleasure group may be driven more by the "feels better" path and the moderate-risk with compulsion group may be driven more by the "must do" path, while the high-risk group is equally driven by both paths (19). The findings offer empirical evidence supporting the I-PACE model, and the study confirms that problematic social media use is influenced by two factors: gratification and compensation. Gratification corresponds to the "feels better" path, characterized by a voluntary and pleasurable process. On the other hand, compensation corresponds to the "must do" path, which denotes a habitual and compulsive process (16). Many addictive disorders involve a transition from pleasure to compulsion, and this same transition could potentially occur in the case of problematic social media use. However, it is important to note that high-risk problematic social media users may encounter heightened levels of both pleasure and compulsion (72). This research partially addresses the issue of insufficient specificity in classifying problematic social media use in prior studies.

4.2 Depression, anxiety, and stress predict latent profiles of problematic social media use

According to the current research, college students who experience depression were more inclined to be moderate-risk with compulsion problematic social media users than moderate-risk with pleasure problematic social media users. Hypothesis 2 was supported.

The moderate-risk with compulsion group obtained higher scores on the relapse criterion, and the criteria of conflict, withdrawal, and relapse have been widely acknowledged as fundamental elements of addiction (73). Some studies have shown that these criteria have strong discriminatory power in identifying whether or not one is a compulsive problematic social media user (28). This is consistent with previous findings, where it was found that depression levels significantly predicted total Internet Addiction Test (IAT) scores among college students (74), and that depression significantly and positively predicted problematic social media use (45). Since the core symptom of moderate-risk with compulsion problematic social media use manifests as relapse, i.e., diminished control over use. According to Billieux's integrative pathway model (43), depression's prediction of moderate-risk with compulsion problematic social media use may be realized through the impulsive-antisocial pathway. This pathway suggests that addictive usage patterns are linked to particular impulsive characteristics. Numerous studies have consistently shown a strong link between depression and impulsive characteristics (75, 76), and that impulsiveness positively predicts problematic social media use (77, 78). Several research studies have verified that there is a connection between depression and impulsive compulsive behaviors like addictive disorders, where impulsiveness acts as a mediator (79, 80). This evidence may explain why depression in college students leads to impaired impulse control and ultimately produces moderate-risk with compulsion problematic social media use.

As with previous findings (39, 41), this study discovered that stress increases the likelihood of college students becoming high-risk problematic social media users. Hypothesis 4 was supported. Previous studies have demonstrated a positive correlation between stress levels and the development of problematic social media (54). Young et al. (81) argued that in Chinese culture, students are under great academic pressure in secondary school, and when they enter university, they will seek happiness through social media, which will lead to addiction in the long run. High-risk problematic social media users who score greater than 3 on all six criteria of addiction not only experience fun and excitement in social media, but also have difficulty controlling their use. According to Billieux et al. (43) integrative pathway model, the prediction of stress on high-risk problematic social media use may be realized through the extroversion pathway, which hypothesizes that highly extroverted individuals who seek sensations and rewards are prone to developing addictive patterns of use. The stress-buffering hypothesis posits that individuals with elevated levels of stress are more prone to exhibit heightened levels of sensation-seeking (82). One study found that people who scored high on aspects of the Behavioral Activation System (i.e., drive, reward responsiveness, fun seeking) were prone to smartphone addiction (23). Research on factors that contribute to addiction vulnerability indicates that

sensation-seeking is a significant predictor of addictive behavior (56). The provided evidence suggests that college students who experience stress are more inclined to seek pleasure, which subsequently leads to the development of compulsive usage patterns. Consequently, this engenders high-risk problematic social media use.

Contrary to prior studies, the current investigation failed to uncover any indication of anxiety predicting problematic social media use (49, 51). Nonetheless, there have been limited investigations indicating comparable outcomes, and one particular study revealed that individuals with elevated scores on the depression and stress scales also exhibited higher scores on problematic Internet use. Notably, no significant association was observed between anxiety and problematic Internet use (83, 84). Furthermore, a 3-year longitudinal study also showed that the development of future problematic smartphone use was not foretold by anxiety (85). Anxious individuals are reluctant to participate in social activities, show lower social interaction expectations, and even social withdrawal. They may resort to avoiding social media use to alleviate distress, e.g., paying less attention to the updated status of others' social media, checking notifications of new information less often, or using other non-social features. Thus, people with high anxiety do not rely on smartphones perhaps due to a lack of social motivation (86). van Deursen et al. (87) found that anxiety was more closely related to process-oriented smartphone use than to social-oriented use. This finding supports social avoidance theory (88) and safety behavior theory (89), suggesting that anxiety can result in avoiding social-oriented smartphone use and instead opting for more process-oriented smartphone use, due to avoidance of social interactions and maintenance of safety behaviors. In the context of compensation Internet use theory (CIUT), anxiety should specifically drive the choice of process-oriented smartphone use as an alternative to choosing social media (90). People experiencing social anxiety desire social connections but are afraid of engaging in social activities, leading them to frequently avoid or reduce interactions due to perceiving them as challenging and uncomfortable (91). The act of avoiding social interactions can be demonstrated by avoiding in-person interactions or by using non-social functions on smartphones instead of engaging in online social media activities (92, 93).

The findings highlight how different latent profiles of problematic social media use are driven by different pathways supported by different psychological processes, as well as emphasizing how depression and stress lead to various latent profiles of problematic social media use. These findings are consistent with the predictions of compensation Internet use theory (CIUT). According to this theory, individuals with depression and stress are more prone to developing problematic social media use. This is because depression and stress compel individuals to resort to social media as a coping mechanism, which in turn leads to unhealthy patterns of social media use (35). Additionally, our findings offer partial validation of the integrative pathway model of problematic smartphone use at the compensatory pathways level. This model suggests that individuals have varying tendencies toward problematic smartphone use (43). According to this model, there are three primary pathways leading to problematic smartphone use, an excessive reassurance pathway, an impulsive-antisocial pathway, and an extraversion pathway. Each pathway is linked to distinct risk factors. Specifically, the present study confirmed the model in problematic social media use. First, according to the extraversion pathway, individuals with a strong inclination toward extraversion and a desire for sensation and reward are prone to problematic social media use. The extraversion pathway applies to individuals whose problematic social media use is characterized by obsessive-compulsive symptoms, attraction to exciting stimuli, or a desire to form new relationships with others. This aligns with the high-risk problematic social media use observed in this study. Second, according to the impulsive-antisocial pathway, problematic social media use is linked to distinct impulsive characteristics, such as a sense of urgency (a proclivity to hastily respond in emotional circumstances), a lack of planning (a proclivity to ignore consequences), or diminished self-control (a propensity to behave automatically rather than with restraint). This pathway is for individuals who are motivated by a lack of self-control, leading to uncontrollable impulsive actions and excessive use of social media. This aligns with the moderate-risk with compulsion problematic social media use observed in this study. Finally, a possible reason why our study did not validate the hypothesis of the excessive reassurance pathway is that the model was originally designed for smartphones, which have other non-social features in addition to social features. It is plausible that individuals with anxiety tendencies are more prone to utilizing the non-social aspects of their smartphones, making the pathway more relevant to other smartphone applications rather than social media.

4.3 Research contribution

First, the current investigation expands prior studies on problematic social media use by utilizing mixed modeling or person-oriented method, allowing for the identification of different latent subgroups and significant distinctions among them. Furthermore, these latent profiles are supported by the I-PACE model (19, 27). Second, our results align with the integrative pathway model of problematic smartphone use, positing that people have varying inclinations toward problematic smartphone use (43). The current research validates the existence of two primary pathways that contribute to problematic social media use, namely the impulsive-antisocial pathway and the extraversion pathway, both of which are linked to distinct risk factors.

The results of this research also carry significance for application, as effective measures to prevent or address problematic social media use should focus on the particular psychological aspects that motivate such behavior. First, stress may result in high-risk problematic social media use among college students. Hence, it is imperative for universities to strengthen students' capacity to deal with pressure, encompassing instruction in emotional intelligence and stress management, alongside tailored coursework to enhance cognitive capabilities. This approach aims to deter students from resorting to excessive social media use as a means of evading stress (94). Second, depression can lead to moderate-risk with compulsion problematic social media use among college students. Hence, it is imperative for universities to prioritize the issue of depression among college students and offer consistent counseling services to individuals experiencing elevated levels of depression, with the aim of mitigating their depressive symptoms. In order to decrease emotional insecurity and reliance on problematic social media use, individuals experiencing severe depression may require increased social support to enhance their mood (23).

5 Limitations

Using the latent profile analysis (LPA) method, this research examined the diversity within college students' problematic social media use. The research classified problematic social media use into four different latent subgroups and investigated the factors that make each subgroup more prone to such behavior. The study addressed certain limitations of the variable-oriented methods to a certain extent, but several shortcomings remain: Firstly, data collection in this study solely relied on the self-assessment questionnaire method, which inevitably introduced the social praise bias. In future research, methods such as the other-assessment method or the experimental method can be used in a comprehensive manner in order to obtain more objective results. Secondly, this study solely relied on a cross-sectional design, making it impossible to establish a causal relationship between the variables. To further substantiate the findings of this research, future studies should consider employing longitudinal or experimental approaches. Furthermore, it is important to highlight that latent profile analysis (LPA) is primarily an exploratory technique. The determination of the number of latent profiles relies on the assessment of fit indices, interpretability, and utility, which can potentially lead to misclassification. It should be validated in future studies in conjunction with clinical diagnosis.

6 Conclusion

Problematic social media use is heterogeneous, problematic social media use among Chinese college students can be categorized into four latent subgroups, namely, the high-risk group, the moderate-risk with pleasure group, the moderate-risk with compulsion group, and the low-risk group. Problematic social media use may be influenced by depression and stress, which are considered as significant factors. College students experiencing depression are more prone to being moderate-risk with compulsion problematic social media users rather than moderate-risk with pleasure problematic social media users, while stress increases the likelihood of college students being high-risk problematic social media users instead of low-risk problematic social media users. In conclusion, distinct forms of social media use might be linked to particular forms of distress.

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 humans were approved by the Ethics Committee of Tianjin Normal University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

JC: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. YW: Data curation, Formal analysis, Investigation, Writing – review & editing. DL: Data curation, Writing – review & editing, Investigation. HY: Conceptualization, Funding acquisition, Validation, Writing – review & editing.

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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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References

1. Bayer JB, Triệu P, Ellison NB. Social media elements, ecologies, and effects. *Annu Rev Psychol*. (2020) 71:471–97. doi: 10.1146/annurev-psych-010419-050944

2. Oulasvirta A, Rattenbury T, Ma L, Raita E. Habits make smartphone use more pervasive. *Pers Ubiquit Comput*. (2012) 16:105–14. doi: 10.1007/s00779-011-0412-2

3. Nikolaidou M, Fraser DS, Hinvest N. Attentional bias in internet users with problematic use of social networking sites. *J Behav Addict*. (2019) 8:733–42. doi: 10.1556/2006.8.2019.60

4. Valkenburg PM. Social media use and well-being: what we know and what we need to know. *Curr Opin Psychol*. (2022) 45:101294. doi: 10.1016/j.copsyc.2021.12.006

5. Ang CS, Talib MA, Tan KA, Tan JP, Yaacob SN. Understanding computer-mediated communication attributes and life satisfaction from the perspectives of uses and gratifications and self-determination. *Comput Hum Behav*. (2015) 49:20–9. doi: 10.1016/j.chb.2015.02.037

6. Khalili-Mahani N, Smyrnova A, Kakinami L. To each stress its own screen: a cross-sectional survey of the patterns of stress and various screen uses in relation to self-admitted screen addiction. *J Med Internet Res*. (2019) 21:e11485. doi: 10.2196/11485

7. Sohn SY, Rees P, Wildridge B, Kalk NJ, Carter B. Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young

people: a systematic review, meta-analysis and GRADE of the evidence. *BMC Psychiatry*. (2019) 19:356. doi: 10.1186/s12888-019-2350-x

8. Yang J, Fu X, Liao X, Li Y. Association of problematic smartphone use with poor sleep quality, depression, and anxiety: a systematic review and meta-analysis. *Psychiatry Res*. (2020) 284:112686. doi: 10.1016/j.psychres.2019.112686

9. Moretta T, Buodo G. Response inhibition in problematic social network sites use: an ERP study. *Cogn Affect Behav Neurosci*. (2021) 21:868–80. doi: 10.3758/s13415-021-00879-9

10. Huang PC, Latner JD, O'Brien KS, Chang YL, Hung CH, Chen JS, et al. Associations between social media addiction, psychological distress, and food addiction among Taiwanese university students. *J Eat Disord*. (2023) 11:43. doi: 10.1186/s40337-023-00769-0

11. Gecaite-Stonciene J, Saudargiene A, Pranckeviciene A, Liaugaudaite V, Griskova-Bulanova I, Simkute D, et al. Impulsivity mediates associations between problematic internet use, anxiety, and depressive symptoms in students: a cross-sectional COVID-19 study. *Front Psych*. (2021) 12:634464. doi: 10.3389/fpsyt.2021.634464

12. Roser K, Schoeni A, Foerster M, Röösli M. Problematic mobile phone use of Swiss adolescents: is it linked with mental health or behaviour? *Int J Public Health*. (2016) 61:307–15. doi: 10.1007/s00038-015-0751-2

13. Tang CSK, Wu AMS, Yan ECW, Ko JHC, Kwon JH, Yogo M, et al. Relative risks of internet-related addictions and mood disturbances among college students: a 7-country/region comparison. *Public Health*. (2018) 165:16–25. doi: 10.1016/j.puhe.2018.09.010

14. Wegmann E, Brand M. Cognitive correlates in gaming disorder and social networks use disorder: a comparison. *Curr Addict Rep*. (2020) 7:356–64. doi: 10.1007/s40429-020-00314-y

15. Andreassen CS, Pallesen S. Social network site addiction-an overview. *Curr Pharm Des*. (2014) 20:4053–61. doi: 10.2174/13816128113199990616

16. Brand M, Young KS, Laier C, Wölfling K, Potenza MN. Integrating psychological and neurobiological considerations regarding the development and maintenance of specific internet-use disorders: an interaction of person-affect-cognition-execution (I-PACE) model. *Neurosci Biobehav Rev*. (2016) 71:252–66. doi: 10.1016/j.neubiorev.2016.08.033

17. Brand M, Rumpf HJ, Demetrovics Z, Müller A, Stark R, King DL, et al. Which conditions should be considered as disorders in the international classification of diseases (ICD-11) designation of "other specified disorders due to addictive behaviors"? *J Behav Addict*. (2020) 11:150–9. doi: 10.1556/2006.2020.00035

18. Müller SM, Wegmann E, Garcia Arias M, Brotóns EB, Giráldez CM, Brand M. Deficits in executive functions but not in decision making under risk in individuals with problematic social-network use. *Compr Psychiatry*. (2021) 106:152228. doi: 10.1016/j.comppsych.2021.152228

19. Brand M. Can internet use become addictive? *Science*. (2022) 376:798–9. doi: 10.1126/science.abn4189

20. Brand M, Rumpf HJ, King DL, Potenza MN, Wegmann E. Clarifying terminologies in research on gaming disorder and other addictive behaviors: distinctions between core symptoms and underlying psychological processes. *Curr Opin Psychol*. (2020) 36:49–54. doi: 10.1016/j.copsyc.2020.04.006

21. Hong L, Lai X, Xu D, Zhang W, Wu B, Yu X, et al. Distinct patterns of problematic smartphone use and related factors in Chinese college students. *BMC Psychiatry*. (2022) 22:747. doi: 10.1186/s12888-022-04395-z

22. Andreassen CS, Torsheim T, Brunborg GS, Pallesen S. Development of a Facebook addiction scale. *Psychol Rep*. (2012) 110:501–17. doi: 10.2466/02.09.18.PR0.110.2.501-517

23. Yang H, Tng GYQ, Khoo SS, Yang S. Multidimensional profiles of addictive smartphone use: a latent profile analysis. *Curr Psychol*. (2022) 41:8410–23. doi: 10.1007/s12144-022-02881-x

24. Cheng C, Ebrahimi OV, Luk JW. Heterogeneity of prevalence of social media addiction across multiple classification schemes: latent profile analysis. *J Med Internet Res*. (2022) 24:e27000. doi: 10.2196/27000

25. Li JB, Wu AMS, Feng LF, Deng Y, Li JH, Chen YX, et al. Classification of probable online social networking addiction: a latent profile analysis from a large-scale survey among Chinese adolescents. *J Behav Addict*. (2020) 9:698–708. doi: 10.1556/2006.2020.00047

26. Bányai F, Zsila Á, Király O, Maraz A, Elekes Z, Griffiths MD, et al. Problematic social media use: results from a large-scale nationally representative adolescent sample. *PLoS One*. (2017) 12:e0169839. doi: 10.1371/journal.pone.0169839

27. Stănculescu E, Griffiths MD. Social media addiction profiles and their antecedents using latent profile analysis: the contribution of social anxiety, gender, and age. *Telemat Inform*. (2022) 74:101879. doi: 10.1016/j.tele.2022.101879

28. Luo T, Qin L, Cheng L, Wang S, Zhu Z, Xu J, et al. Determination the cut-off point for the Bergen social media addiction (BSMAS): diagnostic contribution of the six criteria of the components model of addiction for social media disorder. *J Behav Addict*. (2021) 10:281–90. doi: 10.1556/2006.2021.00025

29. Griffiths M. A 'components' model of addiction within a biopsychosocial framework. *J Subst Use*. (2005) 10:191–7. doi: 10.1080/14659890500114359

30. Brand M, Wegmann E, Stark R, Müller A, Wölfling K, Robbins TW, et al. The interaction of person-affect-cognition-execution (I-PACE) model for addictive behaviors: update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neurosci Biobehav Rev*. (2019) 104:1–10. doi: 10.1016/j.neubiorev.2019.06.032

31. Cao CH, Dang CY, Zheng X, Chen WG, Chen IH, Gamble JH. The psychometric properties of the DASS-21 and its association with problematic internet use among Chinese college freshmen. *Healthcare*. (2023) 11:700. doi: 10.3390/healthcare11050700

32. Ou-Yang Q, Liu Q, Song PY, Wang JW, Yang S. The association between academic achievement, psychological distress, and smartphone addiction: a cross-sectional study among medical students. *Psychol Health Med*. (2023) 28:1201–14. doi: 10.1080/13548506.2022.2148697

33. Squires LR, Hollett KB, Hesson J, Harris N. Psychological distress, emotion dysregulation, and coping behaviour: a theoretical perspective of problematic smartphone use. *Int J Ment Health Addict*. (2021) 19:1284–99. doi: 10.1007/s11469-020-00224-0

34. Çikrikçi Ö. An exploration of the associations among positivity, general distress and internet addiction: the mediating effect of general distress. *Psychiatry Res*. (2019) 272:628–37. doi: 10.1016/j.psychres.2018.12.147

35. Kardefelt-Winther D. A conceptual and methodological critique of internet addiction research: towards a model of compensatory internet use. *Comput Hum Behav*. (2014) 31:351–4. doi: 10.1016/j.chb.2013.10.059

36. Elhai JD, Tiamiyu MF, Weeks JW, Levine JC, Picard KJ, Hall BJ. Depression and emotion regulation predict objective smartphone use measured over one week. *Pers Individ Dif*. (2018) 133:21–8. doi: 10.1016/j.paid.2017.04.051

37. Fu L, Wang P, Zhao M, Xie X, Chen Y, Nie J, et al. Can emotion regulation difficulty lead to adolescent problematic smartphone use? A moderated mediation model of depression and perceived social support. *Child Youth Serv Rev*. (2020) 108:104660. doi: 10.1016/j.childyouth.2019.104660

38. O'Farrell DL, Baynes KL, Pontes HM, Griffiths MD, Stavropoulos V. Depression and disordered gaming: does culture matter? *Int J Ment Health Addict*. (2020) 20:843–61. doi: 10.1007/s11469-020-00231-1

39. Yen JY, Lin HC, Chou WP, Liu TL, Ko CH. Associations among resilience, stress, depression, and internet gaming disorder in young adults. *Int J Environ Res Public Health*. (2019) 16:3181. doi: 10.3390/ijerph16173181

40. Kovacs J, Zarate D, de Sena CG, Tran TTD, Stavropoulos V. Disordered gaming: the role of a gamer's distress profile. *Can J Behav Sci*. (2022). doi: 10.1037/cbs0000335

41. Peng P, Liao Y. Six addiction components of problematic social media use in relation to depression, anxiety, and stress symptoms: a latent profile analysis and network analysis. *BMC Psychiatry*. (2023) 23:321. doi: 10.1186/s12888-023-04837-2

42. Wang Y, Liu B, Zhang L, Zhang P. Anxiety, depression, and stress are associated with internet gaming disorder during COVID-19: fear of missing out as a mediator. *Front Psych*. (2022) 13:827519. doi: 10.3389/fpsyt.2022.827519

43. Billieux J, Maurage P, Lopez-Fernandez O, Kuss DJ, Griffiths MD. Can disordered mobile phone use be considered a behavioral addiction? An update on current evidence and a comprehensive model for future research. *Curr Addict Rep*. (2015) 2:156–62. doi: 10.1007/s40429-015-0054-y

44. Wegmann E, Stodt B, Brand M. Addictive use of social networking sites can be explained by the interaction of internet use expectancies, internet literacy, and psychopathological symptoms. *J Behav Addict*. (2015) 4:155–62. doi: 10.1556/2006.4.2015.021

45. Hong FY, Huang DH, Lin HY, Chiu SL. Analysis of the psychological traits, Facebook usage, and Facebook addiction model of Taiwanese university students. *Telemat Inform*. (2014) 31:597–606. doi: 10.1016/j.tele.2014.01.001

46. Moreau A, Laconi S, Delfour M, Chabrol H. Psychopathological profiles of adolescent and young adult problematic Facebook users. *Comput Hum Behav*. (2015) 44:64–9. doi: 10.1016/j.chb.2014.11.045

47. Knapen J, Vancampfort D, Moriën Y, Marchal Y. Exercise therapy improves both mental and physical health in patients with major depression. *Disabil Rehabil*. (2015) 37:1490–5. doi: 10.3109/09638288.2014.972579

48. Aalbers G, McNally RJ, Heeren A, de Wit S, Fried EI. Social media and depression symptoms: a network perspective. *J Exp Psychol Gen*. (2019) 148:1454–62. doi: 10.1037/xge0000528

49. Elhai JD, Yang H, Fang J, Bai X, Hall BJ. Depression and anxiety symptoms are related to problematic smartphone use severity in Chinese young adults: fear of missing out as a mediator. *Addict Behav*. (2020) 101:105962. doi: 10.1016/j.addbeh.2019.04.020

50. Lepp A, Barkley JE, Karpinski AC. The relationship between cell phone use, academic performance, anxiety, and satisfaction with life in college students. *Comput Hum Behav*. (2014) 31:343–50. doi: 10.1016/j.chb.2013.10.049

51. Elhai JD, Rozgonjuk D, Alghraibeh AM, Levine JC, Alafnan AA, Aldraiweesh AA, et al. Excessive reassurance seeking mediates relations between rumination and problematic smartphone use. *Bull Menn Clin*. (2020) 84:137–55. doi: 10.1521/bumc_2020_84_07

52. Andreassen CS. Online social network site addiction: a comprehensive review. *Curr Addict Rep*. (2015) 2:175–84. doi: 10.1007/s40429-015-0056-9

53. Elhai JD, Levine JC, Dvorak RD, Hall BJ. Fear of missing out, need for touch, anxiety and depression are related to problematic smartphone use. *Comput Hum Behav*. (2016) 63:509–16. doi: 10.1016/j.chb.2016.05.079

54. Hou X-L, Wang H-Z, Guo C, Gaskin J, Rost DH, Wang J-L. Psychological resilience can help combat the effect of stress on problematic social networking site usage. *Pers Individ Dif*. (2017) 109:61–6. doi: 10.1016/j.paid.2016.12.048

55. Kardefelt-Winther D. Problematizing excessive online gaming and its psychological predictors. *Comput Hum Behav*. (2014) 31:118–22. doi: 10.1016/j.chb.2013.10.017

56. Jang SM, Sohn S, Yu M. Perceived stress, alcohol consumption, and internet use among Korean college students: does sensation-seeking matter? *Child Youth Serv Rev*. (2018) 88:354–60. doi: 10.1016/j.childyouth.2018.01.038

57. Gao Q, Jia G, Fu E, Olufadi Y, Huang Y. A configurational investigation of smartphone use disorder among adolescents in three educational levels. *Addict Behav*. (2020) 103:106231. doi: 10.1016/j.addbeh.2019.106231

58. Chen C, Zhang KZK, Gong X, Lee M. Dual mechanisms of reinforcement reward and habit in driving smartphone addiction: the role of smartphone features. *Internet Res*. (2019) 29:1551–70. doi: 10.1108/INTR-11-2018-0489

59. Antony MM, Bieling PJ, Cox BJ, Enns MW, Swinson RP. Psychometric properties of the 42-item and 21-item versions of the depression anxiety stress scales in clinical groups and a community sample. *Psychol Assess*. (1998) 10:176–81. doi: 10.1037/1040-3590.10.2.176

60. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with the Beck depression and anxiety inventories. *Behav Res Ther*. (1995) 33:335–43. doi: 10.1016/0005-7967(94)00075-U

61. Wang K, Shi HS, Geng FL, Zou LQ, Tan SP, Wang Y, et al. Cross-cultural validation of the depression anxiety stress Scale-21 in China. *Psychol Assess*. (2016) 28:e88–e100. doi: 10.1037/pas0000207

62. Dong H, Yang F, Lu X, Hao W. Internet addiction and related psychological factors among children and adolescents in China during the coronavirus disease 2019 (COVID-19) epidemic. *Front Psych*. (2020) 11:00751. doi: 10.3389/fpsyt.2020.00751

63. Cheung T, Wong SY, Wong KY, Law LY, Ng K, Tong MT, et al. Depression, anxiety and symptoms of stress among baccalaureate nursing students in Hong Kong: a cross-sectional study. *Int J Environ Res Public Health*. (2016) 13:779. doi: 10.3390/ijerph13080779

64. Andreassen CS, Billieux J, Griffiths MD, Kuss DJ, Demetrovics Z, Mazzoni E, et al. The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: a large-scale cross-sectional study. *Psychol Addict Behav*. (2016) 30:252–62. doi: 10.1037/adb0000160

65. Leung H, Pakpour AH, Strong C, Lin YC, Tsai MC, Griffiths MD, et al. Measurement invariance across young adults from Hong Kong and Taiwan among three internet-related addiction scales: Bergen Social Media Addiction Scale (BSMAS), Smartphone Application-Based Addiction Scale (SABAS), and Internet Gaming Disorder Scale-Short form (IGDS-SF9) (study part A). *Addict Behav*. (2020) 101:105969. doi: 10.1016/j.addbeh.2019.04.027

66. Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol*. (2003) 88:879–903. doi: 10.1037/0021-9010.88.5.879

67. Nylund-Gibson K, Choi AY. Ten frequently asked questions about latent class analysis. *Transl Issues Psychol Sci*. (2018) 4:440–61. doi: 10.1037/tps0000176

68. Nylund KL, Asparouhov T, Muthén BO. Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study. *Struct Equ Modeling*. (2007) 14:535–69. doi: 10.1080/10705510701575396

69. Cerniglia L, Griffiths MD, Cimino S, De Palo V, Monacis L, Sinatra M, et al. A latent profile approach for the study of internet gaming disorder, social media addiction, and psychopathology in a normative sample of adolescents. *Psychol Res Behav Manag*. (2019) 12:651–9. doi: 10.2147/PRBM.S211873

70. Elhai JD, Contractor AA. Examining latent classes of smartphone users: relations with psychopathology and problematic smartphone use. *Comput Hum Behav*. (2018) 82:159–66. doi: 10.1016/j.chb.2018.01.010

71. Asparouhov T, Muthén B. Auxiliary variables in mixture modeling: three-step approaches using Mplus. *Struct Equ Modeling*. (2014) 21:329–41. doi: 10.1080/10705511.2014.915181

72. Canale N, Pancani L, Pivetta E, Moretta T, Marino C, Buodo G, et al. Heterogeneity of smartphone impact on everyday life and its relationship with personality and psychopathology: a latent profile analysis. *Compr Psychiatry*. (2023) 120:152356. doi: 10.1016/j.comppsych.2022.152356

73. Charlton JP, Danforth IDW. Distinguishing addiction and high engagement in the context of online game playing. *Comput Hum Behav*. (2007) 23:1531–48. doi: 10.1016/j.chb.2005.07.002

74. Orsolini L, Yilmaz-Karaman IG, Longo G, Bellagamba S, Kato TA, Volpe U. Sex-differences in hikikomori traits as predictors of problematic internet use in Italian university students. *J Psychiatr Res*. (2022) 155:211–8. doi: 10.1016/j.jpsychires.2022.08.015

75. Piko BF, Pinczés T. Impulsivity, depression and aggression among adolescents. *Pers Individ Dif*. (2014) 69:33–7. doi: 10.1016/j.paid.2014.05.008

76. Johnson SL, Tharp JA, Peckham AD, Carver CS, Haase CM. A path model of different forms of impulsivity with externalizing and internalizing psychopathology: towards greater specificity. *Br J Clin Psychol*. (2017) 56:235–52. doi: 10.1111/bjc.12135

77. He ZH, Li MD, Ma XY, Liu CJ. Family socioeconomic status and social media addiction in female college students: the mediating role of impulsiveness and inhibitory control. *J Genet Psychol*. (2021) 182:60–74. doi: 10.1080/00221325.2020.1853027

78. Wegmann E, Müller SM, Turel O, Brand M. Interactions of impulsivity, general executive functions, and specific inhibitory control explain symptoms of social-networks-use disorder: an experimental study. *Sci Rep*. (2020) 10:3866. doi: 10.1038/s41598-020-60819-4

79. Santos-García D, de Deus FT, Cores Bartolomé C, Suárez Castro E, Jesús S, Mir P, et al. Depression is associated with impulse-compulsive behaviors in Parkinson's disease. *J Affect Disord*. (2021) 280:77–89. doi: 10.1016/j.jad.2020.11.075

80. Moyano N, Vélez K, Arias A, Sánchez-Fuentes MDM. Two pathways to suicidal intention in Ecuadorian adolescents: the role of parental and peer attachment, depression and impulsivity. *Curr Psychol*. (2022) 41:2306–18. doi: 10.1007/s12144-020-00757-6

81. Young KS, Yue XD, Ying L. *Prevalence estimates and etiologic models of internet addiction*. US: John Wiley & Sons, Inc (2011).

82. Roth M, Liebe N, Altmann T. Testing the stress-buffering hypothesis of sensation seeking in a controlled experimental setting. *Pers Individ Dif*. (2019) 151:109508. doi: 10.1016/j.paid.2019.109508

83. Mamun MA, Hossain MS, Siddique AB, Sikder MT, Kuss DJ, Griffiths MD. Problematic internet use in Bangladeshi students: the role of socio-demographic factors, depression, anxiety, and stress. *Asian J Psychiatr*. (2019) 44:48–54. doi: 10.1016/j.ajp.2019.07.005

84. Javaeed A, Zafar MB, Iqbal M, Ghauri SK. Correlation between internet addiction, depression, anxiety and stress among undergraduate medical students in Azad Kashmir. *Pak J Med Sci*. (2019) 35:506–9. doi: 10.12669/pjms.35.2.169

85. Coyne SM, Stockdale L, Summers K. Problematic cell phone use, depression, anxiety, and self-regulation: evidence from a three year longitudinal study from adolescence to emerging adulthood. *Comput Hum Behav*. (2019) 96:78–84. doi: 10.1016/j.chb.2019.02.014

86. Rozgonjuk D, Levine JC, Hall BJ, Elhai JD. The association between problematic smartphone use, depression and anxiety symptom severity, and objectively measured smartphone use over one week. *Comput Hum Behav*. (2018) 87:10–7. doi: 10.1016/j.chb.2018.05.019

87. van Deursen AJAM, Bolle CL, Hegner SM, Kommers PAM. Modeling habitual and addictive smartphone behavior: the role of smartphone usage types, emotional intelligence, social stress, self-regulation, age, and gender. *Comput Hum Behav*. (2015) 45:411–20. doi: 10.1016/j.chb.2014.12.039

88. Kashdan TB. Social anxiety spectrum and diminished positive experiences: theoretical synthesis and meta-analysis. *Clin Psychol Rev*. (2007) 27:348–65. doi: 10.1016/j.cpr.2006.12.003

89. Rachman S, Radomsky AS, Shafran R. Safety behaviour: a reconsideration. *Behav Res Ther*. (2008) 46:163–73. doi: 10.1016/j.brat.2007.11.008

90. Elhai JD, Levine JC, Dvorak RD, Hall BJ. Non-social features of smartphone use are most related to depression, anxiety and problematic smartphone use. *Comput Hum Behav*. (2017) 69:75–82. doi: 10.1016/j.chb.2016.12.023

91. Hofmann SG. Cognitive factors that maintain social anxiety disorder: a comprehensive model and its treatment implications. *Cogn Behav Ther*. (2007) 36:193–209. doi: 10.1080/16506070701421313

92. Elhai JD, Gallinari EF, Rozgonjuk D, Yang H. Depression, anxiety and fear of missing out as correlates of social, non-social and problematic smartphone use. *Addict Behav*. (2020) 105:106335. doi: 10.1016/j.addbeh.2020.106335

93. Prizant-Passal S, Shechner T, Aderka IM. Social anxiety and internet use–a meta-analysis: what do we know? What are we missing? *Comput Hum Behav*. (2016) 62:221–9. doi: 10.1016/j.chb.2016.04.003

94. Zhang Y, Liu Z, Zhao Y. Impulsivity, social support and depression are associated with latent profiles of internet addiction among male college freshmen. *Front Psych*. (2021) 12:642914. doi: 10.3389/fpsyt.2021.642914