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Individual differences in addictive behaviors

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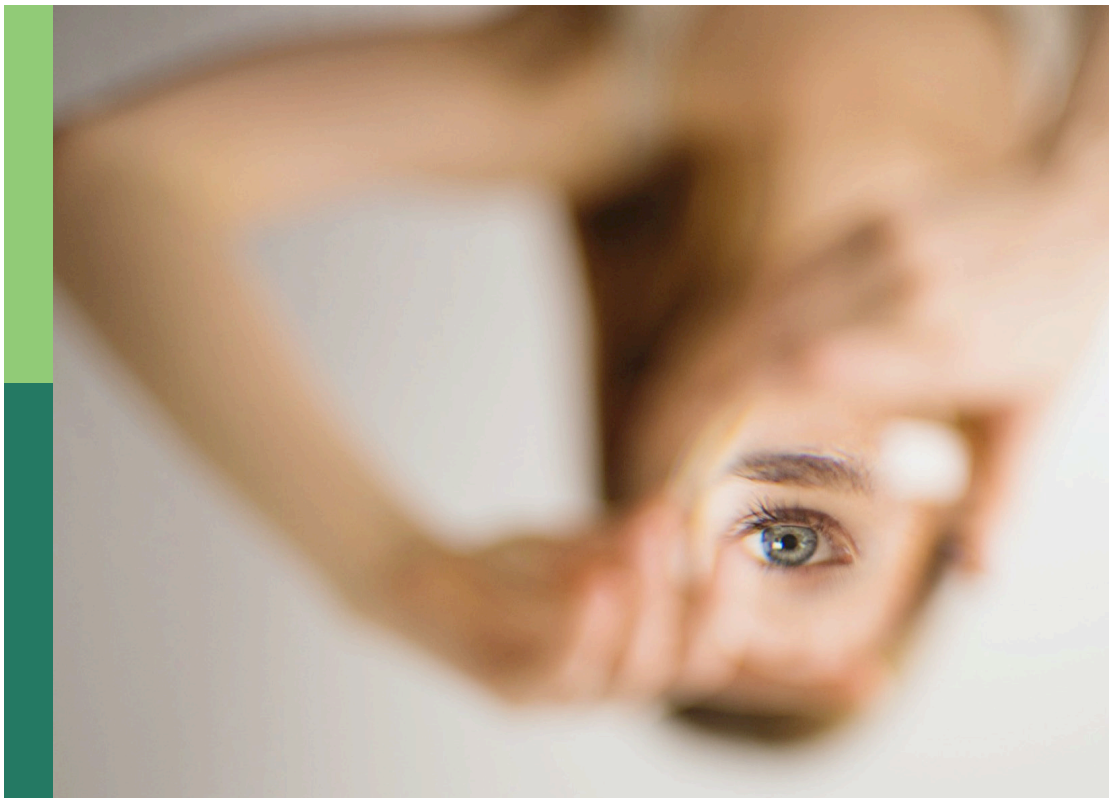

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Individual differences in addictive behaviors

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Editorial: Individual differences in addictive behaviors

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KEYWORDS

addiction, individual differences, technology addiction, substance use disorder, gambling addiction, mental health, comorbidity

Editorial on the Research Topic
Individual differences in addictive behaviors

Theories and explanations of addiction tend to focus on different and often opposing theoretical frame works rooted in specific areas of our understanding of human behavior. For example the disease model of addiction has played a significant role in the literature relating to explanations for addiction (Leshner, 1997). The focus however is shifting to a broader multidisciplinary approach. This takes into account different theoretical perspectives including for example genetics and social environmental variables which clearly have a significant role in explaining, understanding and treating addiction (Volkow et al., 2016). As well as this more inclusive approach, the scientific literature has shifted its focus toward the individual both in respect to understanding addiction and to treating addiction (Drossel et al., 2023). Further to this, as clearly expressed in this Research Topic, understanding addiction is evolving. Not only is the focus for theoretical approaches to understanding addiction shifting to the individual but it is longer the case that when we talk about addiction we are referring just to substance use disorder. As indicated in this Research Topic the role of technology in addiction especially smartphone use and interaction with the internet, has become a central theme in behavioral addiction.

Behavioral addiction

One emerging theme for this Research Topic is the role of external factors in conjunction with internalized variables underpin compulsive and addictive behaviors relating to the use of technology. These exogenous variables intact with endogenous variables, for example socioenvironmental variables and effect the mental health of the individual in the context of addiction. The relationship between parenting style and individual differences along with biological sex differences can both be seen as variables influencing problematic gaming behavior. Rodríguez-Ruiz et al. show how parenting style contributes to scoring highly for neuroticism which is in turn linked to gaming disorder in adolescence. However in relation to excessive gaming behavior, males appear to be more susceptible than females (Rodríguez-Ruiz et al.). In another study reporting the role of parenting on cyber bullying Kim et al. note that self esteem in those reporting bullying mediated the relationship between positive parenting and smart phone addiction.

Smart phone use is also shown to be detrimental to other aspects of wellbeing for example Yang et al. show how excessive smart phone use is linked to poor sleep which in turn is a mediating variable for poor mental health. Excessive smart phone use patterns also seem to be in part at least driven by external factors. Li et al. show how visual cues and inability to exert self-control are driving habitual use patterns. In bringing together both endogenous and exogenous variables Shek et al. explored the effects of the pandemic on internet addiction. They concluded that there was a significant relationship between socioeconomic difficulty, gender and infection with COVID-19 with internet addiction (Shek et al.). In a study investigating the effects of short-form video addiction Xie et al. showed that those undergraduate students who were excessively engaging in short-form video were much more likely to result in academic procrastination. Attentional control was a driving factor in this relationship mediated by boredom (Xie et al.).

Gambling disorder

Gambling disorder is typically explained in relation to behavioral addiction as well as a biological model of addiction (Grant et al., 2016). Interestingly Wu et al. suggest that the disease model of addiction could benefit at risk gamblers. They show that both controlled and at-risk gambling can be described in terms of illness representations, both consequential and emotional, through the lens of the commonsense model of self-regulation. Further to this at risk gambling behaviors would benefit from an educational perspective that adopts an approach that embraces gambling disorder as a illness (Wu et al.). In contrast Çitak proposes an individualistic approach to the identification and treatment of early onset gambling. Using a latent profile analysis of a Turkish population of gamblers identifying emerging profiles of gamblers from a more individualistic perspective (Çitak).

Comorbidity of addiction with mental health

The relationship between addiction and other mental health conditions is complex. In a review of the pairwise relationships between DSM-IV diagnosis indicates that there is significant comorbidity between conditions (McGrath et al., 2020). In this Research Topic Huang et al. present data suggesting that patients with a diagnosis of late onset major mood disorder are more likely to report suicidal ideation. It is therefore important to understand comorbidity between mental health conditions and addiction to provide appropriate support.

Methodological approaches to the study of individual differences in this case biological sex are presented by Farris et al.. Suggesting that female hormonal biomarkers can be used to help understand the comorbidity between anxiety and nicotine craving. Using simple at home hormonal saliva testing alongside ecological momentary analysis they demonstrate the feasibility to collecting psychological data alongside biomarkers to help understand individual differences in smoking behaviors (Farris et al.). These data provide a methodological framework that could be applied in research in other addictive behaviors investigating comorbidity individual difference and addiction.

As behavioral addiction has garnered a great deal of interest in the literature, especially gaming, smart phone use and internet addiction, the relationship between compulsive behaviors and addiction has become a central theme, in particular how these evolve into addictive behaviors (Muela et al., 2022). In this Research Topic Zhao et al. explore how sleep disturbance and it relationship with compulsive behavior is mediated by repetitive negative thinking suggesting that targeting these thought processes within a clinical intervention may lead to a reduction in compulsive behavior in individuals.

Substance use and addiction

Since 2018 legislation in relation to cannabis has changed significantly. It is now possible for patients in the UK who have exhausted all other treatments to be able to be prescribed medical cannabis by a specialist doctor (Torjesen, 2018). It is noted that there is very little research that addresses individual differences in cannabis use patterns and the relationship between medical and recreational cannabis users (Pacula et al., 2016). Ciesluk et al. address this lack of research in individual differences in cannabis use behaviors in the UK, considering its recent legislative changes. Whilst they note significant differences in recreational cannabis users when compared to medical cannabis users, with trait anxiety scores being similar between the two groups, recreational cannabis users reported high levels of state anxiety. There were also differences in age, medical cannabis users being older and differing in their motives for using. However they also show overlap in some motives for using (Ciesluk et al.).

Finally, an interesting study that looks at a consequential outcome of prolonged opium smoking in an Iranian population. Massah et al. present some interesting data that indicates that opium smoking can lead to physical changes in individuals over prolonged time leads to impairment in range of motion and muscle strength in the neck.

This Research Topic reflects the evolving pattern of addiction and its consequences and highlights some important areas that clearly would benefit from more research. It is essential that we consider individual difference as a key part of both theory and treatment in future research in addiction.

Author contributions

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Relationship of Gaming Disorder with parenting based on low affection-communication and personality trait of neuroticism in adolescents

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Background: Gaming Disorder is increasingly common in adolescents. We aimed to evaluate the relationship between parenting, personality traits, and Gaming Disorder.

Methods: An observational and cross-sectional study in six secondary schools of Castelló, obtaining a final sample of 397 students.

Results: Adolescents with Gaming Disorder had lower scores in Adolescent Affection-Communication (F = 8.201; $p < 0.001$), Father's Warmth (F = 3.459; p = 0.028), and Father's Acceptance/Involvement (F = 5.467; p = 0.003), and higher scores in Mother's Revoking Privileges (F = 4.277; p = 0.034) and Father's Indifference (F = 7.868; p = 0.002) than healthy participants. Male sex was a risk factor for Gaming Disorder (OR = 12.221; p = 0.004), while Adolescent Affection-Communication (OR = 0.908; p = 0.001) and Agreeableness (OR = 0.903; p = 0.022) were protective factors. Data modeling described the protective effect that Adolescent Affection-Communication had on Gaming Disorder, which was both directly (B = -0.20; $p < 0.001$) and indirectly mediated by Neuroticism (B = -0.20; $p < 0.001$), while Neuroticism itself was a risk factor for Gaming Disorder (B = 0.50; $p < 0.001$).

Conclusion: These results reflect that Parental style with low affection and communication was directly and indirectly related to the Gaming Disorder, as well as male sex and personality trait of Neuroticism.

KEYWORDS

Gaming Disorder, parenting, personality traits, adolescents, neuroticism, affection-communication

Introduction

Adolescence is a stage of life involving dizzying and radical changes in physical, cognitive, emotional, and social development, in which young adults try to adapt and seek balance within themselves and with society. This period is especially characterized by vulnerability, with those going through it being particularly sensitive to social and environmental models, thereby making it a critical moment for the appearance of both risky and addictive behaviors (Latimer and Zur, 2010). In this context, there is currently some level of social alarm as the result of an increase in excessive substance use and in Gaming Disorder (GD) (Vinet and Faúndez, 2012; López-Caneda et al., 2014). Despite being two different types of addictions, their coexistence is frequent because they both entail similar biological mechanisms (Echeburúa et al., 2009; De Sola et al., 2013). In addition, certain personality variables, understood as persistent patterns of perceiving, thinking, and relating to others, seem to facilitate or predispose individuals to these behaviors (Fantin, 2006).

The problematic use of videogames is an increasingly frequent risky behavior present in the adolescent population. The prevalence of GD in adolescents has increased from 6.1% in 2018 to 7.1% in 2021 (Delegación del Gobierno para el Plan Nacional sobre Drogas, 2021), with these rates being similar to other studies which reported 4.25% in China (Liang et al., 2021) and 8.2% in an international cohort (Porter et al., 2010). According to the Spanish Association of Video Games, 15.9 million people (54.1% men and 45.9% women) were gamers in Spain in 2020 (Asociación Española de Videojuegos, 2020), with this study highlighting the fact that between 68 and 72% of people aged 6–24 years played videogames. Regarding the prevalence in relation to sex, the prevalence increased with age in both sexes, with a range of 53.0–62.4% for men and 29.9–42.3% for women. Adolescents reported playing almost daily (5.8% of boys and 1.3% of girls). Liao et al. (2020) found that being male was significantly related to GD, possibly due to gender differences in online device use. A recent study (Sánchez-Llorens et al., 2021), with high school students, showed that there was a higher proportion of boys with GD. Thus, the probability of GD increased if the subject was male. For this reason, gender was a strong predictor of GD because men are more likely to engage in video game use and to be categorized as more problem gamers than women (Bouna-Pyrrou et al., 2018, Krossbakken et al., 2018).

Consequently, GD, which referred to both offline and online games, was included as a formal diagnosis in the 11th edition of the International Classification of Diseases. Diagnosis includes three negative conditions caused by the misuse of videogames: (1) lack of control of gaming behavior in terms of its initiation, frequency, intensity, duration, completion, and the context in which games are played; (2) the increased priority given to games over other vital interests and daily activities; and (3) maintenance or escalation of the behavior despite being aware of its negative consequences (World Health Organization [WHO], 2018). Although there is controversy over the creation of the Internet Gaming Disorder (IGD) and GD diagnoses, arguing that it could pathologize healthy players and create generalized panic, in addition to the fact that, having used Substance Use Disorder (SUD) diagnostic criteria, an overdiagnosis of GD could be incurred (Billieux et al., 2019). Furthermore, previous literature has generally not distinguished between online vs offline gaming when assessing IGD.

Personality traits can be conceived as habitual patterns of attitude, behavior, emotion, and thought which are relatively stable over time, differ across individuals and influence behavior. The Big Five model of personality conceives of personality as a result of the interactions among five broad personality dimensions: neuroticism, openness to experience, conscientiousness, extraversion, and agreeableness (Gervasi et al., 2017). Certain personality traits have been related to GD, especially low conscientiousness (Sánchez-Llorens et al., 2021), impulsivity, lower self-control/self-regulation, sensation, stimulation, and/or novelty seeking, a tendency toward boredom, risky behavior, hostility/animosity, and enhanced levels of aggression (Paulus et al., 2018). GD has also been related with neuroticism, low self-esteem, alexithymia, and dysfunctions in emotion regulation (Bonnaire and Baptista, 2019). Other personality traits that may predispose individuals to GD are introversion or shyness, decreased openness, agreeableness, resourcefulness, irritability and anxiety, and narcissistic, avoidant, and schizoid traits (Paulus et al., 2018). In contrast, perseverance/grit (Bouna-Pyrrou et al., 2018) and self-directedness may be protective factors against GD (Brand et al., 2016). In the study carried out by Liao et al. (2020), the results indicated that the GD was significantly associated with personality traits such as neuroticism and conscientiousness, a result consistent with previous published literature on the subject (Yan et al., 2014; Yao et al., 2014; Bonnaire and Baptista, 2019; Sánchez-Llorens et al., 2021). The significant relationship between neuroticism and GD is because highly neurotic people see the real world as a threat and often turn to digital worlds, where they feel safe. Consequently, negative emotionality correlates positively with gaming problems and is strongly related to neuroticism (Müller et al., 2014) as long as it is possible to conceptualize problematic online gaming as a maladaptive coping strategy that may serve to reduce tension as a mood modifier (Gervasi et al., 2017). Moreover, adolescents with greater self-control and self-management of time, which also are related to the conscientiousness personality trait, have a lower correlation with GD (Chen et al., 2020), as long as people with low conscientiousness who are less persistent in pursuing personal aims and pay less attention to duties of everyday life may find computer games particularly attractive and do not think through the consequences of engaging in activities excessively. Additionally, decreased agreeableness indicates a higher trend toward competition which may reinforce the game behavior, introvert people which lack social skills may find in computer games a way to search for social contacts in controlled virtual environments and low openness may tend to stick to their gaming behavior instead of exploring new activities (Gervasi et al., 2017; Şalvarlı and Griffiths, 2019).

Abbreviations: AAC, Adolescent Affection-Communication; ADHD, Attention-Deficit Hyperactivity Disorder; AUDIT, Alcohol Use Disorders Identification Test; BASC, Behavior Assessment System for Children; BFQ-NA, Big Five Questionnaire for Children and Adolescents; BSI, Behavioural Symptoms Index; CERV, Questionnaire of Experiences Associated with Videogames; CI, confidence interval; CMC, Clinical Maladjustment; CSE, Compulsory Secondary Education; CTR, corrected typified residuals; EG, Excessive Gaming; ESI, Emotional Symptoms Index; GASA, Game Addiction Scale for Adolescents; GD, Gaming Disorder; IGD, Internet Gaming Disorder; NA, no addiction; OR, odds ratio; PAC, Personal Adjustment; POSIT, Problem Oriented Screening Instrument for Teenagers; SMC, School Maladjustment; ST, supplementary table; SUD, Substance Use Disorder.

The family is the main context of socio-emotional development during childhood and adolescence and so parenting practices or parental socialization styles contribute to the acquisition of skills that prevent addictive behaviors (Koning et al., 2018). Regarding parental socialization styles, two main dimensions are considered: affection-communication (related to the emotional tone and behavior of parents toward their children, by which children feel that they are loved and feel accepted as individuals within the family) and the control-structure of parents/guardians (related to the degree of intensity or type of influence that parents exert on their children's behavior) (Maccoby and Martin, 1983; Benito et al., 2019). Analyzing the most studied parenting practices for their specific relationship with the problematic use of videogames, we find three categories of parental behavior: active mediation (which means having conversations about the use of the Internet and sharing experiences), restrictive mediation (the authorization to use particular online applications) and social co-use (viewing the screen together) (Nathanson, 1999; Valkenburg et al., 1999; Nikken and Jansz, 2014). In this direction, the empirical literature, consisting mainly of cross-sectional studies, seems to be quite inconsistent regarding the role of restrictive parental mediation. While some defend the effectiveness of restrictive parental measures to regulate the use of video games (Martins et al., 2017; Koning et al., 2018), others find that this type of practice encourages their problematic use (Shin and Ismail, 2014; Benrazavi et al., 2015). It is the same for the role of active mediation. In the published literature on the subject, data show that the family environment can be both a risk factor and a protective factor in relation to adolescent gaming behaviors. Thus, parental care expressed as empathy, closeness, emotional warmth, and affection was associated with lower scores in game results (Floros et al., 2013). In this line, Bonnaire and Phan (2017) concluded that the parents' attitude about the use of games, as well as family functioning, are factors that exert a strong influence on the appearance of GD. Prevention strategies should include psychoeducation in order to understand the concept of GD, teach time management skills, stress management and self-control techniques, develop social relationships, set gaming time limits and identify alternative activities (King et al., 2018) which were demonstrated to increase perceptions of risks associated with excessive use of video games, the factors related to GD and of the characteristics of an GD gamer (Bonnaire et al., 2019b). Those prevention polices would be stronger if they included education for parents on how the games and Internet works, including practical tips for monitoring and setting limits (King et al., 2018). As pathological gamers tend to come from less warm and cohesive families with low parental support and adaptability, they may benefit from family-based interventions since by involving parents in therapy in order to close the emotional distance between parents and adolescents that may improve the communication and by changing the negative perception of the adolescent who comes to treatment and avoiding the notion of sole responsibility to allow making better therapeutic alliances with both parents and adolescents (Bonnaire et al., 2019a).

While some studies document familial protective factors of online gaming in adolescents (Estévez et al., 2017; Kim et al., 2018; Liang et al., 2021; Macur and Pontes, 2021), others showed that other important characteristics such as personality, mental health, and other psychological factors may affect online gaming in teenagers (Spilkova et al., 2017). For some adolescents with low levels of emotion regulation or poor emotion regulation skills, playing video games is a maladaptive strategy used to cope with individual and familial difficulties so excessive video gaming can be considered as an escape strategy (Blasi et al., 2019; Bonnaire et al., 2019a). It has been found that emotional warmth of both parents has an influence on adolescents' GD being mediated by time management trait, so parents interacting with adolescents in a warm and accepting way may favor self-control, self-efficacy, and autonomy in order to improve time management and prevent developing of GD (Chen et al., 2020). However, very little literature has integrated parenting and personality traits with the development of GD in adolescents while also considering possible addictions to substances. Perhaps because it is a more complex relationship, we have not found studies that also add the role of gender to the equation. However, it has been suggested that sons and daughters are socialized differently, and that the impact of parenting on behavior problems is different for boys and girls (Barnett and Scaramella, 2013). Since sex differences have also been found in every phase of addiction (acute reinforcing effects, transition from occasional to compulsive use, withdrawal-associated negative affective states, craving, and relapse) (Becker and Chartoff, 2019) we believe it is interesting to study the role of sex in the relationship of these variables.

Thus, the objectives of this current study were to evaluate the parental socialization styles related to GD in adolescents; differences in parenting practices received by adolescents with no addiction (NA), those exhibiting Excessive Gaming (EG) tendencies, or with GD; the relationship of GD and adolescent personality traits, psychopathology, and behavioral problems; and the role of sex in this relationship. Our hypotheses were that: parenting based on affection-communication is negatively related to GD; some personality traits are positively, and others negatively related to GD; psychopathology and behavior are related to GD; and sex moderates these relationships.

Materials and methods

Participants

This was an observational and cross-sectional study. The sample comprised 397 students (and their primary caregivers) in the third or fourth years of Compulsory Secondary Education (CSE). They were all from five private subsidized schools and one public school in the province of Castellón (Spain) that were selected by purposive sampling. With the G*Power 3.1.9.4 program, it was calculated that the sample needed to perform ANOVA with four groups, effect size 0.25, alpha 95% and power 80% was 180 subjects.

Measures

The Questionnaire of Experiences Associated with Videogames (CERV) in its original Spanish initialism (Chamarro et al., 2014), was used to assesses the problematic use of videogames. The CERV comprises 17 items and its cut-off point is ≥26. The Negative Consequences subscale and the Dependence and

Avoidance subscale presented a Cronbach alpha of 0.869 and 0.861, respectively, with an overall Cronbach alpha score of 0.912.

The Game Addiction Scale for Adolescents (GASA) (Lloret et al., 2017) was used to assess GD, and consists of 7 items with a cut-off point ≥4. The Spanish adaptation presented a Cronbach alpha reliability of 0.81, which was consistent with the findings published by the original authors (Lemmens et al., 2009).

The Alcohol Use Disorders Identification Test (AUDIT) (Babor et al., 2001), allowed us to identify excessive alcohol consumption in our cohort. The AUDIT contains 10 questions with a cut-off point of ≥6 in women and ≥8 in men. Its internal consistency indices were usually around 0.80 (Allen et al., 1997). Finally, the instrument showed a sensitivity of 57–59% and a specificity of 91–96% (Álvarez et al., 2001).

The Car, Relax, Alone, Forget, Family/Friends, Trouble (CRAFFT) test (Rial et al., 2019), which comprises six dichotomous items (yes/no) and has a cut-off of ≥2 positive items, was used to screen for the risky use of alcohol and other substances in adolescents. This tool presented an internal consistency of 0.74, with a sensitivity of 74.4% and a specificity of 96.4%.

The Problem Oriented Screening Instrument for Teenagers (POSIT) (Araujo et al., 2018) was employed to assess the risky consumption of alcohol and other drugs in adolescents. POSIT presents 17 dichotomous items and has a cut-off point of ≥2 positive items. The Spanish version presents an internal consistency of 0.82, sensitivity 94.3%, and specificity 83.9%.

The TXP Parenting Questionnaire (Benito et al., 2019) is subdivided into two questionnaires: the TXP-A which is applied to adolescents and the TXP-C applied to the primary caregiver. The TXP-A consists of 29 items and two factors (affection-communication and control-structure), while the TXP-C comprises 16 items and two factors: affection-communication and prosocial values. The overall Cronbach alpha (reliability) of the TXP was 0.87 and the test-retest value was 0.94.

The Parental Socialization Scale, or ESPA-29 in its Spanish acronym (Musitu and García, 2004), assesses parental socialization styles through 212 items that evaluate the adolescent's perception of the way their parents/guardians act in 29 different situations. It is based on two axes of socialization: Acceptance/Involvement (i.e., expression of reactions of approval and affection when children behave in accordance with family norms) and Strictness/Imposition (a socialization style used when children behave in a way that differs from the norms of family functioning). The internal consistency of the ESPA-29 was high and varied between 0.82 and 0.94 depending on the factors (Iglesias and Romero Triñanes, 2009).

The Big Five Personality Test for Children and Adolescents (BFQ-NA) (Barbaranelli et al., 2013) is an adaptation of the Big Five Personality Model. The internal consistency of the overall scale was 0.86 and by subscales it was as follows: Consciousness = 0.87, Agreeableness = 0.82, Neuroticism = 0.83, Extraversion = 0.76, and Openness = 0.75 (Soto et al., 2011).

The Behavior Assessment System for Children (BASC) (González et al., 2004; Reynolds and Kamphaus, 2004) contains 5 components that can be used together or individually. In this current study we used the Self-Report (S3) completed by adolescents and a questionnaire for Parents (P3). The internal consistency of the global dimensions of the BASC were between 0.76 and 0.96, with a mean value of 0.91. S3 provides data from clinical scales and 4 global dimensions: School Maladjustment (SMC), Clinical Maladjustment (CMC), Personal Adjustment (PAC), and the Emotional Symptoms Index (ESI). The P3 questionnaire measures maladaptive behaviors, which allowed us to obtain values for Externalizing problems, Internalizing problems, and Adaptive skills, as well as a Behavioural Symptoms Index (BSI).

Procedure

After authorization by the participating educational centers, a letter was sent to the guardians of the students in the third and fourth years of CSE to request authorization for their children to participate in this study. Once the authorization was obtained, the questionnaires were filled out by the students for an hour and a half during school hours on two consecutive days. The surveys were completed between October and December 2018 with the supervision of two psychologists. The parents/guardians of participating students received the questionnaires by post and returned them completed to the school. Neither the adolescents nor their relatives received compensation of any type for their collaboration.

Four groups were formed: participants with a score above the CERV and the GASA cut-off point (GD; $n = 27$), with a score above the CERV cut-off point and below the GASA cut-off point (EG; $n = 47$) which would be made up of those people with an excessive use of video games without reaching a significant functional impairment that would allow it to be defined as a Gaming Disorder, as has been described in previous research (Kuss and Griffiths, 2012), in order to distinguish between excessive gamers and pathological gamers, those with a (SUD) (a score above the cut-off point for 2 of the AUDIT, CRAFFT, and POSIT questionnaires; $n = 37$), and healthy participants ($n = 171$). Individuals who scored above the cut-off point on only one substance questionnaire were excluded because we considered this insufficient evidence of the presence of a substance addiction, although this result was not considered healthy. Of these excluded subjects, 44.6% had neither GD nor EG, 42.9% had EG, and 12.4% had GD. We also decided to exclude participants with a dual pathology (GD and SUD), as well as any participants with EG and SUD. These two groups were eliminated as they were not independent of the SUD, GD, and EG groups. Also, for presenting sample sizes much smaller than the rest of the groups, since, although recent evidence shows that F is robust to the difference in group size, there is still evidence that in ANOVA an excessively large difference in the sample sizes between groups led to reduced power (Liang et al., 2020).

Statistical analysis

SPSS software (v23, IBM Corp., Armonk, NY, USA) was employed to check compliance with the assumptions of the statistical tests used and analyse the relationships between the study variables by using chi-squared (categorical variables) and ANOVA (quantitative variables) tests, considering the results significant when $p < 0.05$. Once the comparisons between the four groups were made, to explore the variables specifically related to the healthy-excessive gaming-pathological gaming progression, these comparisons were repeated comparing these

three groups (NA, EG, and GD). Substance use disorders were evaluated only to control for this variable, which could distort the results referring to the objectives of the study. Since the SUD is more studied, the rest of the analyzes were carried out excluding this group to specifically explore the variables related to gaming. We used multinomial logistic regression by a forward stepwise method to study whether the independent variables of parental socialization, personality, psychopathology, and behavior, and the sociodemographic variables that were significant in ANOVA and chi-squared tests allowed the dependent variables of GD and EG to be predicted (using as reference category NA). To avoid multicollinearity problems, we run linear regression procedures and successive logistic regression models until finding the model that contained the uncorrelated independent variables with the highest predictive power. Finally, a model was constructed using PROCESS v3.4 (Hayes, 2017) for SPSS to evaluate the hypothesis that parenting is a protective factor against GD. The PROCESS model that best fit the data was number 14: X = AAC, Y = GD, M = Neuroticism, W = Sex.

Ethics

The principles of the Declaration of Helsinki and the Convention of the Council of Europe (World Medical Association [WMA], 2013) were always met. The confidentiality of the participants and their data was guaranteed according to the General Data Protection Regulation (GDPR) law of May 2016 (European Parliament and the Council of the European Union, 2016). The students and guardians included in this study signed their informed consent prior to participation. The overall study protocol was authorized by the Ministry of Education, Research, Culture, and Sport (CN00A/2018/25/S), the ethics committee at the Cardenal Herrera-CEU University (CEI18/112), and by the Research commission of the Consorci Hospitalari Provincial de Castelló (3-16/12/19).

Results

Of the 397 participants, 43.1% (n = 171) had NA, 11.8% (n = 47) showed EG, 6.8% (n = 27) had GD, 9.3% (n = 37) exhibited a SUD, 3.8% (n = 15) had an EG and SUD, and 1.5% (n = 6) had a GD and SUD. Comorbid participants (who showed both EG and a SUD or both GD and a SUD) were excluded from the following analyses. **Tables 1–3** and **Supplementary Table 1** show the descriptions and significant differences between the four groups included in terms of the sociodemographic data and TXP, ESPA-29, BFQ-C, and BASC questionnaire results.

We studied the differences between parenting practices, personality, psychopathology, and the behavior of adolescents with EG, GD, or NA (excluding those with SUD). **Tables 4**, **5** show the differences between the NA, EG, and GD groups. Regarding parental socialization, participants with GD had lower scores in Adolescent Affection-Communication (AAC), Father's Warmth, and Father's Acceptance/Involvement and higher scores in Mother's Revoking Privileges and Father's Indifference than individuals with NA, while those showing EG had higher AAC, Father's Reasoning, and Father's Acceptance/Involvement scores than in the GD group as well as higher Father's Indifference than the NA group. Regarding personality traits, the participants with GD presented higher Neuroticism and lower scores in Conscientiousness, Openness, Extraversion, and Agreeableness than individuals with NA. In turn, participants with GD obtained higher scores in Neuroticism and lower scores in Conscientiousness and Agreeableness than those with GA. No differences were found in personality traits between the EG and NA groups.

Supplementary Table 2 shows the unadjusted logistic regression model, while **Table 6** shows the model adjusted for age, parenting, personality, behavior, and psychopathology. The presence of GD was predicted by Male Sex with an Adjusted Odds Ratio (OR) of 12.221, as well as AAC (OR = 0.908), and Agreeableness (OR = 0.903). Furthermore, GA was also predicted by Male Sex (OR = 27.645). The separate ORs of each questionnaire are shown in the Supplementary material (**Supplementary Tables 3–11**).

Finally, **Figure 1** shows the model that describes the protective effect of AAC on GD, both directly (the more AAC, the less GD) and indirectly, with the latter being mediated by Neuroticism, for which it was also a protective factor (the more AAC, the less Neuroticism). Indeed, Neuroticism was a risk factor for GD (the more Neuroticism, the more GD) and was moderated by Sex: it is mainly in boys where this relationship between Neuroticism and GD occurs, that is, Neuroticism is a risk factor for GD mainly in boys.

Discussion

We fulfilled the main objective of this study: to identify the relationship between GD and parenting, personality traits, psychopathology, and behavioral problems in adolescents, while also exploring the differences between individuals with NA and those showing EG or a GD. The main contribution of this work is that the perception by adolescents that their relationship with their parents or guardians presented Affection-Communication behaved as a protective factor against the development of GD. Another important scientific contribution, which can also be applied in prevention and treatment programs, is the different role of Affection-Communication between the EG and GD groups, which could mean that a parental relationship based on affection and communication can prevent an adolescent with excessive videogames use from developing an addiction.

Indeed, previous studies have shown the relevance of communication between parents/guardians and children in relation to the development of GD (Estévez et al., 2017). Liang et al. (2021) showed that a high Parent-Adolescent Communication score can help adolescents feel satisfied in their basic psychological needs without having to resort to psychological compensation through the addictive use of videogames. Another study also revealed higher odds of GD among adolescents with greater difficulties in communicating with their parents/guardians (Macur and Pontes, 2021). The study in Korean adolescents by Kim et al. (2018) revealed that Affection and Communication with the father reduced the risk of developing GD, without the same influence being noted for this factor in the mother. Similarly, our study revealed a relationship between GD and

TABLE 1 Descriptive statistics of the sociodemographics of the overall sample and by the no addiction, Excessive Gaming, Gaming Disorder, and Substance Use Disorder groups.

	Total *n* = 397 *n* (%)/M (SD)	NA *n* = 171 *n* (%)/M (SD)	EG *n* = 47 *n* (%)/M (SD)	GD *n* = 27 *n* (%)/M (SD)	SUD *n* = 37 *n* (%)/M (SD)	χ^2 (P); ES (CTR)/F (P); ES *Post-hoc*: (*P*)	Effect size
Sex						**59.99 (< 0.001); 0.46**	0.46
Female	226 (57.1)	**122 (74.4)**	6 (3.7)	10 (6.1)	26 (15.9)	(**5.6**/**-6.9**/**-2.4**/1.6)	
Male	170 (42.9)	48 (41)	**41 (35)**	**17 (14.5)**	11 (9.4)	(**-5.6**/**6.9**/**2.4**/-1.6)	
Age in years	14.82 (0.74)	14.73 (0.70)	14.62 (0.64)	14.59 (0.69)	15.00 (0.67)	**2.68 (0.047); 0.02**	0.02
School year						**7.85 (0.049); 0.16**	0.16
Third year of CSE	169 (42.7)	83 (62.9)	23 (17.4)	16 (12.1)	10 (7.6)	(0.8/0.3/1.3/-**2.6**)	
Fourth year of CSE	227 (57.3)	87 (58.4)	24 (16.1)	11 (7.4)	**27 (18.1)**	(-0.8/-0.3/-1.3/**2.6**)	
Repeated courses (school years)						6.41 (0.379)	0.11
None	281 (80.5)	123 (59.1)	36 (17.3)	23 (11.1)	26 (12.5)		
1 repeated course	46 (13.2)	16 (61.5)	1 (3.8)	2 (7.7)	7 (26.9)		
2 repeated courses	22 (6.3)	7 (58.3)	2 (16.7)	1 (8.3)	2 (16.7)		
Number of siblings of the student	2.10 (0.96)	2.03 (0.99)	2.08 (0.86)	2.42 (1.27)	2.17 (0.79)	1.28 (0.283)	0.01
People with whom they live						10.61 (0.101)	0.14
Both parents	270 (77.1)	109 (58.6)	34 (18.3)	18 (9.7)	25 (13.4)		
Father or mother only	73 (20.9)	35 (62.5)	5 (8.9)	6 (10.7)	10 (17.9)		
Others	7 (2)	1 (25)	1(25)	2 (50)	0 (0)		

CTR, corrected typified residuals; those under -1.96 or over 1.96 were considered significant. The groups from among the categorical variables in which the CTRs were significant are shown in bold; EG, Excessive Gaming; ES, effect size; GD, Gaming Disorder; M, average; n, sample; NA, no addiction; SD, standard deviation; SUD, Substance Use Disorder; χ^2, Pearson chi-squared test; The variables that were significant in chi-squared and ANOVA tests ($p < 0.05$) are shown in bold. Pearson chi-squared test's effect size = Cramer's V: 0-1. ANOVA's effect size = partial eta squared: 0.01 small, 0.06 medium, 0.14 large. Differences between the variables were tested using chi-squared and ANOVA tests.

low Warmth, Acceptance/Involvement, and high Indifference from the father, while the mother impacted GD through Revoking Privileges. Therefore, psychotherapy that improves affection and communication can lead to a decrease in GD symptoms, as was demonstrated by a study of an intervention program for adolescents with GD that included a module of family communication (Torres-Rodríguez et al., 2018a) or by a randomized controlled trial of Family therapy to reduce GD (Nielsen et al., 2021).

However, Xu et al. (2015) found that maternal attachment factors were more significantly associated with addiction and the onset of GD than paternal attachment. This suggests that when adolescents feel in a safe parental environment, they tend to present fewer risky behaviors, with their family being perceived as a pivotal factor in determining their ability to develop skills for coping with life's difficulties, with such learning serving to reinforce emotional regulation (Estévez et al., 2017). Therefore, if an individual feels unlovable and neglected and has developed a negative self-concept because of negative relationships during childhood, videogames may offer safer environments for adolescents to develop their self-esteem and identity because they can create alternative virtual identities and use them as a shelter or escape (Estévez et al., 2017).

Regarding personality, various publications have shown a relationship between GD and personality traits (Sánchez-Llorens et al., 2021). Focusing on the Big-Five Personality Traits, our study showed that low Agreeableness as well as Neuroticism acted as a risk-factors for the development of GD as a result of low Affection-Communication, with the same differences also being found with respect to adolescents with GD. Furthermore, our data also revealed that adolescents with GD presented lower levels of Conscientiousness, Openness, and Extraversion than those with NA. The relationship between low Agreeableness and GD can be explained because these individuals tend to compete rather than cooperate, as usually occurs in the types of online videogames that require high levels of competitiveness.

Teenagers with high Neuroticism tended to perceive the real world as more threatening and so they often took refuge in the virtual world of videogames in the search for a safer and more controllable environment. Adolescents with low Conscientiousness levels presented lower scores for self-directedness and attention to everyday obligations, which was directly related to SMC, represented by a negative attitude toward school and teachers, itself a risk for developing GD. In addition, these adolescents tended to be disorganized and unstructured and so finding an environment

TABLE 2 Descriptive statistics of parenting of the overall sample and by the no addiction, Excessive Gaming, Gaming Disorder, and Substance Use Disorder groups.

	Total *n* = 397 M (SD)	NA *n* = 171 M (SD)	EG *n* = 47 M (SD)	GD *n* = 27 M (SD)	SUD *n* = 37 M (SD)	F (P); ES *Post-hoc*: (P)	Effect size
TXP Parenting Questionnaire							
Adolescent: affection–communication	82.79 (14.49)	86.78 (12.83)	85.09 (14.50)	75.37 (16.23)	72.97 (18.75)	**12.41 (< 0.001); 0.12 0.008 (NA > GD) 0.001 (NA > SUD) 0.011 (EG > SUD)**	0.29
Adolescent: control–structure	35.08 (5.88)	35.86 (5.64)	35.56 (6.18)	34.85 (6.18)	31.92 (6.63)	**4.49 (0.004); 0.04 0.002 (NA > SUD) 0.032 (EG > SUD)**	0.05
Caregivers: prosocial values	19.40 (1.42)	19.62 (0.94)	18.81 (2.83)	19.27 (1.03)	19.07 (1.59)	**3.60 (0.014); 0.04**	0.10
Caregivers: affection–communication	54.82 (7.51)	56.39 (7.16)	52.91 (9.12)	52.86 (9.48)	52.95 (8.97)	**2.97 (0.033); 0.04**	0.11
ESPA-29							
Mother's reasoning	2.97 (0.70)	3.03 (0.68)	3.00 (0.71)	2.91 (0.65)	2.82 (0.81)	0.80 (0.494)	0.04
Mother's warmth	2.99 (0.78)	3.04 (0.79)	3.04 (0.80)	2.93 (0.72)	2.73 (0.84)	1.31 (0.271)	0.03
Mother's detachment	1.34 (0.37)	1.26 (0.28)	1.33 (0.35)	1.39 (0.41)	1.50 (0.47)	**4.38 (0.005); 0.06**	0.13
Mother's indifference	1.76 (0.73)	1.65 (0.68)	1.90 (0.88)	1.86 (0.70)	1.94 (0.80)	2.11 (0.100)	0.04
Mother's physical punishment	1.06 (0.15)	1.04 (0.13)	1.07 (0.15)	1.13 (0.23)	1.10 (0.16)	**3.55 (0.015); 0.04**	0.02
Mother's revoking privileges	1.72 (0.64)	1.63 (0.62)	1.86 (0.68)	2.00 (0.73)	1.70 (0.65)	**2.85 (0.038); 0.03**	0.01
Mother's verbal scolding	2.57 (0.67)	2.54 (0.72)	2.59 (0.69)	2.80 (0.58)	2.72 (0.52)	1.23 (0.301)	0.007
Mother's acceptance/ involvement	3.24 (0.49)	3.30 (0.48)	3.22 (0.41)	3.15 (0.47)	3.04 (0.59)	2.02 (0.114)	0.07
Mother's strictness/imposition	1.79 (0.41)	1.75 (0.42)	1.83 (0.45)	1.97 (0.46)	1.84 (0.36)	1.82 (0.144)	0.006
Father's reasoning	2.74 (0.77)	2.81 (0.79)	2.95 (0.74)	2.41 (0.70)	2.64 (0.69)	2.46 (0.064)	0.11
Father's warmth	2.76 (0.86)	2.89 (0.82)	2.88 (0.86)	2.36 (0.99)	2.59 (0.85)	**2.98 (0.033); 0.04**	0.11
Father's detachment	1.46 (0.50)	1.38 (0.52)	1.39 (0.49)	1.51 (0.47)	1.62 (0.38)	1.84 (0.142)	0.09
Father's indifference	1.96 (0.82)	1.73 (0.73)	2.08 (0.79)	2.35 (0.87)	2.27 (0.79)	**7.39 (< 0.001); 0.09 0.004 (NA < GD) 0.004 (NA < SUD)**	0.12
Father's physical punishment	1.05 (0.16)	1.04 (0.15)	1.01 (0.04)	1.10 (0.19)	1.13 (0.27)	**3.87 (0.010); 0.05**	0.15
Father's revoking privileges	1.62 (0.59)	1.56 (0.61)	1.79 (0.65)	1.82 (0.54)	1.64 (0.58)	2.08 (0.104)	0.05
Father's verbal scolding	2.38 (0.64)	2.33 (0.67)	2.54 (0.73)	2.52 (0.62)	2.49 (0.55)	1.27 (0.286)	0.02
Father's acceptance/involvement	3.00 (0.59)	3.13 (0.57)	3.06 (0.51)	2.65 (0.61)	2.82 (0.55)	**4.85 (0.003); 0.08 0.006 (NA > GD)**	0.17
Father's strictness/imposition	1.68 (0.37)	1.64 (0.39)	1.78 (0.41)	1.81 (0.38)	1.75 (0.36)	2.11 (0.101)	0.04

EG, Excessive Gaming; ES, effect size; GD, Gaming Disorder; M, average; n, sample; NA, no addiction; SD, standard deviation; SUD, Substance Use Disorder; variables with significant ANOVA test results ($p < 0.05$) are shown in bold. Effect size = partial eta squared: 0.01 small, 0.06 medium, 0.14 large. Differences between variables were tested by ANOVA.

with a structure and clear rules such as in a videogame may have been attractive to them.

Low extraversion and GD could be related because of a lack of social skills, low sociability (Festl et al., 2013), and problems with interpersonal relationships. This means that these adolescents may have compensated for difficulties in making and maintaining friendships in the real world by interacting with other people online through videogames where they could form new relationships and even have a sense of belonging and group identity (Gallimberti et al., 2016; Estévez et al., 2017). Another possible interpretation is because the use of videogames is usually a solitary activity (Gallimberti et al., 2016). Finally, low Openness could be related to the development of GD because participants with this trait tend to cling to play behavior rather than exploring novel activities (Müller et al., 2014; Torres-Rodríguez et al., 2018b; González-Bueso et al., 2020). Perhaps for this same reason, unlike previous studies (Hu et al., 2017), we found no relationship between Sensation Seeking and GD.

Regarding psychopathology and behavioral problems, there is evidence of a relationship between GD and symptoms of anxiety, depression, suicidal ideation, Attention-Deficit Hyperactivity Disorder (ADHD), autism spectrum disorder, and obsessive-compulsive disorder (Andreassen et al., 2016; Torres-Rodríguez et al., 2018b). The findings in our study were similar, with GD

TABLE 3 Descriptive statistics of personality traits of the overall sample and by the no addiction, Excessive Gaming, Gaming Disorder, and Substance Use Disorder groups.

	Total *n* = 397 M (SD)	NA *n* = 171 M (SD)	EG *n* = 47 M (SD)	GD *n* = 27 M (SD)	SUD *n* = 37 M (SD)	F (P); ES *Post-hoc*: (P)	Effect size
Conscientiousness	54.00 (9.63)	57.04 (8.99)	54.60 (9.98)	48.33 (9.42)	48.00 (8.90)	**14.55 (< 0.001); 0.13 < 0.001 (NA > GD) < 0.001 (NA > SUD) 0.026 (EG > GD) 0.007 (EG > SUD)**	0.13
Openness	55.92 (9.46)	57.96 (9.39)	57.06 (10.28)	52.37 (10.05)	50.32 (8.19)	**8.34 (< 0.001); 0.08 0.024 (NA > GD) < 0.001 (NA > SUD) 0.007 (EG > SUD)**	0.08
Extraversion	50.72 (10.00)	51.19 (9.69)	49.96 (9.39)	45.26 (11.78)	48.00 (11.17)	**3.28 (0.021); 0.03 < 0.024 (NA > GD)**	0.03
Agreeableness	52.97 (9.48)	54.49 (9.30)	54.34 (9.70)	45.37 (8.09)	49.05 (8.83)	**10.27 (< 0.001); 0.10 < 0.001 (NA > GD) 0.007 (NA > SUD) < 0.001 (EG > GD) 0.046 (EG > SUD)**	0.10
Neuroticism	50.07 (11.35)	47.45 (11.26)	46.87 (9.04)	53.96 (12.31)	60.32 (10.80)	**16.36 (< 0.001); 0.15 0.023 (NA < GD) < 0.001 (NA < SUD) 0.039 (EG < GD) < 0.001 (EG < SUD)**	0.15

EG, Excessive Gaming; ES, effect size; GD, Gaming Disorder; M, average; n, sample; NA, no addiction; SD, standard deviation; SUD, Substance Use Disorder; Variables with significant ANOVA test results ($p < 0.05$) are shown in bold. Effect size = partial eta squared: 0.01 small, 0.06 medium, 0.14 large. Differences between variables were tested by ANOVA.

TABLE 4 Differences between the no addiction, Excessive Gaming, and Gaming Disorder groups according to ANOVA analysis (F[p]); ES.

	NA		
	Parenting	Personality traits	Behavior and psychopathology
EG	Father's indifference: 7.868 (0.029); 0.08^{EG}		Conduct problems: 2.678 (0.036); 0.02 ^{NA}
GD	Adolescent affection–communication: 8.201 (< 0.001); 0.06 ^{NA} Father's warmth: 3.459 (0.028); 0.03 ^{NA} Father's acceptance/involvement: 5.467 (0.003); 0.07 ^{NA} Mother's revoking privileges: 4.277 (0.034); 0.04^{GD} Father's indifference: 7.868 (0.002); 0.08 ^{GD}	Conscientiousness: 10.706 (< 0.001); 0.08 ^{NA} Openness: 3.935 (0.015); 0.03 ^{NA} Extraversion: 4.230 (0.011); 0.03 ^{NA} Agreeableness: 11.588 (< 0.001); 0.08 ^{NA} Neuroticism: 4.428 (0.013); 0.03 ^{GD}	Interpersonal relationships: 11.184 (0.005); 0.08 ^{NA} Relationship with parents: 9.938 (0.006); 0.07 ^{NA} Self-esteem: 6.682 (0.032); 0.05 ^{NA} Self-reliance: 11.304 (0.005); 0.08 ^{NA} Personal adjustment: 16.992 (0.001); 0.12 ^{NA} Negative attitude toward school: 9.072 (< 0.001); 0.07 ^{GD} Negative attitude toward teachers: 9.523 (0.003); 0.07 ^{GD} Atypicality: 3.021 (0.039); 0.02 ^{GD} Locus of control: 12.092 (< 0.001); 0.09 ^{GD} Social stress: 21.823 (< 0.001); 0.15 ^{GD} Anxiety: 3.317 (0.029); 0.02 ^{GD} Depression: 18.814 (< 0.001); 0.13 ^{GD} Sense of inadequacy: 10.816 (0.007); 0.08 ^{GD} Clinical maladjustment: 8.557 (< 0.001); 0.06 ^{GD} School maladjustment: 9.612 (< 0.001); 0.07 ^{GD} ESI: 19.648 (0.001); 0.14 ^{GD} Attention problems: 6.130 (0.002); 0.05 ^{GD}

EG, Excessive Gaming; ES, effect size; ESI, Emotional Symptom Index; GD, Gaming Disorder; NA, no addiction; the name of the group (GD, EG or NA) that scored highest in Tukey *post-hoc* tests for homogeneous variance or in Games–Howell *post-hoc* significance comparison tests for non-homogeneous variance ($p < 0.05$) is shown after each variable in superscript.

being related to CMC and emotional symptoms such as anxiety and depression that could explain the use of videogames as a maladaptive form of emotional self-regulation. We also found that GD was related to attention problems, which may be because ADHD is a risk factor for addiction on its own, but also because a person with ADHD may begin to seek rewards and show hyperfocus through behaviors such as becoming absorbed in videogames, perhaps even using them as a form of "self-medication."

Playing videogames requires a series of cognitive functions such as attention, visual processing, visuospatial memory, and executive control (Mathews et al., 2019). Our data show that a

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TABLE 5 Differences between Excessive Gaming and Gaming Disorder according to ANOVA analysis (*F*[*p*]); ES.

	EG		
	Parenting	Personality traits	Behavior and psychopathology
GD	Adolescent affection–communication: 8.201 (0.010); 0.06 [EG] Father's reasoning: 3.139 (0.038); 0.03 [EG] Father's acceptance/Involvement: 5.467 (0.043); 0.07 [EG]	Conscientiousness: 10.706 (0.015); 0.08 [EG] Agreeableness: 11.588 (< 0.001); 0.08 [EG] Neuroticism: 4.428 (0.022); 0.03 [GD]	Interpersonal relationships: 11.184 (0.013); 0.08 [EG] Relationship with parents: 9.938 (0.004); 0.07 [EG] Self-reliance: 11.304 (0.021); 0.08 [EG] Personal adjustment: 16.992 (0.001); 0.12 [EG] Negative attitude toward school: 9.072 (0.005); 0.07 [GD] Locus of control: 12.092 (0.001); 0.09 [GD] Social stress: 21.823 (< 0.001); 0.15 [GD] Depression: 18.814 (0.002); 0.13 [GD] Sense of inadequacy: 10.816 (0.038); 0.08 [GD] Clinical maladjustment: 8.557 (0.006); 0.06 [GD] School maladjustment: 9.612 (0.021); 0.07 [GD] ESI: 19.648 (0.003); 0.14 [GD]

EG, Excessive Gaming; ES, effect size; ESI, Emotional Symptom Index; GD, Gaming Disorder; the name of the group (GD or EG) that scored highest in Tukey *post-hoc* tests for homogeneous variance or in Games–Howell *post-hoc* significance comparison tests for non-homogeneous variance ($p < 0.05$) is shown after each variable in superscript.

sense of inadequacy, low self-esteem, and low self-reliance are often found in adolescents with GD, which may be related to their need to improve their self-esteem through game features such as feedback, promotions, scoring, accomplishments, anonymity, creation of personal social identities, comfortable expression of self, or interaction with other players (Toker and Baturay, 2016). Regarding such behavior, some studies such as the one by Kim et al. (2018) have related aggressive behavior to presenting a higher risk of developing GD. However, in our study we did not find differences regarding aggressiveness between those with GD and healthy adolescents.

Moreover, like most other studies (Paulus et al., 2018; Macur and Pontes, 2021), we found that male sex was an important predictor of GD. The disparity between genders was attributed in some studies, such as the one by Phan et al., to the differences in videogame preferences between genders, with men preferring strategy, role-playing, action, and fighting genres and women preferring social, puzzle, card, music, dance, educational, and simulation genres (Phan et al., 2012). In other more recent studies such as the one by Dong et al. the difference in risk between genders was related to differences at the neurobiological level, demonstrating greater activation in men in the right striatum, right orbitofrontal cortex, left inferior frontal gyrus, and right middle occipital gyrus, with bilateral decline when exposed to gaming-related cues thereby also generating more craving (Dong et al., 2018).

TABLE 6 Odds ratio of the multiple logistic regression model (using no addiction as the reference category) adjusted by age, parenting, personality, behavior, and psychopathology by a forward stepwise method to predict the dependent variables of Excessive Gaming and Gaming Disorder.

Dependent variables	Independent variables	OR (95% CI)	*p*-value
EG	**Sex***	**27.645 (7.121–107.318)**	**<0.001**
	Adolescent affection–communication	0.975 (0.915–1.039)	0.431
	Agreeableness	1.004 (0.943–1.070)	0.896
GD	**Sex***	**12.221 (2.275–65.635)**	**0.004**
	Adolescent affection–communication	**0.908 (0.857–0.962)**	**0.001**
	Agreeableness	**0.903 (0.827–0.986)**	**0.022**

CI, confidence interval; EG, Excessive Gaming; GD, Gaming Disorder; OR, odds ratio; The variables with a significant OR in the multiple logistic regression model ($p < 0.05$) are shown in bold.
*Belonging to the male sex.

According to the data obtained in our study, the probability of presenting a video game use disorder seems to be greater in males, as shown in the published literature on the subject (Liao et al., 2020; Sánchez-Llorens et al., 2021). So, gender appears to be a strong predictor of GD. Boys are more likely to engage in video game use and to be categorized as more problem gamers than girls (Sánchez-Llorens et al., 2021). On the other hand, GD is significantly associated with some personality traits, such as neuroticism (Liao et al., 2020). The relationship between neuroticism and GD occurs mainly in boys, precisely because the prevalence of the disorder is higher in this population. In the model proposed in our work, gender moderates the direct relationship between neuroticism and DG, but they do not have a direct effect on DG; thus, the boys who present greater neuroticism will present greater GD. As there are more boys with GD, this aspect may have influenced the result. In this sense, it could be thought that the differences found between GD and SUD may be due to sex, so that, *a posteriori*, we repeat all the analyzes adjusting for sex and age. The results did not vary substantially, maintaining these significant differences.

Regarding the limitations of this study, first, its cross-sectional design implies that causality cannot be inferred based on these data. Second, there is still a lack of consensus regarding the criteria and psychometric instruments required to diagnose GD. In our study, EG and GD were classified using screening questionnaires, which must be considered when making comparisons with other studies and in the extrapolation of results. In addition, the study relies on self-reported metrics, which can originate bias effects and under- or overreporting of behaviors and may therefore result in

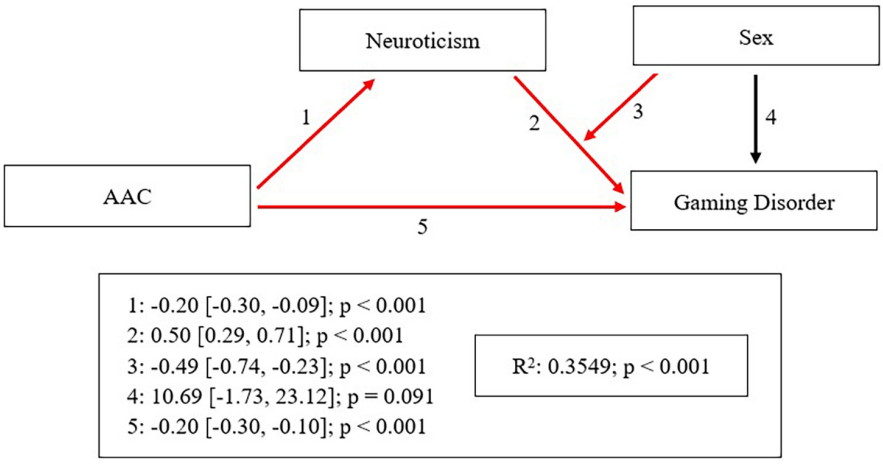

FIGURE 1
Explanatory model between parenting, personality, and Gaming Disorder. Significant relationships are shown in red. AAC, Adolescent affection-communication.

social desirability bias. Another limitation is that the videogame genres used by the participants was not considered even though this factor may be relevant when identifying specific risk factors for subpopulations of adolescents with GD. However, the exclusion of patients with SUD from the final analyses, but above all having considered problematic or risky substance use as an exclusion criterion (score on a single screening questionnaire), should be considered as a selection bias take into account when generalizing the results. Moreover, we have decided to exclude SUD from the analyzes since it is a more studied topic and thus specifically explore the variables related to GD. Furthermore, our study cohort consisted of a convenience sample since the secondary schools included were not randomly chosen. To finalize the limitations, it should be noted that the educational centers did not provide reliable information regarding the total number of students in the target population, which has prevented us from establishing a response rate of students who participated. In addition, the requirements related to the protection of personal data do not allow us to know the reasons for non-participation.

Regarding the strengths of this study, we evaluated variables both from the perspectives of adolescents and of their guardians, which helped to provide us with a broader vision of the outcomes. We also included metrics of parental socialization, personality, and psychopathological variables in the same study. In addition, we differentiated two profiles of videogame users, one with an excessive but not addicted gaming profile and the other with an addiction profile with greater problems at the paternal-filial, personality, and psychopathological levels. It is also noteworthy that most of the effect sizes of the significant differences between the groups are medium-large, which is especially striking since gaming is a complex multi-causal phenomenon.

Conclusion

In this work, the parental style of low affection and communication was directly related to the GD. In addition, low affection and communication was also indirectly related to high neuroticism in adolescents, which in turn, was linked to GD. Furthermore, male sex was also related to GD. However, only male sex was shown to be related to EG in adolescents and so neither parental style nor personality traits seemed to be relevant to this diagnosis.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Ministry of Education, Research, Culture, and Sport Ethics Committee at the Cardenal Herrera-CEU University Research Commission of the Consorci Hospitalari Provincial de Castelló. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

MM-S, AB, and GH conceptualized and designed the study. GH obtained the founding sources and ethical authorizations. MM-S, IA-F, and FC-G collected the data. FR-R and MS-L performed quality assurance for all the data and coordinated database activities. FR-R and AB performed the data analysis and interpretation. FR-R drafted the manuscript. AB and GH supervised the study and elaboration of all the manuscript. All authors assisted with subsequent drafts, were responsible for reviewing and approving the final version of the manuscript, had full access to all data in the study, took responsibility for the integrity of the data and the accuracy of the data analysis, and contributed 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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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1147601/full#supplementary-material

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The correlation between strength and range of motion of the neck muscles and opium smoking in Iran

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Objectives: Opium smoking is commonly practiced via traditional and novel routes in Iran. Both smoking methods are practiced in a non-ergonomic position. According to previous studies and our hypothesis, it can be potentially harmful to the cervical spine. Thus, the present study aimed to investigate the relationship between opium smoking and neck range of motion and neck muscle strength.

Methods: In this cross-sectional and correlational study, the range of motion and strength of the neck muscles of 120 men with drug use disorder were measured by a CROM goniometer and a hand-held dynamometer. Other data gathering was performed using a demographic questionnaire, the Maudsley Addiction Profile, and the Persian version of Leeds Dependence Questionnaire. The obtained data were analyzed by Shapiro–Wilks test, Pearson's correlation coefficient and stepwise linear regression.

Results: There was no significant correlation between the age of drug use onset and range of motion and muscle strength of the neck; however, the daily duration of opium smoking and the number of years of opium smoking were inversely and significantly correlated with the range of motion and muscle strength of the neck in some directions. Daily opium smoking time for decreasing in neck range of motion and total duration of opium smoking for reduction of neck muscles strength are stronger predictor variables.

Conclusion: Opium smoking by traditional routes causes non-ergonomic positions and has a moderate significant correlation with reduced range of motion and neck muscle strength, in Iran.

KEYWORDS

opium smoking, drug use disorder, neck range of motion, neck muscles strength, Iran

Highlights

- The harm of drug use disorder is not only AIDS and hepatitis, and harm reduction programs should go beyond the prevention of AIDS and hepatitis. According to more than 90% of smoking use of drug compared to other methods (oral and injectable, etc.) musculoskeletal disorders caused by the smoking use of drugs, have a greater cost burden in reducing the quality of life and the need for rehabilitation.
- Drug abuse treatment and harm reduction programs should focus more seriously on replacing smoking use of drugs with oral medications assisted treatment.
- Although in Iran and some countries in the region, a large number of people smoke opium for many years and sometimes all their lives, daily in a completely non-ergonomic position, but studying the deformation of the posture and musculoskeletal disorders related to the body position in them, is not a scientific concern and neither physical therapy researchers have paid attention to it nor addiction researchers.
- Neck muscles strength and range of motion in opium addicts are correlated to the number of years of opium smoking and daily minutes of opium smoking, but not to its oral use.
- There is no significant correlation between the onset age of continues and permanent opium smoking and substance dependence severity with neck range of motion and muscles strength.
- People with drug use disorder (especially smoking users) as a large group of vulnerable people, should be the target population of musculoskeletal disorders researchers and addiction harm reduction researchers, and more experimental, comparative, cohort, etc. researches should be designed and implemented for them.

Introduction

The physical posture of individuals is generated by their movement habits. Moreover, it is formed on a morphological and functional basis and is a manifestation of the individual's physical and mental conditions (1). Therefore, it is an indicator of one's kinetic status, as well as muscle balance and neuromuscular coordination. The human body condition is influenced by changes throughout life. In fact, posture visibly echoes musculoskeletal activity (2, 3). Modern urban life is associated with rapid changes in the environment, lifestyle, physical activity restrictions, and improper nutrition (4). Despite numerous preventive and protective measures, many health problems are caused by the contemporary world's lifestyle (5).

As long as corrective action is not taken to improve posture, its adverse effects on the body will continue and postural pressure will be imposed on the person. Accordingly, the odds of musculoskeletal disorders related to work or non-ergonomic position remains high (3). Performing repetitive tasks in incorrect posture and non-neutral position leads to postural strain, fatigue, and pain (6). In such positions, the muscles bear further load and are exposed to damage along with the surrounding connective tissues. If continued and repetitive, these positions can lead to irreversible changes in the form of shortening or stretching of muscle fibers and soft tissues (advancing from the elasticity stage to the plasticity phase) (7, 8). Therefore, being in certain recurrent positions over days and hours leads to alternations in the musculoskeletal system. In addition, such cases have been proven in various operations and sports activities (9, 10). Considering the high prevalence of musculoskeletal disorders in today's societies (11), investigating the prevalence of these conditions and the factors affecting them in diverse age groups, genders, occupations, etc., is an essential area of research in rehabilitation. The smoking of opium is common in traditional (using a device called Vafour) and novel (using a type of hookah called in Iran "Gholgholei" or using spoke and pin called in Iran "Sikh-o-sang") methods in Iran. Furthermore, as both methods are a non-ergonomic position, individuals with opium use disorder who consume via smoking route are more prone to some musculoskeletal disorders. This issue can be attributed to long-term exposure to non-ergonomic positions during consumption, as well as the lack of movement, malnutrition, and unhygienic conditions, heavy smoking, and so on (12–14). Opium smoking is not common in other regions. In European and American countries, heroin and marijuana are mainly smoked, and their smoking time is very short, compared to opium; therefore, this issue has not been a research priority in Europe and America. Opium smoking is very common in the Middle East and especially in Iran (15). In addition, its use has increased after the onset of Coronavirus Disease 2019 (COVID-19) pandemic (due to the false belief that opium use can prevent the spread of COVID-19) (16). Iran has the highest prevalence rate of opium smoking in proportion to the population globally (17), Thus, this study aimed to investigate the relationship between the Range of Motion (ROM) of the neck and its muscle strength and opium smoking and the severity of opium use disorder.

Methods

This cross-sectional and correlation study was conducted in 2021 in Tehran City, Iran. By snowball sampling method, we selected 120 men from four main branches according to the inclusion and exclusion criteria of the study among the referrals to four outpatient and residential substance abuse treatment centers.

The inclusion criteria were as follows: a diagnosis of substance use disorder according to the International Classification of Diseases-11th Revision (ICD-11) criteria (18), ability to stand, age between 25 and 50 years, Body Mass Index (BMI) below 27.5 kg/m^2 (there are lower probabilities of musculoskeletal disorders in these age and BMI ranges). Also, the exclusion criteria were a history of neuromuscular or skeletal disease, a history of surgery in spine and shoulder girdle areas, a history of championship or practicing sports regularly, any impairments in balance control caused by a specific disease, any obvious postural deformities and anatomical disorders, and using smartphones and tablets for more than 30 min a day (19).

Data collection was performed using demographic questionnaire, Maudsley Addiction Profile (MAP) (20) and Persian version of Leeds Dependence Questionnaire (LDQ) (21). The maximal isometric strength of flexor, extensor, and lateral flexor muscles of the neck (MVIC) was measured by a hand-held dynamometer (Model: Micro Manual Muscle Tester; North Coast Medical Inc.). Before starting the measurement, the device was calibrated using standard weights. The dynamometer was programmed for 7 s, and after placing the device on the head, the person increased the contraction force of the muscle within 2 s to reach the maximum contraction force, and then kept it in the same position for 5 s. All tests were performed once (due to the odds of encountering fatigue in repetitions and associations distorted results) and the data obtained from the strength measurement tests were normalized to the BMI of the study subjects. The neck ROM was calculated using a cervical inclinometer (Model: Baseline CROM-3 goniometer), while the subject was sitting on a chair and the chest was tied to the chair support with a tight band.

To confirm the reliability of the measurement method, 10 subjects participated in an extra four testing sessions of neck muscle strength and ROM test in 2 weeks.

Statistical analysis was done by SPSS software version 23 through Shapiro–Wilk test, correlation coefficient tests (ANOVA and Pearson) and stepwise linear regression.

The study has been approved by the Ethics Committee of the University of Social Welfare and Rehabilitation Sciences with the code of IR.USWR.REC.1398.120. This article is extracted from doctoral thesis of the first author.

TABLE 1 Substance use profile of participants.

Variables	Mean	SD
Age of substance use onset (year)	23.15	7.20
Age of continued substance use (year)	28.20	6.15
The duration of any type of substance use (year)	16.50	8.25
The duration of opium smoking (month)	110.45	31.70
Daily opium smoking time (minute)	212.35	48.45
The severity score of substance use disorder	25.20	4.35

Results

The mean ± SD age of the study participants was 39.30 ± 5.05 years and their mean BMI score was 24.29 ± 2.12 kg/m^2. 53 people were workers, 58 people were employees, and the rest were unemployed. Also, 37 people had primary education, 68 people had high school education, seven people had university education, and the rest were illiterate. The substance use profile of the study participants is available in Table 1.

The results of inter-rater and intra-rater reliability tests suggested that the measurement methods were reliable. For inter-rater reliability, the Intraclass Correlation Coefficients (ICCs) ranged from 0.6 (CI: 0.18–0.86) for measuring the range of left lateral flexion to 0.88 (CI: 0.64–0.95) for forward flexion; regarding muscle strength, ICCs ranged from 0.64 (CI: 0.22–0.91) for extension to 0.92 (CI: 0.66–0.97) for forward flexion. For intra-rater reliability, the ICCs ranged from 0.68 (CI: 0.20–0.90) for right lateral flexion to 0.94 (CI: 0.86–0.98) for extension; and in muscle strength ICCs, they ranged from 0.68 (CI: 0.20–0.89) for left lateral flexion to 0.9 (CI: 0.65–0.93) for extension.

There was no significant relationship between the onset age of permanent opium smoking and the ROM of the neck. However, a significant correlation was recorded between the opium smoking duration (months/lifetime) and daily opium smoking time (minutes/day), and the ROM of the neck in most directions (Table 2).

Furthermore, as per Table 3, the maximum contraction strength of the neck muscles were significantly and inversely correlated with the opium smoking duration (months/lifetime) and daily opium smoking duration (minutes/day).

In order to determine the most effective independent variable in decreasing the range of motion and muscles strength of neck, stepwise regression analysis was used. For this purpose, the average of the total range of motion of the neck in all six directions was calculated for each participant and considered as a unique index of the range of motion of the neck. Also, average muscle strength in four directions was used as an index of neck muscle strength in regression analysis. As shown in Table 4, opium smoking duration (month) is the first predictive variable for the possibility of decreased neck muscles strength and daily opium smoking time (minute) for decrease in neck range of motion. According to the results of the regression analysis, daily opium smoking time predicts the reduction of neck range of motion. According to these results, it predicts 10% of decreasing the range of motion of neck and the sum of the two predictive variables (daily opium smoking time and opium smoking duration) predicts 16%. 13% of the decrease in the strength of the neck muscles can be predicted by the duration of opium smoking and 17% by the sum of the opium smoking duration and daily opium smoking time.

Discussion

Perhaps in recent decades, the most serious complication and the riskiest consequence of substance use disorder is the transmission of Human Immunodeficiency Virus (HIV) and hepatitis viruses to substance users, through injection drug use. However, it is certainly not the most frequent issue, especially if we consider the harms associated with substance use disorder regionally and the most common route of substance use in that region (17). For example, in Iran, on the one hand, the use of injectable drugs was greatly reduced

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TABLE 2 Correlation coefficients of neck range of motion with the age of starting permanent opium smoking, drug dependence severity, daily opium smoking duration, and life opium smoking duration.

Variables		Correlation coefficient	*p* value
Predictor variable	Criterion variable		
Job[1]	Forward flexion ROM	0.38*	0.045
	Extension ROM	0.15	>0.05
	Right lateral flexion ROM	0.13	>0.05
	Left lateral flexion ROM	0.19	>0.05
	Right lateral rotation ROM	0.24	>0.05
	Left lateral rotation ROM	0.29	>0.05
Consumption route[1]	Forward FLEXION ROM	0.23	>0.05
	Extension ROM	0.38	>0.05
	Right lateral flexion ROM	0.17	>0.05
	Left lateral flexion ROM	0.16	>0.05
	Right lateral rotation ROM	0.31	>0.05
	Left lateral rotation ROM	0.18	>0.05
The onset age of continues and permanent opium smoking (year)	Forward flexion ROM	0.19	0.112
	Extension ROM	0.23	0.209
	Right lateral flexion ROM	0.22	0.095
	Left lateral flexion ROM	0.31	0.092
	Right lateral rotation ROM	0.33	0.117
	Left lateral rotation ROM	0.24	0.213
Total duration of substance use	Forward flexion ROM	0.11	0.296
	Extension ROM	0.32	0.098
	Right lateral flexion ROM	0.29	0.114
	Left lateral flexion ROM	0.34	0.132
	Right lateral rotation ROM	0.28	0.337
	Left lateral rotation ROM	0.36	0.105
Opium smoking duration (month)	Forward flexion ROM	−0.36	0.065
	Extension ROM	−0.63*	0.022
	Right lateral flexion ROM	−0.59**	<0.001
	Left lateral flexion ROM	−0.39	0.055
	Right lateral rotation ROM	−0.52*	0.001
	Left lateral rotation ROM	−0.43*	0.040
Daily opium smoking time (minute)	Forward flexion ROM	−0.22	0.096
	Extension ROM	−0.61**	<0.001
	Right lateral flexion ROM	−0.33	0.068
	Left lateral flexion ROM	−0.24	0.135
	Right lateral rotation ROM	−0.46*	0.040
	Left lateral rotation ROM	−0.63**	<0.001
Drug dependence severity	Forward flexion ROM	0.11	0.092
	Extension ROM	0.24	0.174
	Right lateral flexion ROM	0.27	0.090
	Left lateral flexion ROM	0.30	0.102
	Right lateral rotation ROM	0.19	0.103
	Left lateral rotation ROM	0.29	0.078

[1]The exact probability value for nominal variables was mentioned only if it was significant; otherwise, >0.05 was written.

*$p < 0.05$, **$p < 0.001$

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TABLE 3 Correlation coefficients of neck muscles strength with the age of starting permanent opium smoking, drug dependence severity, daily opium smoking duration and life opium smoking duration.

Variables		Correlation coefficient	*p* value
Predictor variable	Criterion variable		
Job	Flexor muscles strength	0.39	>0.05
	Extensor muscles strength	0.27	>0.05
	Right lateral flexor muscles strength	0.21	>0.05
	Left lateral flexor muscles strength	0.14	>0.05
Consumption route	Flexor muscles strength	0.20	>0.05
	Extensor muscles strength	0.16	>0.05
	Right lateral flexor muscles strength	0.11	>0.05
	Left lateral flexor muscles strength	0.22	>0.05
Onset age of continues drug use (year)	Flexor muscles strength	0.21	0.112
	Extensor muscles strength	0.18	0.214
	Right lateral flexor muscles strength	0.26	0.108
	Left lateral flexor muscles strength	0.24	0.091
Total duration of substance use	Flexor muscles strength	0.33*	0.038
	Extensor muscles strength	0.37*	0.049
	Right lateral flexor muscles strength	0.31	0.174
	Left lateral flexor muscles strength	0.33	0.094
Opium smoking duration (month)	Flexor muscles strength	−0.33*	0.044
	Extensor muscles strength	−0.35*	0.037
	Right lateral flexor muscles strength	−0.41*	0.046
	Left lateral flexor muscles strength	−0.39*	0.021
Daily opium smoking time (minute)	Flexor muscles strength	−0.29*	0.036
	Extensor muscles strength	−0.51*	0.007
	Right lateral flexor muscles strength	−0.33*	0.018
	Left lateral flexor muscles strength	−0.44*	0.005
Drug dependence severity	Flexor muscles strength	0.33	0.203
	Extensor muscles strength	0.24	0.088
	Right lateral flexor muscles strength	0.29	0.085
	Left lateral flexor muscles strength	0.19	0.105

*$p < 0.05$, **$p < 0.001$

by starting an opioid maintenance treatment program with agonist medications (22, 23). On the other hand, the use of smoking drugs, especially opium smoking, is traditionally and historically very common (15). Moreover, its prevalence increased due to the COVID-19 pandemic (16). Therefore, the harm of substance use disorder is no longer limited to HIV and Hepatitis contradiction. Thus, depending on the specific geographical region, the scope of harm reduction programs should be expanded. Musculoskeletal-related adverse effects of substance smoking, i.e., caused by long-term placement in non-ergonomic positions, are prevalent disorders. Subsequently, if not taken into account in prevention and harm reduction programs, such conditions can exorbitant rehabilitation costs.

Many people, depending on their habit or work needs, foster an inappropriate body position, which causes postural pains in the long term. Each individual, depending on the type of practiced physical or sports activities, is prone to certain types of mild postural abnormalities or deviations, i.e., suitable for that activity at that given time (24, 25). However, over years of repetition, these postural deviations may lead to a wide range of disorders (26). This is why disabled people who use a computer head controller have reduced neck ROM and neck muscles strength in some directions, which correlates with their head movement habits (27). Obviously, the unusual neck movements and non-ergonomic positions performed during opium smoking are related and consistent with the opium smoking duration (minutes per day) and the years of overall course of opium smoking. In this study, there was an inverse and significant correlation between the ROM and muscles strength of the neck in most directions with the increase in the duration of opium smoking. To some extent, these findings are in line with those of Ghamkhar's study. In their study, although the performance of the neck muscles did not reveal a relationship with forward head posture and even neck pain and disability (in patients with chronic neck pain), the reduction in endurance and strength of the neck muscles was associated with some postural deformities (28).

TABLE 4 Stepwise regression analysis for neck range of motion and neck muscles strength (criterion variable) based on predictor variables.

Criterion variable	Step	Predictor variable	*R*	R^2	Adjusted R^2	*β*	*p value*
Neck range of motion	1	Daily opium smoking time (minutes)	0.393	0.154	0.101	0.39	<0.001
	2	Opium smoking duration (month)	0.459	0.210	0.160	0.20	<0.001
Neck muscles strength	1	Opium smoking duration (month)	0.425	0.181	0.130	0.42	<0.001
	2	Daily opium smoking time (minutes)	0.474	0.225	0.176	0.23	<0.001

These findings are also in line with the results of studies conducted on dentists. Because dentists also work in the same harmful position for several hours a day, and the reduction of function and mobility of the neck and the strength of the neck muscles and decreasing in neck range of motion has been proven in many studies (29–31).

Posture deformities, i.e., mostly acquired and caused by non-ergonomic positions, are related to the ROM of the neck (32, 33). As per the study of Quek et al., there was a significant correlation between thoracic hyperkyphosis and forward head posture, and the ROM of the neck (34); these results are in line with those obtained in this study. A large body of literature has reported a relationship between repetitive work positions and the use of upper body and upper limbs when operating with work tools, and the occurrence of musculoskeletal disorders of the neck (35). Opium smoking tools also force the user to hold this position for several hours a day. As a result, after years, the risk of such conditions, as reduced ROM of the neck and declined strength of the neck muscles is not far from expected. In a similar way and with the same mechanism, welders and many workers in other industries suffer from reduced neck range of motion (36, 37). Decreasing in neck muscles strength due to non-ergonomic positions of opium smoking is similar to what happens in industries workers (38).

Furthermore, previous studies indicated a correlation between psychosocial characteristics and mental health confounders as well as the incidence of musculoskeletal disorders; the results of this study are in line with these prior investigations. This is because substance use disorder is among the main psychosocial health disorders in today's societies (39, 40).

Limitations and suggestions

The main limitation of this study was the lack of previous similar studies and the literature review was not very helpful. I hope this study will draw the attention of researchers and policymakers to the allocation of funds and efforts for this issue, and will make them document more convincing results with more extensive studies and with more accurate scientific and experimental methods. Another limitation of this study was that the samples were only male. Although we did not intend to do so from the beginning, we had to use only men.

Conclusion

The traditional and novel methods of opium smoking, which are used in the Persian Gulf countries, the Middle East, Central Asia, and even the countries of East Asia, and require sitting in non-ergonomic positions for long hours, have a significant correlation with neck problems and it seems to be effective in reducing muscle strength and range of motion of neck.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of the University of Social Welfare and Rehabilitation Sciences with the code of IR.USWR.REC.1398.120. This article is extracted from doctoral thesis of the OM in PhD by Research of Addiction Studies. The patients/participants provided their written informed consent to participate in this study.

Author contributions

Data gathering and data analysis were done by OM. OM, AA, AF, MN, and FH contributed to design, drafting, and writing and editing of the article. All authors contributed to the article and approved the submitted version.

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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The relationship between sleep disturbance and obsessive–compulsive symptoms: the mediation of repetitive negative thinking and the moderation of experiential avoidance

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Background: Studies have found that sleep disturbance is associated with obsessive–compulsive symptoms. This study aimed to elaborate on the mediating and moderating mechanisms between these two variables. We hypothesized that repetitive negative thinking plays a mediating role in the relationship between sleep disturbance and obsessive–compulsive symptoms, and experiential avoidance plays a moderating role.

Method: This study included 639 Chinese adults. A questionnaire survey was used to assess sleep quality, obsessive–compulsive symptoms, experiential avoidance, repetitive negative thinking, and depression symptoms. A moderated mediation model was established.

Results: After controlling for depressive symptoms, repetitive negative thinking partially mediated the positive correlation between sleep disturbance and obsessive–compulsive symptoms. This indirect relationship was significant in individuals with lower experiential avoidance levels. Particularly, the relationship between sleep disturbance and repetitive negative thinking was significant among individuals with lower experiential avoidance levels, but not among individuals with higher experiential avoidance levels.

Conclusion: This study demonstrated that repetitive negative thinking partially mediated the impact of sleep disturbance on obsessive–compulsive symptoms. The findings suggest that when providing support to individuals with sleep disturbance and obsessive–compulsive symptoms, assessing their level of experiential avoidance is necessary for performing targeted interventions. Individuals with low experiential avoidance may benefit from a clinical intervention targeting repetitive negative thinking to improve sleep quality and obsessive–compulsive symptoms.

KEYWORDS

sleep disturbance, repetitive negative thinking, obsessive-compulsive symptoms, experiential avoidance, mediation, moderation

Introduction

Sleep is a vital psychobiological process related to physical and mental health. Sleep disturbances are often accompanied by certain psychiatric disorders. A review of cross-sectional and longitudinal studies found a positive relationship between sleep difficulties and anxiety symptoms among community and clinical participants, including children and adolescents (Willis and Gregory, 2015). Notably, a number of studies have identified a significant positive association between sleep problems and obsessive–compulsive symptoms (Paterson et al., 2013; Nota and Coles, 2015; Cox and Olatunji, 2016). Eveningness gradually influenced the progress of obsessive–compulsive symptoms (OCS) to some degree in an adult clinical sample due to its impact on sleep disturbance (Cox et al., 2018a). Sleep disturbance levels were correlated with OCS, even after controlling for depression among 2071 participants in a national representative survey of English-speaking adults in the United States (Cox and Olatunji, 2016). In addition, a case study indicated that cognitive behavioral therapy with adjunctive chronotherapy was beneficial for treating OCD patients with elevated rates of delayed sleep phases (Coles and Sharkey, 2011). An intervention study with a pediatric sample demonstrated that sleep problems at baseline interfered with the effectiveness of cognitive behavior therapy in reducing OCS symptoms (Ivarsson and Skarphedinsson, 2015). Overall, this indicates that sleep disturbance may aggravate OCS and impede its recovery, where interventions for sleep disturbance may decrease OCS. However, we should notice that higher OCD symptom severity were was significantly associated with more depressive symptoms in a clinical sample, so depression needs to be controlled when examining the relationship between sleep disturbance and OCS (Browning et al., 2021).

Previous research mainly focused on exploring whether sleep disruption is related to OCS. However, the underlying mechanisms remain unclear. As sleep disturbances commonly result in dysfunctional cognitive processes, such as repetitive negative thinking (RNT; Nota and Coles, 2015; Collet et al., 2020) and OCS is associated with these cognitive processes according to a meta-analysis (Norman et al., 2019), these cognitive processes may be crucial for understanding the relationship between sleep disturbance and OCS. Therefore, this study aimed to examine the role of dysfunctional cognitive processes, namely, RNT, in the relationship between sleep disturbances and OCS. Furthermore, the condition under which sleep disturbance is related to OCS was investigated. Experiential avoidance was considered the moderator, based on its moderating effect on some mental health problems (Andrew and Dulin, 2007; Levin et al., 2018).

Mediating role of RNT

RNT refers to a sustained and abstract focus on the negative individual experiences that are difficult to restrain (Watkins, 2008). It is a cognitive emotion regulation strategy and an established transdiagnostic phenomenon associated with anxiety and mood psychopathology (Ehring and Watkins, 2008; McEvoy et al., 2010). Sleep disturbances may aggravate RNT. A cross-sectional study with 1,021 adolescents from a public school district found that sleep problems were linked to RNT, such as rumination, obsessions, and post-event processing (Stewart et al., 2020). Another cross-sectional study reported that poor sleep quality was positively correlated with worry and rumination among adolescents (Lin et al., 2019). A longitudinal study indicated that chronic sleep problems had a causal effect on RNT presented as obsessions and rumination through inhibitory control (Cox et al., 2018b). Another longitudinal study found that insomnia symptoms increased RNT through executive and emotional regulatory functions (Cox et al., 2019).

RNT was found to be associated with emotional disorders, including OCD (Ehring and Watkins, 2008), and there was a positive correlation between RNT and OCS (Arditte et al., 2016). The relationship between RNT and OCS is associated with a lack of inhibitory control (Nota et al., 2016). Impairments in inhibitory control can lead to complex cognitions and behaviors, including repetitive intrusive thoughts, repetitive negative thinking, and excessive perseverative behaviors that define OCS (Nota et al., 2016). RNT may refer to the metacognitive, and metacognitive beliefs associated with obsessive–compulsive symptoms (Wells and Papageorgiou, 1998), further suggesting the relationship between RNT and OCD. In a study with 95 OCD patients, participants who received group metacognitive therapy (MCT) improved significantly more than those who received CBT (Papageorgiou et al., 2018). In addition, deterioration rate was lower with MCT than behavioral activation (BA) for other outpatients (Schaich et al., 2023).

Therefore, sleep disturbance may impact OCS through RNT. That is, sleep disturbance may perturb the capacity to inhibit distractors for the sake of focusing on the desired stimulus, which may facilitate RNT and further confer vulnerability to OCS.

Moderating role of experiential avoidance

Although researchers have empirically established that sleep disturbance is related to various psychological symptoms, little attention has been paid to the moderators of these effects. Therefore, examining variables that may regulate the link between sleep disturbance and adverse psychological outcomes is crucial. This study, proposed that experiential avoidance is a critical moderator and investigated whether the extent of individuals' experiential avoidance caused variations in direct and indirect pathways. Experiential avoidance is characterized by an inclination to avert or inhibit personal thoughts and feelings. Experiential avoidance is a manifestation of an individual's unwillingness to accept their feelings and thoughts, causing them to attempt to avoid disliked events and thoughts.

An empirical study (Spinhoven et al., 2017) and review (Brereton and McGlinchey, 2020) demonstrated the risky role of experiential avoidance in the etiology, development, and alteration of a variety of psychopathology, including depression, worry, OCS, posttraumatic stress disorders, and self-harm. Researchers found that experiential avoidance moderated psychological distress (Pickett et al., 2011; Bardeen et al., 2013; Bardeen, 2015; Levin et al., 2018; Williams et al., 2019). Specifically, Bjornsson et al. (2010) reported that experiential avoidance moderated the relationship between rumination and depression by demonstrating that rumination was only related to depressive symptoms with high experiential avoidance. Williams et al. (2019) found that experiential avoidance regulated the relationship between behavioral inhibition system susceptibility and prolonged grief disorder. In particular, the correlation between the above two was

significant with high experiential avoidance. Additional cross-sectional and longitudinal studies reported an interaction between anxiety sensitivity and experiential avoidance by demonstrating that the correlation of anxiety sensitivity with perceived stress was significant among individuals with high experiential avoidance (Bardeen et al., 2014). As high experiential avoidance may increase the negative effect of some psychological variables on psychopathology, it may serve as an added element to the potential hazards of sleep disturbance. However, some studies reported a differential pattern of experiential avoidance's moderation effect by demonstrating a significant positive association between anxiety sensitivity and perceived stress at low, but not high, levels of experiential avoidance (Bardeen et al., 2013). Based on the above research, we speculated that the relationship between sleep disturbances and OCS via RNT would be significant among individuals with high experiential avoidance.

In summary, this study examined the mechanism underlying the relationship between sleep disturbances and OCS. Sleep disturbance was anticipated to be linked to higher levels of OCS through RNT (Hypothesis 1). We further explored whether the indirect relationship is regulated by experiential avoidance (Hypothesis 2). Specifically, mediation was expected in individuals with high experiential avoidance.

Materials and methods

Participants

Participants were recruited through social media, such as WeChat, advertisements, and online forums. The inclusion criteria were: being aged 18–75 years and having no severe mental disorders such as suicidal tendencies, and schizophrenia, or severe physical illnesses. The participants received 10 RMB as compensation. This study recruited 721 adults, of which 82 were excluded due to completing less than half of the survey. The final sample consisted of 639 participants.

TABLE 1 Sociodemographic information of the participants (N=639).

Demographic variables	
Age	24.88 (6.67)
Range	18–64
Gender	
Male	206 (32.2%)
Female	433 (67.8%)
Education level	
Below middle school	47 (7.4%)
Above college	527 (82.4%)
Above master	65 (10.2%)
Occupation	
University students	318 (49.8)
Full time job	283 (44.3%)
Other	38 (6%)
Marital status	
Single	327 (51.2%)
In relationship	312 (48.8%)

Their mean age was 24.88 years, ranging from 18 to 64 years. Most participants were female (67.8%). Demographic information is shown in Table 1.

Measurement

Obsessive compulsive inventory-revised

Distress related to the multiple dimensions of OCD was assessed using the Obsessive Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). This measure consists of six subscales: ordering, washing, hoarding, checking, obsession, and neutralizing. The validity and reliability of the scale were confirmed (Peng et al., 2011; Chasson et al., 2013; Tang et al., 2015). The Cronbach's α coefficient of the OCI-R in the current sample was 0.955, demonstrating satisfactory internal consistency reliability. A cut-off score of >20 was considered appropriate to determine OCD (Zhang et al., 2020).

Pittsburgh sleep quality index

Subjective sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI), which includes nine self-rated questions with 18 items (Buysse et al., 1989). Several dimensions are used to assess sleep quality, such as onset latency, duration, and efficiency. Each dimension adopts a 0–3 scoring system. Scores range from 0 to 21, with lower scores indicating better sleep quality. The reliability and validity of the Chinese version of the PSQI is good (Liu et al., 1996), and the internal consistency reliability was adequate in the current sample (Cronbach's $\alpha = 0.739$). A cut-off score of >7 was confirmed appropriate to determine poor sleep (Zhang et al., 2020).

Acceptance and action questionnaire – II

The Acceptance and Action Questionnaire (AAQ) was developed by Bond et al. (2011). This study utilized the second edition of the AAQ (AAQ-II). The scale contains seven items rated on a seven-point Likert scale (1 = never; 7 = always). Scores range from 7 to 49, with higher scores indicating higher experiential avoidance tendency. Cao et al. (2013) translated this scale into Chinese version and tested its validity and reliability, and the result is good. The internal consistency was good in the present sample (Cronbach's $\alpha = 0.901$).

Repetitive thinking questionnaire

The Repetitive Thinking Questionnaire comprises 10 items (McEvoy et al., 2010) modified from the Rumination Response Scale (Items 1, 3, 10), Penn State Worry Questionnaire (Items 5, 6, 8, 9), and the Post-event Processing Questionnaire-Revised (Items 2, 4, 7). Scores range from 10 to 50 (or 9–49 for the nine items). The RTQ-10 has demonstrated good reliability and validity, and the Chinese version has been validated in a sample of Taiwanese university students (Hu, 2015). The internal consistency of the present sample was good (Cronbach's $\alpha = 0.897$).

Depression subscale of the depression anxiety stress scale

The Repetitive Thinking Questionnaire comprises (DASS) is used to describe negative emotional experiences or physical reactions in the past week (Akin and Çetin, 2007), with responses rated on a four-point Likert scale (0 = Did not apply to me at all; 3 = Applied to me

very much or most of the time). This measure consists of three subscales targeting depression, anxiety, and stress. Each subscale consists of seven items. The present study used the seven items of the Depression subscale. The total score ranges from 0 to 21. The revised Chinese version has good reliability and validity (Gong et al., 2010). The internal consistency reliability was good in the current sample (Cronbach's $\alpha = 0.878$).

Ethics

The ethics committee of East China Normal University approved all procedures (No. HR1-1047-2020).

Statistical analysis

SPSS was used to analyze the data, PROCESS, a freely available SPSS computational tool (Hayes, 2013), was utilized to test the potential mediation effect of RNT and moderating role of experiential avoidance in the relationship between sleep disturbance and OCS.

The total missing values were less than 0.01%, and the information loss was less than 0.1% for each participant. Data were imputed using the average value of each scale.

The normal distribution of the data was examined using the Kolmogorov–Smirnov test, and all variables exhibited a normal distribution. Descriptive statistics for each variable were expressed as mean scores, and standard deviations. Pearson correlation coefficients were used to explore the associations among sleep disturbance, experiential avoidance, RNT, and OCS when controlling for depression.

The mediating role of RNT between sleep disturbances and OCS was examined using Model 4 of PROCESS. Bias-corrected bootstrap tests were conducted to measure the significance of the indirect effects with 95% CI. Depression was regarded as a covariate.

The moderating effect of experiential avoidance was tested using Model 59 of PROCESS. The model examined whether direct and indirect effects varied at different levels of experiential avoidance. Depression was a covariate.

Results

Descriptive statistics of the main variables

Among the participants, 35.8% of those with sleep disturbances exceeded cut-off scores. 42.1% of those with obsessive–compulsive symptoms exceeded cutoff scores.

The means and standard deviations for the study variables of interest and partial correlations are presented in Table 2. Sleep disturbance was positively correlated with RNT, experiential avoidance, and OCS. RNT was positively correlated with experiential avoidance and OCS. Experiential avoidance was positively associated with OCS.

Mediation analysis

The results indicated that sleep disturbance had a direct relationship with OCS ($\beta = 0.38$, 95% CI [0.03, 0.72]) and an indirect relationship with OCS through RNT ($\beta = 0.14$, 95% CI [0.06, 0.24]). Figure 1 presents the detailed information.

As this cross-sectional study could not reveal causal relationships, we did an explorative analysis of the relationship between RNT and OC symptoms via sleep disturbance as a reference. The results demonstrated that the mediation effect was significant. The direct association coefficient between RNT and OC symptoms was 0.34 (0.20, 0.47). The correlations between RNT and sleep disturbance was 0.06 (0.03, 0.09), and that between sleep disturbance and OC symptoms was 0.38 (0.03, 0.72). The indirect effect was 0.02 (0.0005, 0.05).

Moderate mediation analysis

The results indicated that sleep quality was positively and insignificantly correlated with OCS ($\beta = 1.03$, 95% CI [−0.13, 2.19]). Sleep quality was significantly positively correlated with RNT ($\beta = 0.93$, 95% CI [0.39, 1.47]), and the interaction term of sleep quality and experiential avoidance significantly impacted RNT ($\beta = -0.03$, 95% CI [−0.05, −0.01]). The association between sleep quality and RNT was significant with low levels of experiential avoidance (-1SD; $\beta = 0.39$, 95% CI [0.15, 0.64]) but not high (+1SD: $\beta = -0.03$, 95% CI [−0.24, 0.17]; see Figure 2).

The interaction term of sleep quality and experiential avoidance did not significantly influenced OCS ($\beta = -0.03$, 95% CI [−0.06, 0.01]). However, the association between sleep disturbance and OCS was significant with low experiential avoidance (-1SD; $\beta = 0.53$, 95% CI [0.02, 1.04]) but not high (+1SD; $\beta = 0.14$, 95% CI [−0.26, 0.54]; see Figure 3).

The product terms of RNT and experiential avoidance had no significant influence on OCS ($\beta = -0.002$, 95% CI [−0.02, 0.01]).

The conditional indirect effect was significant with low experiential avoidance (-1SD; $\beta = 0.09$, 95% CI [0.01, 0.19]) but not high (+1SD; $\beta = -0.01$, 95% CI [−0.06, 0.04]).

TABLE 2 Descriptive statistics and partial correlations between study variables after controlling for depression symptoms.

Variables	Means (SD)	Sleep disturbance	Experiential avoidance	Repetitive negative thinking
Sleep disturbance	6.86 (3.29)	1		
Experiential avoidance	26.62 (8.28)	0.22***	1	
Repetitive negative thinking	27.99 (8.52)	0.16***	0.52***	1
OC symptoms	19.60 (14.16)	0.12***	0.22***	0.21***

OC symptoms = obsessive compulsive symptoms.
***$p < 0.001$.

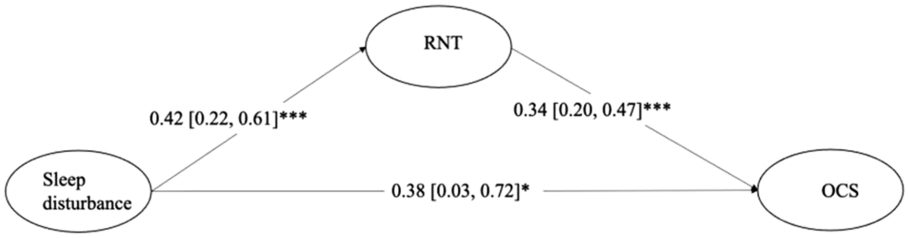

FIGURE 1
Mediation model indicating the effects of sleep disturbance on obsessive–compulsive symptoms through repetitive negative thinking. ***p<0.001, **p<0.01, *p<0.05. RNT=repetitive negative thinking. OCS=obsessive–compulsive symptoms. Depression symptoms were controlled in the analysis.

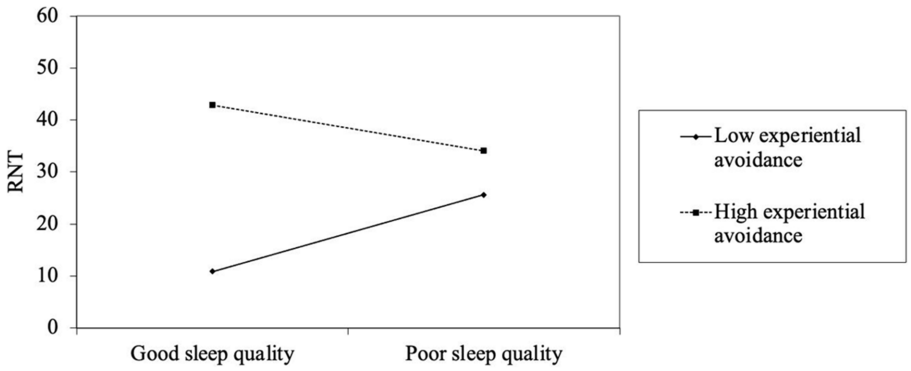

FIGURE 2
The moderating role of experiential avoidance in the relationship between sleep disturbance and repetitive negative thinking. RNT=repetitive negative thinking. Depression symptoms were controlled in the analysis.

Discussion

This study shed light on the pathogenesis through which sleep disturbance is associated with OCS by showing that RNT significantly mediated the correlation between sleep disturbance and OCS. Moreover, the indirect relationship was stronger among participants with lower experiential avoidance.

The prevalence of people who met the cutoff criteria of insomnia was comparable to that of previous studies, such as a systematic review that found that the proportion of insomnia during the COVID-19 pandemic was as high as 39.1%, with 37.0% in the early stage and 41.8% in the late stage (Li et al., 2022). The prevalence of people who met the cutoff criteria of OCD was higher than that reported by previous studies (Foa et al., 2002; Tang et al., 2015). The average score of OCI-R was higher than that of college students in China (M = 9.90, SD = 9.31; Tang et al., 2015), but was comparable to those in other studies: M = 18.82, SD = 11.10 (Foa et al., 2002) and M = 28.0, SD = 13.53 (AlHusseini et al., 2021). There are three reasons for this. First, the subjects were recruited at the end of 2020 when the COVID-19 pandemic may have an impact on the OCS in the general population. As is shown in AlHusseini et al.'s (2021) survey, 62.4% of 2,186 people 21 cutoff score in OCI-R. Second, different from Tang et al.'s (2015) study which employed college students as the subjects, most participants in our study were working people. Thirdly, our recruitment advertisement is about sleep. People with sleep disturbances may have been more willing to participate in our study, and these people may have had higher obsessive–compulsive symptoms.

Consistent with previous studies (Nota and Coles, 2015; Cox and Olatunji, 2016), sleep disturbance was directly related to OCS in this sample, even after controlling for depression. RNT mediated this relationship, supporting Hypothesis 1. A possible explanation is that poor sleep leads to a decline in the ability to restrain RNT, and excessive invasion of RNT causes vulnerabilities for the development of psychopathology, such as OCD, as demonstrated in a previous review (Leyro et al., 2010). Although researchers have suggested that sleep disruption aggravates RNT, which leads to negative psychological consequences (Nota et al., 2016), no studies have tested this hypothesis. The present findings demonstrated that sleep disturbance contributed to OCS via the transdiagnostic process of RNT. However, further prospective studies are needed to verify this. These results have considerable implications for the precautions against and therapy for OCD. Sleep could be a crucial target for treating OCD. Regaining good sleep could enhance cognitive control and consequently strengthen the ability to regulate RNT and decrease OCS. Furthermore, as the relevance of RNT for OCD, interventions, such as metacognitive therapy, targeting RNT might be helpful.

The study showed that experiential avoidance played a moderate role in the above relationship. The impact of sleep disturbance on the psychological consequences of RNT and OCS disappeared with high experiential avoidance. These results were consistent with one study (Bardeen et al., 2013) but contradicted other studies (Bjornsson et al., 2010; Pickett et al., 2011). A possible reason is that individuals who choose to avoid their inner experience appear more likely to perceive

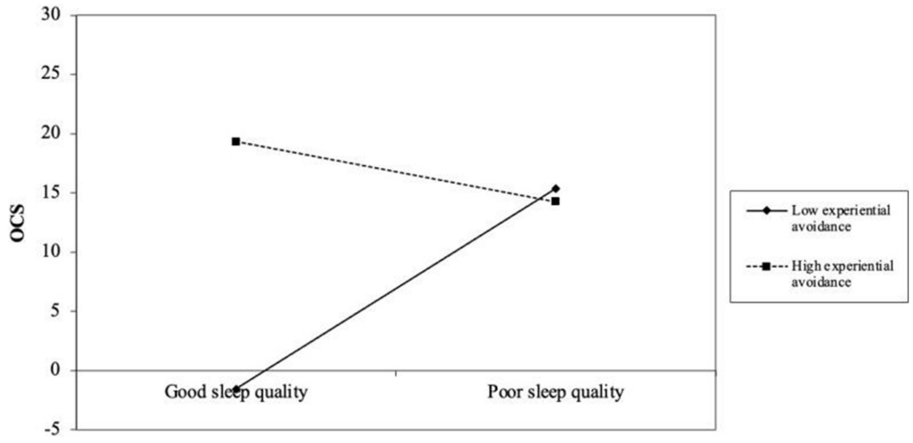

FIGURE 3
The moderating role of experiential avoidance in the relationship between sleep disturbance and obsessive–compulsive symptoms. OCS=obsessive–compulsive symptoms. Depression symptoms were controlled in the analysis.

their RNT and OCS as stressful and unbearable; thus, they may be overwhelmed by RNT and OC symptoms independent of their sleep quality. However, for those lower in experiential avoidance, the negative impacts of sleep disturbance on repetitive negative thinking and obsessive–compulsive symptoms may be evident. The results indicated a diverse pattern of the moderate effect of experiential avoidance between psychopathological variables. Although a number of studies found significant relationships among psychopathological variables under high levels of experiential avoidance (Bjornsson et al., 2010; Pickett et al., 2011), some studies indicated the opposite results. For example, Bardeen et al. (2013) found that experiential avoidance moderated the relationship between anxiety sensitivity and perceived stress, and anxiety sensitivity shared a significant positive association with perceived stress at low, but not high, levels of experiential avoidance. Pickett and Kirby (2010) demonstrated individuals with lower experiential avoidance scores exhibited a bias towards activating positive emotion inferences, which indicated the moderated role of EA in the emotional processing. As this may be the first study to examine the interactive relationship between experiential avoidance and sleep disturbances, the conclusion requires further examination, and a follow-up study is needed.

The present findings could assist in future intervention development. Sleep-related interventions may provide better responses by tailoring elements for those with low experiential avoidance among OCD patients. Among individuals with high experiential avoidance, sleep disturbance did not show a statistically significant or clinical relationship with RNT or OCS, suggesting that sleep intervention among this subpopulation may be ineffective or should be performed after their levels of experiential avoidance decrease. In contrast, significant direct and indirect effects among individuals with low experiential avoidance indicate a further need for intervention to remove the effects of sleep disturbance on RNT and OCS. Therefore, for OCD patients with varying levels of experiential avoidance, the influence of sleep disturbance on OCS differs, and intervention elements should be modified.

Furthermore, RNT mediates the sleep disturbance and OCS in people's daily life. For instance, when people have difficulty falling asleep, they often engage in repetitive negative thinking, such as, "If I cannot fall asleep right now, I will have insomnia tonight and will not have energy tomorrow." This type of thinking may result in a vicious circle and generate compulsive thinking and obsessive–compulsive behavior, which may lead to OCS and even OCD.

This study had some limitations. First, cross-sectional data were used to conduct this research; therefore, causal inferences could not be made. It remains unclear whether unhealthy sleep results in more severe OCS via RNT, as the opposite direction is possible. We did an explorative analysis of a mediation model with sleep disturbance (M) mediating the OC symptoms (Y) in relation to RNT (X), and the results showed that the mediation model is valid. Prospective studies should be longitudinal or interventional to examine causal relationships. Second, this study relied exclusively on self-reported information, which may be a limitation for evaluating symptoms through self-assessment. Further studies may benefit from observation, physiological scores aimed at anxiety, and emotion recognition scenarios based on the situation. Moreover, an objective assessment of sleep, such as polysomnography, may be valuable considering the subjective characteristics of the PSQI. Third, the present study omitted biological factors that mediate the relationship between sleep quality and OCS. Previous research has demonstrated a connection between OCS and the cortico-striato-thalamo-cortical circuit (Tang et al., 2016). The thalamus and cortex are involved in conscious awareness and closely linked to human sleep. Therefore, activity in some brain regions may regulate the connection between sleep disturbances and OCS. In addition, environmental factors, such as the COVID-19 pandemic, may be a confounding factor, which increases the risk of OCD (Wheaton et al., 2021; Kroon et al., 2022). Furthermore, the almost half of the participants were college students, and 92% had college education or higher. Therefore, these findings may not generalizable to the general population. The sample should be expanded to other educational level groups in future studies. Moreover, a non-clinical community sample was investigated in this study. Adding clinical samples in future studies would expand practical significance and enrich the clinical value of the findings. Finally, the subtypes of sleep disturbance and OCD should be further examined in future studies.

Conclusion

This study examined the mediation effect of RNT in the relationship between sleep disturbance and OCS and the moderating role of experiential avoidance in this relationship. When treating patients diagnosed with OCD who have comorbid sleep disturbance, clinical workers should evaluate and focus on experiential avoidance levels. Individuals with low experiential avoidance may benefit from clinical interventions targeting repetitive negative thinking to improve sleep quality and obsessive–compulsive symptoms.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of East China Normal University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

NZ: conceptualization, methodology, formal analysis, writing – original draft, writing – review and editing, supervision, and project administration. XZ: investigation and writing –original draft. LS: conceptualization, writing – review and editing, and supervision. YP: methodology, formal analysis, writing –review and editing, and supervision. XW: investigation, writing – review and editing, and supervision. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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Investigating the associations of the illness representations of gambling disorder with superstitious and responsible gambling

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Background: As a theoretical framework for understanding illness self-management, the commonsense model of self-regulation (CSM) has been commonly used to promote health behaviors. However, its application to examining gambling disorder (GD) is still in an exploratory stage.

Objectives: Based on CSM, the current study aimed to address this knowledge gap and test whether illness representations (i.e., perceived consequences, illness coherence, and emotional representations) of GD are associated with gambling behaviors (i.e., responsible gambling [RG] and superstitious gambling). We also aimed to explore the potential mediating role of positive gambling beliefs (i.e., personal responsibility about gambling and gambling literacy) in such associations.

Methods: An online questionnaire survey with snowballing sampling method was administered to Chinese adult past-year gamblers, and 603 valid responses were collected. The structural equation modeling (SEM) analysis with a bootstrapping approach was utilized to test the associations of illness representations with gambling behaviors and the hypothesized mediation effects of positive gambling beliefs.

Results: We found that (a) perceived consequences of GD had significant, positive associations with RG and negative associations with superstitious gambling, with positive gambling beliefs acting as full mediators; (b) emotional representations for GD showed significant, negative correlations with RG and positive ones with superstitious gambling, with positive gambling beliefs acting as full and partial mediators, respectively; (c) the direct effect of illness coherence of GD on superstitious gambling behaviors was unexpectedly positive, and its indirect effects *via* positive gambling beliefs were nonsignificant.

Discussion: Under the framework of CSM, the current findings provided new insights in understanding both controlled and at-risk gambling patterns from a perspective of illness self-management. We suggest future GD prevention campaigns may adopt psychoeducational programs to help gamblers form a better understanding about GD as an illness, which may promote RG practices and hence lower the risk of developing GD.

KEYWORDS

commonsense model, illness perception, positive gambling, superstitious gambling, gambling beliefs

Introduction

Gambling disorder (GD) is a serious behavioral addictive disorder that poses great harm to gamblers' physical and mental health, as well as their social functioning (American Psychiatric Association, 2013; Langham et al., 2015; Abbott, 2020). A variety of risk and protective factors of GD have been investigated to inform prevention efforts to mitigate the development of GD; however, the results are still inconclusive (Menchon et al., 2018). To advance the current knowledge of GD, this study aimed to apply the common-sense model of self-regulation (CSM; Diefenbach and Leventhal, 1996; Leventhal et al., 2012, 2016) to gain a better understanding of individual differences regarding engagement in responsible and superstitious gambling to provide insights for GD-prevention efforts. According to CSM, individuals are active problem solvers in dealing with ongoing or future health threats (Leventhal et al., 1998). Based on external information and internal experiences, individuals form illness representations of a given illness, which determines their subsequent cognitive, affective, and behavioral responses to the health threat (Diefenbach and Leventhal, 1996; Leventhal et al., 1998). These illness representations are some common-sense beliefs about a certain illness and include a series of aspects, such as its cause (i.e., the cause of an illness), consequences (i.e., the perceived consequences of a health threat), illness coherence (i.e., the clear and coherent comprehension of an illness), and emotional representations (i.e., emotional responses to the illness; Moss-Morris et al., 2002).

In the past, CSM has been widely applied to physical diseases to facilitate patients' health behaviors, such as treatment seeking and adherence (Hagger and Orbell, 2003), and these applications generally have shown considerable efficacy in improving individuals' self-management in the face of health threats (Brandes and Mullan, 2014). However, only one published study to date has applied CSM to GD. Dang et al. (2022) adapted the Revised-Illness Perception Questionnaire (IPQ-R) to investigate GD among Chinese adults and found that compared to the non-GD group, the probable GD group reported lower perceived consequences of GD and showed stronger negative emotional responses to GD. They also found that ever-gamblers understood GD better than never-gamblers in that they had higher levels of illness coherence of GD. Their findings generally provided evidence that illness representations of GD are associated with individuals' gambling engagement and patterns. If these associations can be replicated and extended to different patterns of gambling to improve our understanding of the underlying mechanism, then these representations may be targeted in future interventions for gambling problems. The present study hence aimed to explore the cognitive mechanisms of gambling behaviors (related to responsible gambling [RG] and superstitious gambling in our case) under the framework of CSM in a sample of Chinese adult gamblers; it tested (a) the associations between three types of illness representations of GD (i.e., perceived consequences, illness coherence, and emotional representations) and gambling behaviors, as well as (b) the potential mediation effects of positive gambling beliefs on these associations.

Associations of illness representations of GD with RG and superstitious gambling

RG behaviors, from the perspective of gamblers, refer to the practices that an individual gambler implements to minimize the personal harm caused by gambling engagement (Blaszczynski et al., 2011), which is often manifested as setting time/money limits spent on gambling (i.e., precommitment to gambling involvement) and/or being honest about and take good control of gambling behaviors (i.e., honesty and control over gambling; Wood et al., 2017; Tong et al., 2020). Previous research has shown that RG behaviors are associated with a lower risk of GD and can be regarded as a GD-prevention strategy (Wood et al., 2017; Tong et al., 2020). In contrast, gambling-related superstitions appear to be manifestations of gambling-related cognitive distortions and are linked to higher levels of gambling intensity, as well as a higher risk of problem gambling (Joukhador et al., 2004; Wu et al., 2012; Leonard et al., 2015). In particular, superstitious gambling behaviors (e.g., wearing red underwear when gambling) have been shown to be positively correlated with symptoms of problem gambling in Chinese gamblers (Ohtsuka and Chan, 2010; Wu et al., 2012), who tend to be more likely to report these behaviors than gamblers from other countries (Kim et al., 2016; Chan et al., 2019). Under the theoretical framework of CSM, illness representations of GD and their associations with these two types of gambling behaviors were explored in this study, with the hope of discovering new ways to lower gamblers' GD vulnerability and promote RG.

Gambling habits and behaviors are controllable for individuals who are not yet addicted to gambling (Currie et al., 2020). According to Dang et al.'s (Dang et al., 2022) pioneering study on illness representations of GD, people's gambling behaviors vary according to their perceptions of the consequences of GD, perceived coherence of GD, and emotional representations of GD. In particular, gamblers of high GD risks were found to perceive GD as having fewer harmful consequences than their counterparts. Previous research also suggested that perceiving an illness as having severe consequences can have positive effects on individuals' functioning and wellbeing by promoting individuals' proactive coping (Hagger and Orbell, 2021), and Dang et al.'s finding is in keeping with the notion that gamblers who perceive GD as having severe adverse consequences would try to prevent themselves from developing GD and gamble in a more controlled manner in the first place. In this study, we hence made the following hypotheses:

> *H1*a: Perceived consequences of GD is positively associated with RG behaviors.

> *H1*b: Perceived consequences of GD is negatively associated with superstitious gambling behaviors.

Despite the scarcity of research on illness representations of GD, CSM has already been used to investigate various physical illnesses (e.g., breast cancer) and mental disorders (e.g., social anxiety disorder; Costanzo et al., 2011; Dias et al., 2018). Results of a recent meta-analysis of 254 studies based on CSM showed that among patients with chronic illnesses, illness coherence was positively associated with adaptive coping, better physical functioning, and psychological wellbeing (Hagger et al., 2017). In contrast, strong negative emotional representations of an illness were linked to a higher tendency to adopt avoidance coping strategies and negative health outcomes (Hagger et al., 2017). Given that a better understanding of mental disorders has been linked to higher levels of self-efficacy among patients with mental disorders (Goyal et al., 2020), it is plausible that perceived coherence of an illness may empower individuals to constructively manage their illness condition and to adopt positive strategies in coping with the illness. Taking GD as an example, gamblers with a clearer concept of GD (i.e., a higher level of illness coherence of GD) may feel more self-efficacious over controlling their gambling *via* RG practices and be less likely to engage in superstitious gambling, which is often done in an attempt to gain a sense of control *via* external means. Hence, we made the following hypotheses:

> *H2*a: Illness coherence of GD is positively associated with RG behaviors.
>
> *H2*b: Illness coherence of GD is negatively linked to superstitious gambling.

Conversely, individuals with strong negative emotional responses to a health threat are likely to become rapidly overwhelmed by negative emotions, which would take up lot of their resources for regulation and thus emotional-focused or avoidance coping strategy instead of a problem-focused coping strategy (Leventhal et al., 2016). Therefore, gamblers with high levels of emotional representations of GD (e.g., feeling very anxious and scared of GD) may tend to avoid thinking about GD-related problems and be less driven to control their gambling. Indeed, the only study on illness representations of GD has shown that probable GD gamblers tended to report stronger emotional representations of GD than their non-GD counterparts (Dang et al., 2022). In this study, we therefore made the following hypotheses:

> *H3*a: Emotional representations of GD is associated with fewer RG behaviors.
>
> *H3*b: Emotional representations of GD is associated with more superstitious gambling behaviors.

Positive gambling beliefs as mediators

According to CSM, illness representations influence illness-related cognitions and emotions, which in turn determine one's coping strategy and behaviors in response to the health threat (Leventhal et al., 1998). Along these lines, the cognitive-behavioral theory of problem gambling deems that gambling-related cognitions (e.g., gamblers' beliefs regarding gambling outcomes) are a salient antecedent of gambling behaviors (Sharpe and Tarrier, 1993); moreover, evidence of this gambling-specific cognitive-behavioral link has been documented by an abundance of empirical research (Tang and Wu, 2012; Wu et al., 2013). For example, Goodie and Fortune (Goodie and Fortune, 2013) conducted a review and meta-analysis of studies using gambling-related beliefs scales, discovering that the effects of erroneous beliefs (e.g., illusion of control on game outcomes) on problem gambling were robust. On the other hand, accurate gambling beliefs were found to be positively associated with RG behaviors and negatively associated with GD symptoms (He et al., 2023).

According to both CSM and the cognitive-behavioral theory of problem gambling, gambling-specific cognitions (i.e., positive gambling beliefs in this study) is an antecedent of individuals' gambling behaviors. Positive gambling beliefs refer to the beliefs about gambling that reduce gamblers' risk for problem gambling (Wood et al., 2017). There are two major aspects of positive gambling beliefs, namely, personal responsibility (i.e., the belief that gamblers should take responsibility for not letting themselves fall into problem gambling) and gambling literacy (i.e., the recognition that gambling is not a way to make money and the awareness of the chance nature of gambling outcomes). If gamblers believe they are responsible for their gambling behaviors/outcomes and have an accurate understanding of the nature of games, they are more likely to gamble in a rational and responsible manner. Indeed, empirical findings have supported this premise: positive gambling beliefs have been shown to have significant, negative associations with gambling-related superstitions and positive associations with RG behaviors (Tong et al., 2020).

Research on GD illness representations and gambling-specific beliefs appears to be lacking. To our best knowledge, although CSM suggest that illness representations of GD may shape gamblers' gambling beliefs, which in turn determine their gambling behaviors, no research to date has examined the indirect effects (e.g., *via* positive gambling beliefs in our case) of GD illness representations on gambling. This study was the first to empirically test the indirect role of illness representations of GD *via* the two mediators of positive gambling beliefs (i.e., personal responsibility and gambling literacy) on both responsible and superstitious gambling behaviors in order to clarify the cognitive mechanism underlying the effects of illness representations of GD on gambling patterns.

According to CSM, the negative association between perceived consequences and symptoms of GD (Dang et al., 2022) may be attributed to the motivational effect of the illness representation (Diefenbach and Leventhal, 1996; Cameron and Moss-Moris, 2010), which may drive gamblers to not only build greater awareness of their relation to, and responsibility over, the illness, but also to acquire better knowledge about games and gambling to avoid GD development; this resultant awareness and acknowledgment, in turn, are believed to result in more RG behaviors and fewer superstitious gambling behaviors. Therefore, it is hypothesized that:

> *H4*a: Personal responsibility mediates (at least partially) the relationship between perceived consequences of GD and RG behaviors.
>
> *H4*b: Gambling literacy mediates the relationship between perceived consequences of GD and RG behaviors.

H4c: Personal responsibility mediates the relationship between perceived consequences of GD and superstitious gambling.

H4d: Gambling literacy mediates the relationship between perceived consequences of GD and superstitious gambling.

Similarly, greater overall understanding of GD, which gamblers with high levels of illness coherence of GD have, may allow them to assume responsibility for their gambling behaviors and motivate them to improve their gambling literacy. We hence hypothesized that:

H5a: Personal responsibility mediates the association between illness coherence of GD and RG behaviors.

H5b: Gambling literacy mediates the association between illness coherence of GD and RG behaviors.

H5c: Personal responsibility mediates the association between illness coherence of GD and superstitious gambling.

H5d: Gambling literacy mediates the association between illness coherence of GD and superstitious gambling.

In contrast, stronger negative emotional responses to GD may consume the cognitive resources necessary to conduct a logical and thorough analysis of their responsibility as gamblers, as well as gambling rules or strategies; as a result, negative emotional responses to GD would be expected to lead to fewer RG behaviors and more superstitious gambling behaviors. In this study, we thus made the following hypotheses:

H6a: Personal responsibility mediates the association of emotional representations of GD with RG behaviors.

H6b: Gambling literacy mediates the association of emotional representations of GD with RG behaviors.

H6c: Personal responsibility mediates the association of emotional representations of GD with superstitious gambling.

H6d: Gambling literacy mediates the association of emotional representations of GD with superstitious gambling.

Methods

Participants and procedures

An online survey was conducted from February 2022 to March 2022. Ethics approval for this study was obtained from the department of psychology at the university to which the corresponding author is affiliated. A convenience sampling method *via* snowballing was adopted to recruit eligible participants who were required to be gamblers of Chinese ethnicity, aged 18 or above, who had engaged in gambling during the past 12 months. The questionnaire was written in simplified Chinese, and participation was completely anonymous and voluntary. The desired minimum sample size is determined as 330 according to the *N*:*p* ratio of 10:1 (*N* = the number of participants, *p* = the number of measured indicator variables; Nunnally, 1967). To encourage potential participants to actively take part in the study, those who completed the online questionnaire received a small but random amount of money as a reward (1–20 RMB [approximately 0.15–2.9 USD]). After reading the aim of the study and the rights of participants, as well as providing their consent to participate, participants began completing the formal questionnaire. In the end, a total of 603 valid responses were collected and included for formal analyses after three cases were excluded because of either a specific response pattern (i.e., selecting the first option on every item of all the eight [sub]scales of the current study) or missing all the items of the two dependent variables (i.e., RG behaviors and superstitious gambling behaviors). The characteristics of this sample are summarized in the section of *Sample Characteristics and Descriptive Analyses* in the Results section.

Measures

Illness representations for GD

Three illness representations (i.e., consequences, illness coherence, and emotional representations) for GD were measured using the Chinese version of the Revised Illness Perceptions Scale for Gambling Disorder (Dang et al., 2022), which was validated among Chinese adults and showed satisfactory validity and reliability. Respondents rated agreement with items on a 5-point Likert scale (scores ranged from 1 to 5; 1 = *strongly disagree* and 5 = *strongly agree*), with higher mean scores representing higher corresponding illness representations of GD. For the 6-item consequences subscale (sample item "GD has major consequences on one's life"), Cronbach's $\alpha = 0.85$ in this study. For the 5-item illness coherence subscale (sample item "I have a clear picture or understanding of GD"), $\alpha = 0.67$. For the 5-item emotional representations subscale (sample item "You get depressed when you think about GD"), $\alpha = 0.91$ in the current study.

Positive gambling beliefs

The positive play belief subscale of the Chinese version of the Positive Play Scale (PPS) was adopted to assess positive gambling beliefs (Wood et al., 2017; Tong et al., 2020). This scale consists of two dimensions, namely "personal responsibility" (4 items; sample item "I should only gamble when I have enough money to cover all my bills first") and "gambling literacy" (3 items; sample item "Gambling is not a good way to make money"). Participants responded on a 5-point Likert scale in which 1 = *strongly disagree* and 5 = *strongly agree*, with a higher mean scale score representing a higher level of the corresponding belief. Given that previous validation studies have consistently found gambling literacy to have a relatively low α, based on their recommendations regarding this issue (Tabri et al., 2019; Tong et al., 2020), values of both Cronbach's α and McDonald's ω were computed to evaluate the reliability for the two subscales: for personal responsibility, $\alpha = 0.82$, $\omega = 0.89$; and for gambling literacy, $\alpha = 0.56$, $\omega = 0.78$, in the current study.

RG behaviors

The behavior subscale of the validated Chinese version of PPS was adopted to assess gamblers' RG behaviors (Tong et al., 2020). This scale consists of two dimensions, namely RG-honesty and control (3

items; sample item "I was honest with my family and/or friends about the amount of time I spent gambling") and RG-precommitment" (4 items; sample item "I considered the amount of money I was willing to lose before I gambled"), with both having a 5-point Likert response scale, in which 1 = *never* and 5 = *always*. A higher mean score represented a higher frequency of the corresponding type of RG behavior. For RG-honesty and control and RG-precommitment, α = 0.82 and 0.89, respectively, in our study.

Superstitious gambling behaviors

The superstition subscale of the behavior scale of the Revised Gambling Motives, Attitudes, and Behaviors Inventory (GMAB-R) was used to assess participants' superstitious gambling behaviors (Wu et al., 2012). The subscale has three items, with a sample item being, "You gather charms to enhance your chance of winning." Participants rated their agreement with these items on a 4-point Likert scale, in which 1 = *never* and 4 = always, in which higher mean scores represented higher frequencies of superstitious behaviors. For this subscale, α = 0.70 in the current study.

Demographics

Participants were asked to report their age (years), sex (male = 1, female = 2), and educational level (none = 1, primary = 2, junior high = 3, senior high = 4, undergraduate = 5, postgraduate = 6).

Statistical analysis

Descriptive statistics and reliability analyses were conducted in SPSS 26.0. SEM, including measurement model testing and structural model testing, was conducted in Mplus 8.3 to determine how the hypothesized structural model for RG behaviors and superstitious gambling behaviors fit with our collected data. The full-information maximum likelihood (FIML) estimation was applied to handle missing values (Enders, 2010). Based on potential demographic effects on gambling cognitions/behaviors (Miller and Currie, 2008; Jimenez-Murcia et al., 2020; Allami et al., 2021), the three demographic variables (sex, age, and educational level) were controlled for in the structural model tested. As suggested (Hu and Bentler, 1999), comparative fit index (CFI; acceptable >0.90), Tucker-Lewis index (TLI; acceptable >0.90), standardized root mean square residual (SRMR; acceptable <0.08), and root mean square error of approximation (RMSEA; acceptable <0.08) were adopted to evaluate the goodness of model fit. For mediation effects testing, the indirect effects of illness representations for GD, *via* positive gambling beliefs to gambling behaviors, were examined using a bootstrapping approach with 5,000 re-samples in Mplus 8.3.

Results

Sample characteristics and descriptive analyses

Our sample consisted of 603 Chinese adult past-year gamblers (54.1% males), with a mean age of 40.57 years (SD = 12.11; range = 18–72 years). Around two thirds (i.e., 68.2%) of the participants had a college education or above, whereas 28.8 and 3.0%, respectively, received secondary education and primary education or below. As shown in Table 1, our participants were quite neutral when asked about their perceived coherence and emotional representations of GD (M = 2.82 and 3.08, respectively). In general, they tended to view GD as having severe consequences (M = 4.03) and to endorse beliefs about both gambling literacy (M = 3.93) and personal responsibility (M = 4.07). In addition, they reported more RG behaviors (M = 3.54 and 3.92 in honesty and control, as well as precommitment behaviors, respectively) but fewer superstitious behaviors (M = 1.58).

Measurement model

We first evaluated the goodness-of-fit of the original measurement model: $\chi^2(467) = 1736.47$, $p < 0.001$, $CFI = 0.88$, $TLI = 0.86$, $SRMR = 0.08$, and $RMSEA = 0.07$ (*90% CI* [0.064, 0.071]). The fit was only marginally satisfactory, and thus we added four pairs of within-variable residual covariances (i.e., residual covariance between item 5 and item 6 of consequences subscale; residual covariance between item 1 and item 2 of emotional representations subscale; residual covariance between item 1 and item 2, as well as between item 3 and item 4, of RG-precommitment subscale) based on the modification indexes. This procedure improved model fit to an acceptable level: $\chi^2(463) = 1162.92$, $p < 0.001$, $CFI = 0.93$, $TLI = 0.92$, $SRMR = 0.08$, and $RMSEA = 0.05$ (*90% CI* [0.046, 0.054]). The standardized factor loadings of all indicators for latent variables were also significant. Therefore, we were able to conclude that our measurement model fit the data well and was appropriate for structural modeling. The intercorrelation coefficients of all latent variables are shown in Table 2.

Structural model

The structural model (see Figure 1) showed a good model fit, $\chi^2(544) = 1414.78$, $p < 0.001$, $CFI = 0.92$, $TLI = 0.91$, $SRMR = 0.08$, and

TABLE 1 Descriptive statistics for all measures (N = 603).

Measures	M	SD	Range
IR of GD - Consequences	4.03	0.76	1–5
IR of GD - Illness coherence	2.82	0.74	1–5
IR of GD - Emotional representations	3.08	0.92	1–5
Belief - Personal responsibility	4.07	0.79	1–5
Belief - Gambling literacy	3.93	0.76	1–5
RG-Honesty and control	3.54	1.22	1–5
RG-Precommitment	3.92	1.18	1–5
Superstitious gambling behaviors	1.58	0.61	1–4

M, mean of all items; SD, standard deviation; IR, illness representations; GD, gambling disorder; RG, responsible gambling.

RMSEA = 0.05 (*90% CI* [0.048, 0.055]). The model explained 39.9% of the variance in beliefs regarding personal responsibility, 15.9% in beliefs regarding gambling literacy, 38.6% in RG-honesty and control, 52.0% in RG-precommitment, and 24.1% in superstitious gambling behaviors.

As shown in Table 3 [(a) Total effects], the total effect of perceived consequences on the three behavioral constructs was statistically significant in the expected directions ($\beta = 0.26$ and 0.33, $p < 0.001$ for two types of RG behaviors and $\beta = -0.17$, $p = 0.002$ for superstitious behaviors), supporting *H1*a and *H1*b. However, the *H2*a and *H2*b hypotheses regarding illness coherence were not supported as both its total and direct effects on the two types of RG behaviors were nonsignificant ($p = 0.056$–0.188) while the total effect of illness coherence on superstitious behaviors was significant but positive ($\beta = 0.15$, $p = 0.017$). For emotional representations, its total effects on RG-honesty and control (but not RG-precommitment), as well as superstitious gambling behaviors, were statistically significant in the expected directions ($\beta = -0.09$, $p = 0.039$ and $\beta = 0.23$, $p < 0.001$, respectively), supporting *H3*a and *H3*b. As for the two positive gambling beliefs, belief in personal responsibility showed significant, positive associations to both perceived consequences of GD, as well as the two types of RG behaviors ($\beta = 0.37$–0.61, $p < 0.001$). Gambling literacy belief showed significant, negative links to emotional representations, as well as superstitious behaviors ($\beta = -0.21$ and -0.36, $p < 0.001$), whereas it was positively linked to perceived consequences and RG-honesty and control ($\beta = 0.31$, $p < 0.001$ and $\beta = 0.12$, $p = 0.013$ respectively). However, illness coherence of GD was not significantly associated with any positive gambling beliefs and the indirect effects of illness coherence on RG behaviors, as well as superstitious gambling behaviors, were also nonsignificant. So, *H5*a, *H5*b, *H5*c, and *H5*d lacked support from our data.

As displayed in Table 3 [(b) Mediation model], the indirect effects of perceived consequences on RG behaviors (both honesty-control and precommitment) were significant *via* beliefs about personal responsibility, with standardized indirect effect = 0.19 (*95% CI* [0.119, 0.267]), $p < 0.001$, and standardized indirect effect = 0.30 (*95% CI* [0.218, 0.400]), $p < 0.001$, respectively, supporting *H4*a. Its indirect effect on RG-honesty and control *via* gambling literacy belief was also significant, with standardized indirect effect = 0.04 (*95% CI* [0.009, 0.075]), $p = 0.026$, supporting *H4*b. However, only the indirect effect of perceived consequences on superstitious gambling behaviors *via* gambling literacy beliefs, but not personal responsibility, was significant, with standardized indirect effect = −0.11 (*95% CI* [−0.187, −0.058]), $p = 0.001$ and standardized indirect effect = −0.05 (*95% CI* [−0.127, 0.012]), $p = 0.205$, respectively, supporting *H4*d but not *H4*c. The indirect effect from emotional representations of GD to RG-honesty and control was significant (standardized indirect effect = −0.03, *95% CI* [−0.055, −0.007], $p = 0.036$), *via* gambling literacy as a full mediator, whereas the indirect effect of emotional representation on superstitious behaviors was also significant, with standardized indirect effect = 0.08 (*95% CI* [0.036, 0.133]), $p = 0.002$, *via* gambling literacy as a partial mediator. Therefore, *H6*b and *H6*d were supported. However, the *H6*a and *H6*c hypotheses regarding the indirect effect of emotional representations *via* personal responsibility belief on two types of RG behaviors and superstitious gambling behaviors (standardized indirect effect = −0.03 to 0.01, $p = 0.200$ to 0.387) were not supported.

Discussion

Using a CSM framework to examine gambling-related beliefs and behaviors, our study was the first to explore the cognitive mechanisms underlying the potential influences of illness representations of GD on gambling behaviors. The findings of the current study not only demonstrated that illness representations of GD are associated with gamblers' healthy and superstitious patterns of gambling but also revealed the mediating role of positive gambling beliefs in such associations.

As hypothesized (*H1*a and *H1*b), perceived consequences showed an overall positive effect on RG and a negative effect on superstitious

TABLE 2 Estimated correlation matrix for the latent variables (*N* =603).

Latent variables	1	2	3	4	5	6	7
1. IR of GD - Consequences	–						
2. IR of GD - Illness coherence	−0.15**	–					
3. IR of GD - Emotional representations	0.16***	−0.28***	–				
4. Belief - Personal responsibility	0.55***	−0.03	−0.03	–			
5. Belief - Gambling literacy	0.27***	0.05	−0.17***	0.27***	–		
6. RG-Honesty and control	0.33***	0.10*	−0.12*	0.54***	0.26***	–	
7. RG-Precommitment	0.39***	0.07	−0.05	0.69***	0.22***	0.75***	–
8. Superstitious gambling behaviors	−0.14**	0.10	0.17***	−0.19***	−0.42***	−0.14**	0.00

IR, illness representation; GD, gambling disorder; RG, responsible gambling. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

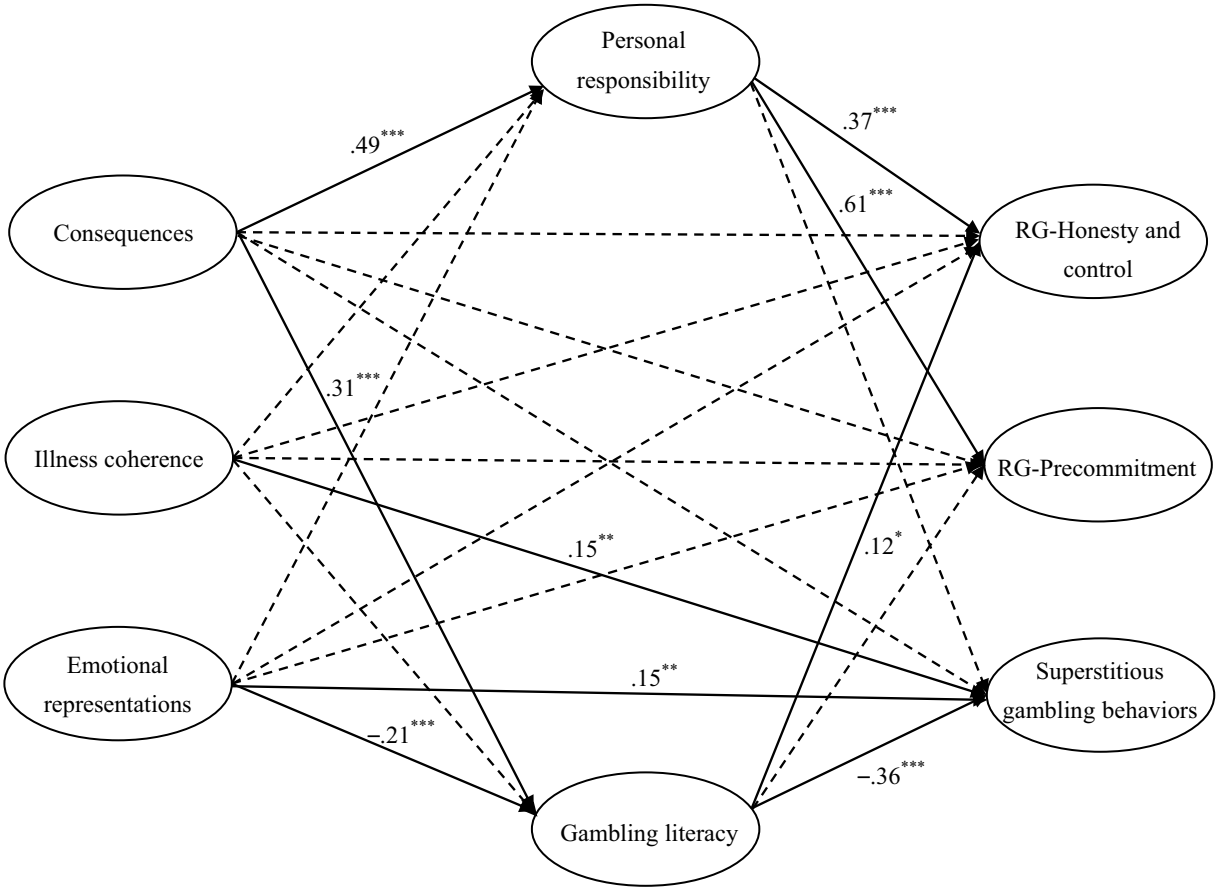

FIGURE 1
The structural model for responsible gambling behaviors and superstitious gambling. Sex, age, and educational levels were controlled for all latent variables in the model. Standardized coefficients are presented. Residuals covariance between RG-honesty and control and RG-precommitment is not shown. Coefficients of non-significant paths (dotted-line) (range from −0.06 to 0.08) are also not shown to keep the clarity of the figure. *p<0.05, **p<0.01, ***p<0.001; RG, responsible gambling.

gambling among Chinese adult gamblers. Although an early meta-analysis of 45 empirical studies utilizing CSM as a framework suggested that patients who perceived greater consequences of their illnesses were more likely to adopt avoidance coping strategies (Hagger and Orbell, 2003), more recent studies conducted among general patient populations and those with mental disorders have shown that perceived consequences of an illness were associated with higher levels of healthcare use, as well as help-seeking and active coping, respectively, with respect to physical diseases (Frostholm et al., 2005; Baines and Wittkowski, 2013; Richardson et al., 2017). The finding of this study added to the literature that this specific illness representation may be a salient factor for enhancing precautionary behaviors (e.g., controlled gambling in our case) and hindering vulnerable ones (e.g., superstitious gambling in our case) for behavioral addictions.

The results of mediation testing further revealed that perceived consequences most likely influenced those behaviors indirectly *via* promoting beliefs of positive gambling, in terms of taking self-responsibility to protect oneself from gambling-related harms and having a more accurate perception of the true nature of gambling, which is based on chance. Our corresponding hypotheses, *H4*a, *H4*b, *H4*c, and *H4*d, were all supported by SEM results, showing that the associations between perceived consequences of GD and gambling behaviors were fully mediated by positive gambling beliefs. These findings suggest that introduction or/and education about the severe consequences of GD may be considered in future programs that aim to promote RG in gamblers.

The findings of a previous systematic review supported a mild positive association of illness coherence with problem-focused coping (Richardson et al., 2017), and thus this illness representation may properly help individuals deal with the health threat. To our surprise, SEM results showed that illness coherence of GD was not significantly related to either positive gambling beliefs or RG behaviors. Furthermore, illness coherence was even found to be positively, instead of negatively, associated with superstitious gambling behaviors, although its indirect effects on responsible/superstitious gambling behaviors were found to be nonsignificant. Therefore, our testing failed to support all our hypotheses about illness coherence (i.e., *H2*a, *H2*b, *H5*a, *H5*b, *H5*c, and *H5*d). These findings are plausible because such perceptions of GD are the result of a subjective evaluation of self-knowledge about GD and thus may be susceptible to misinformation and self-serving biases. The potential discrepancy between the actual knowledge level of GD and the perceived level may explain the nonsignificant association between illness coherence of GD and positive gambling beliefs, including gambling literacy, in this study. Furthermore, given previous findings showing that the effects of illness

TABLE 3 Testing the pathways of the mediation model (N =603).

Path	Standardized effect	95% Confidence interval	
		Lower	Upper
a. Total effects			
Consequences → RG-Honesty and control	0.26***	0.173	0.352
Consequences → RG-Precommitment	0.33***	0.226	0.427
Consequences → Superstitious behaviors	−0.17**	−0.278	−0.062
Illness coherence → RG-Honesty and control	0.06	−0.031	0.153
Illness coherence → RG-Precommitment	0.07	−0.022	0.158
Illness coherence → Superstitious behaviors	0.15*	0.020	0.262
Emotional representations → RG-Honesty and control	−0.09*	−0.167	−0.004
Emotional representations → RG-Precommitment	−0.04	−0.126	0.042
Emotional representations → Superstitious behaviors	0.23***	0.126	0.323
b. Mediation model			
Direct effects			
Consequences → RG-Honesty and control	0.04	−0.069	0.152
Consequences → RG-Precommitment	0.01	−0.091	0.121
Consequences → Superstitious behaviors	−0.01	−0.133	0.127
Illness coherence → RG-Honesty and control	0.06	−0.020	0.149
Illness coherence → RG-Precommitment	0.08	−0.001	0.156
Illness coherence → Superstitious behaviors	0.15**	0.030	0.269
Emotional representations → RG-Honesty and control	−0.04	−0.121	0.044
Emotional representations → RG-Precommitment	0.00	−0.078	0.085
Emotional representations → Superstitious behaviors	0.15**	0.041	0.246
Indirect effects: Positive ambling belief - Personal responsibility as the mediator			
Consequences → Belief - Personal responsibility → RG-Honesty and control	0.19***	0.119	0.267
Consequences → Belief - Personal responsibility → RG-Precommitment	0.30***	0.218	0.400
Consequences → Belief - Personal responsibility → Superstitious behaviors	−0.05	−0.127	0.012
Illness coherence → Belief - Personal responsibility → RG-Honesty and control	0.00	−0.042	0.027
Illness coherence → Belief - Personal responsibility → RG-Precommitment	−0.01	−0.067	0.044
Illness coherence → Belief - Personal responsibility → Superstitious behaviors	0.00	−0.006	0.019
Emotional representations → Belief - Personal responsibility → RG-Honesty and control	−0.02	−0.056	0.011
Emotional representations → Belief - Personal responsibility → RG-Precommitment	−0.03	−0.086	0.019
Emotional representations → Belief - Personal responsibility → Superstitious behaviors	0.01	−0.002	0.028
Indirect effects: Positive ambling belief - Gambling literacy as the mediator			
Consequences → Belief - Gambling literacy → RG-Honesty and control	0.04*	0.009	0.075
Consequences → Belief - Gambling literacy → RG-Precommitment	0.02	−0.015	0.052
Consequences → Belief - Gambling literacy → Superstitious behaviors	−0.11***	−0.187	−0.058
Illness coherence → Belief - Gambling literacy → RG-Honesty and control	0.00	−0.010	0.022
Illness coherence → Belief - Gambling literacy → RG-Precommitment	0.00	−0.004	0.017
Illness coherence → Belief - Gambling literacy → Superstitious behaviors	−0.01	−0.052	0.035
Emotional representations → Belief - Gambling literacy → RG-Honesty and control	−0.03*	−0.055	−0.007
Emotional representations → Belief - Gambling literacy → RG-Precommitment	−0.01	−0.037	0.009
Emotional representations → Belief - Gambling literacy → Superstitious behaviors	0.08**	0.036	0.133

RG, responsible gambling. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

coherence on outcomes (e.g., role functioning and disease state) are not mediated by problem-focused coping and that the association of illness coherence with mental wellbeing is stronger when compared to its association with problem-focused coping (Hagger et al., 2017; Richardson et al., 2017), we also speculate that one's having a better and more coherent understanding of an illness may play a more prominent

role in protecting one's psychological wellbeing than it does in promoting preventive behaviors. Further research on the effects of perceived and actual illness understanding across multiple illnesses is warranted to test the aforementioned speculations. Moreover, qualitative studies may be called for to gain a clearer picture of gamblers' understanding of GD.

The negative link between emotional representations of GD and RG behaviors (*H3*a) and the positive link between emotional representations of GD and superstitious gambling (*H3*b) were supported by our SEM results. These findings are congruent with the CSM framework, which proposes that strong emotional responses to a health threat will drive individuals to avoid dealing with the threat, which results in maladaptive coping behaviors and poor health outcomes (Leventhal et al., 1998, 2012). Indeed, the impeding effects of emotional representations of physical illnesses on various health behaviors (e.g., proactive coping like medication adherence) have been consistently reported in previous empirical studies (Kucukarslan, 2012; Hagger et al., 2017; Hagger and Orbell, 2021). Specifically, this study identified gambling literacy belief as a full and partial mediator of the effect of emotional representations of GD on responsible and superstitious gambling, supporting *H6*b and *H6*d, respectively. Our findings showed that strong negative emotional responses, such as fear and anxiety regarding GD, may hinder gamblers from developing gambling literacy, which leads to lower adherence to RG practices and more irrational (e.g., superstitious) behaviors during gambling.

In contrast, gamblers with greater levels of emotional representations of GD may directly utilize superstitious gambling to regulate negative emotions related to GD because individuals often cope with such negative emotions with emotion-focused strategies (Leventhal et al., 1998); moreover, superstition can, in fact, be an emotion-focused coping *per se* (García-Montes et al., 2008; Dömötör et al., 2016). However, emotional representations of GD were not significantly linked to beliefs in personal responsibility, at least among our Chinese adult gamblers, and *H6*a and *H6*c were not supported. Future research may further test the indirect effects of illness representations of GD on RG *via* other gambling beliefs (e.g., erroneous gambling beliefs) to explore the most useful type(s) of beliefs and relevant mechanisms that may inform more cost-effective RG interventions.

Limitations

There are some limitations of this study that should be noted. First, causal relations among the psychological variables cannot be inferred based on our results, as a cross-sectional research design was adopted (Solem, 2015; Spector, 2019). We suggest that future researchers conduct a randomized control trial study to test whether enhancing gamblers' perceived consequences would result in higher levels of positive gambling beliefs and RG adherence. We also recommend using longitudinal studies to test the potential reciprocal effects between illness representations of GD and gambling-specific beliefs. Second, the convenience sampling method may limit the generalizability of our current findings to all Chinese gamblers and gamblers of other ethnicities. To test the replicability of current findings, future researchers may want to involve other ethnic populations with a probability sampling method. Third, as a self-report survey, our results might be influenced by social desirability bias (Nederhof, 1985). We recommend that future research consider collecting data, particularly those related to gambling behaviors, from multiple sources (e.g., the information provided by participants' family members or close friends) for cross-examination. Furthermore, CSM, the theoretical framework of this study, does not take individuals' actual understanding of GD (e.g., the accuracy and extent of their knowledge of GD) into account. Future studies can compare some subjective perceptions of GD (i.e., illness representations defined in the current study) with its alternative objective form for further exploration.

Implications and conclusion

Despite the aforementioned limitations, the current study has several notable theoretical and practical implications. First, we extended the application of CSM to controlled and at-risk gambling by empirically providing evidence that illness representations of GD, at least with respect to perceived consequences and emotional representations, are significantly associated with both responsible and superstitious gambling behaviors. Second, we provided some empirical support for the mediating role of gambling-specific cognitions (i.e., positive gambling beliefs in our case) on the relationship between GD representations and gambling behaviors. Such findings provide a theoretical framework for guiding future research, which may perhaps adopt a cognitive-behavioral perspective when evaluating the direct and indirect effects of different types of cognitions of GD, as well as gambling, on healthy and/or disordered gambling patterns. Third, the significant, direct effects of emotional representations of GD on superstitious behaviors suggest that superstitious gambling may serve as an emotional regulation strategy for gamblers, which provides new insights into gambling-related superstitions from an emotional perspective. Last but not least, the differential associations of personal responsibility and gambling literacy with both GD representations and gambling behaviors were revealed in our study for the first time, suggesting the necessity of further examining the potential diverse effects of individual gambling-specific beliefs across gambling behaviors in future studies.

Based on the current findings, we recommend that psychoeducation programs (e.g., in the form of educational videos; Hollingshead et al., 2019) be adopted in RG promotion campaigns in both the general public and gamblers to alter their illness representations (e.g., to heighten their awareness of the negative consequences of GD while lowering their negative responses to GD, which may be due to misunderstanding or stigma regarding people with GD) *via* providing better information about GD as a mental illness. Promoting more accurate knowledge about consequences of a disorder and weakening its negative emotion representation may also improve help-seeking (Hubbard et al., 2016; Yang et al., 2022). Moreover, future RG promotion campaigns may consider instilling positive gambling beliefs in gamblers because gambling beliefs (particularly gambling literacy) may promote gamblers' RG while hindering their superstitious gambling, which may reduce their risk of developing GD, benefiting both the wellbeing of gamblers and the society in the long run.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the research ethics committee of the Department of Psychology at the University of Macau (reference number: 2022-02). The patients/participants provided their written informed consent to participate in this study.

Author contributions

AW: conceptualization, funding acquisition, methodology, supervision, coordination, and writing – reviewing and editing. HY: conceptualization, data collection, methodology, data analysis, finding interpretation, writing – original draft, and writing – reviewing and editing. HZ, LD, and JC: writing – reviewing and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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Differences in the prevalence and clinical correlates of comorbid suicide attempts in patients with early- and late-onset major depressive disorder

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Objective: There are many studies on differences in the onset age of major depressive disorder (MDD) patients. However, study on differences in clinical correlates of suicide attempts between early- and late-onset MDD patients is limited. The aim of this study was to investigate the differences in the prevalence and clinical correlates of suicide attempts in patients with early- and late-onset MDD in China.

Methods: A total of 1718 adult outpatients with MDD were recruited. Demographic and clinical data were collected. The 17-item Hamilton Rating Scale for Depression (HAMD-17), Hamilton Anxiety Rating Scale (HAMA), Positive and Negative Syndrome Scale (PANSS) positive subscale, and Clinical Global Impression-Severity (CGI-S) Scales were used to assess their depressive, anxiety, psychotic symptoms, and the severity of the clinical symptoms, respectively.

Results: The prevalence of suicide attempts was higher in late-onset MDD patients (291/1369, 21.3%) than in early-onset MDD patients (55/349, 15.8%) (p=0.023). However after Bonferroni correction no significant difference was found in the prevalence of suicide attempts in late-onset and late-onset MDD patients (p>0.05). In both early- and late-onset groups, univariate analysis showed that the following characteristics were significantly associated with suicide attempts: HAMA, HAMD and PANSS positive subscale scores, thyroid stimulating hormone (TSH) levels, blood glucose levels, systolic blood pressure (SBP), and diastolic blood pressure (DBP). In both the early- and late-onset groups, the prevalence rates of severe anxiety disorder and psychotic symptoms were significantly higher in the suicide attempt group than in the non-suicide attempt group. In regression analysis, disease duration, TSH levels and HAMA score were independently associated with suicide attempts in the early-onset group, while TSH levels, HAMA and HAMD score were independently associated with suicide attempts in the late-onset group.

Conclusion: This study suggests that suicide attempts are not frequent in early-onset outpatients with MDD compared with late-onset, and some clinical correlates are associated with suicide attempt in early- and late-onset MDD.

KEYWORDS

MDD (major depressive disorder), suicide attempts, age at onset, prevalence, outpatients

1. Introduction

Depression is one of the most prevalent disabling illnesses in the world, with an estimated 264 million people suffering from it worldwide (1). Major depressive disorder (MDD) is one of the leading causes of disability contributing to the global burden of disease. MDD is marked by signs and symptoms such as depressed feelings that persist for more than 2 weeks and lead to emotional distress, health issues, and suicide (2). In China, depression is estimated to be the second leading cause of disability in terms of life expectancy (3). The total lifetime prevalence of depression in the Chinese population is approximately 6.9% (4).

Suicide is a serious public health problem. In recent years, the correlation between depression and suicide attempts has received significant attention. Suicide in MDD and other mood disorders might be multidimensional, including several easy treatment, perhaps with different neurobiological underpinnings. For example, homocysteine dysregulation may be associated with suicide ideation in alexithymic MDD outpatients (5). Genetics could also play an important role in affecting an individual's suicide risk (6). Preventing suicide in personalized and accurate psychiatry is needed (7). Indeed, MDD is the most common psychiatric diagnosis associated with suicide (8). Suicide imposes a heavy burden on society, with nearly 800,000 people dying by suicide each year (9). The results of a meta-analysis by Cai et al. has shown that the overall prevalence of suicidal ideation in MDD patients is 37.7% and the combined prevalence of suicidal planning is 15.1% (10). Additional data show an upward trend in suicide rates compared to the past decades (11). An understanding of the clinical and neuropsychological risk factors associated with suicidal behavior will provide the possibility to prevent such behaviors in patients with MDD in clinical practice.

Based on the time of onset, MDD patients can be classified as early-onset or late-onset groups. Whether early-onset MDD patients have a higher incidence of suicidal behavior than late-onset MDD patients remains controversial. However, early-onset MDD patients have more severe illness, psychosis, and suicidal ideation than late-onset MDD patients. For example, childhood-onset MDD is associated with a higher rate of serious cardiovascular events compared to adult-onset MDD (12). A study by Zisook et al. showed that compared to late-onset MDD, patients with early-onset MDD have a higher burden of illness, including more impaired social and occupational functioning, poorer quality of life, a more negative view of life, suicide attempts and suicidal ideation (13). Compared to early-onset patients with MDD, late-onset MDD patients were less likely to have a history of self-harm or to take psychotropic medications (14). Patients with early-onset MDD more frequently suffered from recurrent depression and were reported to have suicidal ideation compared to those with moderate-onset and late-onset MDD patients. Xiao et al. also found that early-onset MDD patients had more severe symptoms, negative views of self, suicidal ideation, and restlessness compared to late-onset MDD patients (15). In Chinese Han women with MDD, early-onset patients were associated with more suicidal ideation and attempts and higher levels of neuroticism than late-onset patients (16). However, Chan et al. found that MDD patients with an onset age older than 50 years were at higher risk for subsequent Parkinson's disease (17). In addition, a previous study by Herzog et al. showed that the outcome of antidepressant treatment for MDD patients depended on their age of onset, and early-onset patients report more often suicidal ideation compared with intermediate and late-onset MDD patients (18). Park et al. found that early-onset depression was related with chronic (recurrent and longer episode) and severe (higher lifetime suicidality) clinical features among korean adults aged 40 and older MDD (19).

Studies on differences in clinical correlates of suicide attempts between early- and late-onset MDD patients are still limited, especially in Han Chinese population. Therefore, using a large sample of first-episode, untreated Chinese MDD patients, we aimed to compare the differences in the prevalence and clinical correlates of suicide attempts between early- and late-onset MDD patients. We hypothesized that early-onset MDD patients would have a higher prevalence and more severe clinical symptoms than late-onset MDD patients.

2. Methods

2.1. Design and participants

This cross-sectional study was conducted at the First Hospital of Shanxi Medical University, Taiyuan, China during 2015–2017. The study was approved by the Ethics Committee of the hospital (No. 2016-Y27). All participants signed an informed consent form before participating in the study. Eligibility criteria included: (1) MDD diagnosed by two independent psychiatrists based on the Structured Clinical Interview for DSM-IV (SCID), (2) first episode, not receiving any medication before, (3) male or female patients aged 18–60 years, Han Chinese, (4) willing to participate in the study, and (5) able to understand the instructions of clinical psychiatrists. A total of 1796 individuals were screened. 78 patients were excluded for the following reasons: (1) severe physical illness and severe personality disorder ($n = 24$); (2) substance abuse and dependence, including alcohol consumption but not smoking ($n = 9$); (3) female patients who were pregnant or breastfeeding ($n = 10$); (4) unable to be interviewed for an acute clinical condition ($n = 5$), (5) unwillingness to provide a written consent form ($n = 21$) and other unspecified reasons (n = 9). Finally a total of 1718 outpatients were recruited from the Department of Psychiatry of this hospital.

2.2. Sociodemographic information and clinical measures

Sociodemographic information was collected for each patient, including age, gender, marital status, age at onset of MDD, duration of disease, and education level.

Clinical information included body weight and height, systolic blood pressure (SBP), and diastolic blood pressure (DBP), which were collected by trained investigators. The calculation of BMI is weight divided by the square of height. Based on previous studies, clinical experience and the age distribution of the included patients to involve a sufficient sample size of subgroups to have statistical power, 22 years was used as the MDD onset age cut-off value in this study (early onset, <22 years; late onset, ≥22 years) (20, 21).

In the present study, the symptoms of anxiety, depression, psychosis, and the severity of illness were assessed by the Hamilton Anxiety Rating Scale (HAMA), 17-item Hamilton Rating Scale for Depression (HAMD-17), Positive and Negative Syndrome Scale

(PANSS) positive subscale, and Clinical Global Impression-Severity (CGI-S), respectively. The maximum score of the HAMA is 56 with 14-point scale. The score of 18–24 is considered mild to moderate severity and 25–30 is considered as moderate to severe (22). The HAMD-17 consisted of eight items that are scored on a 5-point scale, ranging from 0 (none) to 2 (symptom-specific severity), with higher scores indicating more severe depressive symptoms (23). Psychotic symptoms were assessed by the Positive and Negative Syndrome Scale (PANSS) positive subscale. The score consists of 7 items that scored on a 7-point scale, ranging from 1 (non-existent) to 7 (extremely severe). Patients with a total positive symptom score ≥ 15 were identified as having psychotic symptoms (24).

A suicide attempt is an attempt by an individual to self-harm in some way to end his or her life. Participants were asked: "Have you ever attempted suicide in your life?" If the response was yes. He/she was categorized as a suicide attempter. Else, he/she was a non-suicide attempter. We also inquired for specific details about their suicide attempts, including the number, timing, and method of attempts, the method of the suicide attempt. If the patient could not provide a definitive answer, we performed additional interviews with family members or friends to obtain clarification of this information.

The above information was obtained from two experienced psychiatrists with special training. The internal consistency coefficients of the HAMD, HAMA and PANSS total scores were 0.85, 0.84 and 0.82, respectively.

2.3. Measurement of thyroid function, lipid profile, and fasting glucose

Biochemical indicators, including fasting blood glucose, thyroid stimulating hormone (TSH), free triiodothyronine 3 (FT3) and free thyroxine 4 (FT4), were obtained for each patient under fasting conditions (between 6 and 8 am). Serum levels of TSH, FT3 and FT4 were measured by electrochemiluminescence immunoassay (Roche Diagnostics, Indianapolis, IN, United States). The glucose oxidase method was used to test fasting blood glucose levels. Enzymatic colorimetric assay was used to test the lipid profile.

2.4. Statistical analysis category

The data were analyzed by using SPSS version 26.0. The distribution of the data was tested by Kolmogorov–Smirnov (KS) two-sample test. Normally distributed variables were compared between the two groups by ANOVA, and non-normally distributed data were compared by the Mann–Whitney U test. Chi-square tests were performed to compare the categorical variables. Bonferroni correction was used for multiple testing. Binary regression analyses were performed to explore factors independently associated with suicide attempts. In logistic regression analysis, suicide attempts in each onset age group were the dependent variable, whereas variables that differed significantly between the groups with and without suicide attempts in univariate analysis were independent variables. Area under receiver operating characteristic (AUCROC) was used to determine the ability of important variables to discriminate between early-onset and late-onset MDD patients with and without suicide attempts. A consistency statistic >0.7 was generally considered acceptable (25, 26). A two-tailed p value of 0.05 was set for significance.

3. Results

3.1. Comparison of the prevalence of suicide attempts of MDD patients in terms of age at onset

A total of 1718 patients were included in the statistics (49 patients of age < 22 years, 344 patients of age 22–29 years, 377 patients of age 30–39 years, 395 patients of age 40–49 years, and 253 patients of age > 49 years). There were 349 patients included in early-onset group (age < 22 years) and 1,369 patients included in late-onset group (age ≧ 22). Patients in the early-onset group reported fewer suicide attempts (55/349, 15.8%) than those in the late-onset group (291/1369, 21.3%; $p = 0.023$, OR = 1.443, 95% CI = 1.052–1.979). After Bonferroni correction, no significant difference was found in the suicide attempt rate ($p > 0.05$). MDD patients in the late-onset group were older, had a longer disease duration, higher SBP, higher DBP, and higher rates of married status compared to those in the early-onset group (all $p < 0.05$).

3.2. Comparison of suicide attempts In MDD patients in terms of age at onset

In both early- and late-onset groups, univariate analysis (Table 1) showed that the following characteristics were significantly associated with suicide attempts: HAMA, HAMD and PANSS positive subscale scores, TSH levels, blood glucose levels, SBP and DBP (all $p < 0.05$). In both the early- and late-onset groups, the prevalence rates of severe anxiety disorder and psychotic symptoms were significantly higher in the suicide attempt group than in the non-suicide attempt group (both $p < 0.001$). In the late-onset group, the duration of illness was significantly longer in the suicide attempt patients than in the non-suicide attempt group, however it did not remained after Bonferroni correction ($F = -2.064$, $p = 0.04$; Bonferroni corrected $p > 0.05$).

3.3. Risk factors for suicide attempts in early-onset group

Logistic regression analysis showed that in the early-onset group, the following variables were independently associated with suicide attempts: the duration of illness ($p = 0.033$, OR = 1.14, 95% CI = 1.01–1.28), TSH level ($p = 0.006$, OR = 1.29, 95% CI = 1.08–1.55) and HAMA score ($p = 0.009$, OR = 1.22, 95% CI = 1.05–1.41). In addition, the AUCROC showed the following values for each risk factor: duration of illness was 0.534, TSH was 0.763, and HAMA was 0.738. When we combined parameters with AUC values ≥0.7, we found that the combination of TSH level and HAMA score had a higher AUC value of 0.808, which could distinguish suicide attempters from non-suicide attempters in MDD patients ($p < 0.001$, 95% CI = 0.751–0.864) (Table 2; Figure 1).

TABLE 1 Differences in sample characteristics by suicide attempts and age of onset in MDD.

	Early onset (*n*=349)				Late onset (*n*=1,369)			
	With suicide attempts (*n* =55)	Without suicide attempts (*n*=294)	*F*	*P*	With suicide attempts (*n*=291)	Without suicide attempts (*n*=1,078)	*F*	*p*
Actual age, year	19 (18,20)	19 (18,20)	−1.633	0.107	38(30.5,48)	39 (29,47)	−0.716	0.474
Duration of disease, month	3.5 (2.5,6)	3.5 (2.5,5)	−1.153	0.253	6(4,9)	5.5 (3,8.75)	−2.064	0.04
Sex, *n* (%)			0.085	0.771			0.159	0.69
Male	22 (40)	127(43.2)			90 (30.93)	349 (32.37)		
Female	33 (60)	167(56.8)			201 (69.07)	729 (67.63)		
Married, *n* (%)	5 (9.1)	27(9.2)	0.001	0.983	246 (84.5)	938 (87)	1.0001	0.317
Education level, *n* (%)			0.645	0.885			5.592	0.133
1	2 (3.6)	8 (2.7)			98 (33.7)	305 (28.29)		
2	39 (70.90)	197 (67.0)			102 (35.1)	422 (39.15)		
3	13 (23.6)	81 (27.6)			68 (23.4)	287 (26.62)		
4	1 (1.8)	8 (2.7)			23 (7.9)	64 (5.94)		
TSH	6.95 (4.7,9.23)	4.14 (2.85,5.77)	−6.486	<0.001	6.71 (4.39,8.865)	4.73 (2.9,6.22)	−10.424	<0.001
BMI	23.56 (22.37,25.175)	24.13 (23.14,25.47)	0.931	0.355	24.36 (23.32,26.11)	24.25 (23.25,25.6)	0.053	0.958
T3	4.89 (0.76)	4.97 (0.72)	0.486	0.486	4.91 (0.72)	4.9 (0.7)	0.487	0.485
T4	17.19 (2.94)	16.65 (3.03)	1.489	0.223	16.58 (3.16)	16.7 (3.1)	0.506	0.477
Fating blood glucose (mmol/L)	5.67 (0.79)	5.28 (0.63)	16.73	<0.001	5.57 (0.73)	5.4 (0.6)	23.066	<0.001
SBP, mmHg	116.3 (11.28)	108.71 (8.771)	31.378	<0.001	126.0 (11.5)	120.8 (9.0)	64.311	<0.001
DBP, mmHg	72.69 (5.68)	71.5 (5.95)	16.732	<0.001	79.2 (7.8)	76.3 (6.0)	46.512	<0.001
Severe anxiety, *n* (%)	14 (25.5)	17 (5.8)	19.79	<0.001	97 (33.3)	76 (7.1)	141.012	<0.001
Exhibiting psychotic symptoms, *n* (%)	14 (25.5)	22 (7.5)	14.291	<0.001	74 (25.4)	61 (5.7)	98.556	<0.001
HAMD	32 (31,34)	30 (28,32)	−6.569	<0.001	32 (30,34)	30 (28,32)	−12.519	<0.001
HAMA	23 (21,24.5)	20 (18,22)	−6.007	<0.001	23 (21,27)	20 (18,22)	−15.691	<0.001
PANSS	7 (7,15.5)	7 (7,7)	−3.564	<0.001	8 (7,17.5)	7 (7,7)	−8.422	<0.001

Data expressed as mean ± SD, median (interquartile range), or percentage. Education degree: 1, middle school; 2, high school; 3, college; 4, graduate. TSH, thyroid stimulating hormone; BMI, body mass index; FT3, free triiodothyronine; FT4, free thyroxine; SBP, systolic blood pressure; DBP, diastolic blood pressure; HAMD, Hamilton Rating Scale for Depression; HAMA, Hamilton Anxiety Scale; PANSS, Positive and Negative Syndrome Scale.

3.4. Risk factors for suicide attempts in late-onset group

Logistic regression analysis showed that in the late-onset group, the following variables were independently associated with suicide attempts: TSH level ($p=0.001$, OR = 1.13, 95%CI = 1.06–1.23), SBP ($p=0.017$, OR = 1.02, 95%CI = 1.00–1.04), HAMD ($p=0.017$, OR = 1.09, 95%CI = 1.02–1.17) and HAMA ($p<0.001$, OR = 1.29, 95%CI = 1.22–1.38). Furthermore, the AUCROC showed the following values for each risk factor: TSH was 0.698, SBP was 0.638, HAMD was 0.724, and HAMA was 0.775. When we combined the parameters with an AUC value ≥0.7, we found that the combination of HAMD and HAMA scores had a higher AUC value of 0.784, which could distinguish suicide attempters from non-suicide attempts in MDD patients ($p<0.001$, 95% CI = 0.755–0.813) (Table 3; Figure 2).

4. Discussion

To our knowledge, this is the first study to examine differences in the prevalence of suicide attempts and associated risk factors in Chinese MDD outpatients based on their age of onset. Our main findings were: (1) no significant difference was found that the prevalence of suicide attempts in early-onset MDD patients was not higher than that in late-onset MDD patients, (2) for both early- and late-onset MDD patients, patients with comorbid suicide attempts had higher HAMD score, HAMA score, PNASS score, the incidence of psychotic symptoms, as well as higher levels of TSH and blood glucose, and higher blood pressure, (3) for early-onset MDD patients, risk factors for comorbid suicide attempts were longer disease duration, higher TSH levels and anxiety symptoms; and (4) for late-onset MDD patients, risk factors for suicide

attempts were higher TSH levels, SBP, HAMA score, and HAMD score.

Our study showed that no significant difference was found in the prevalence of suicide attempts in late-onset and early-onset MDD patients, which is inconsistent with previous studies, since most previous studies have shown that early-onset MDD is a distinct subtype with greater symptom severity and a higher incidence of suicidal ideation. For example, Xiao et al. found that MDD patients with earlier onset age (18–44 years) had greater comorbidity of suicidal ideation compared with those with later onset age (60–85 years) (15). Herzog et al. reported similar results, showing that early-onset MDD patients reported suicidal ideation more frequently compared with intermediate-onset and late-onset patients (18). The study by Sung et al. also showed that MDD patients with early-onset age (age < 18 years) had a higher prevalence of suicidal behavior and psychotic symptoms (27). Another study found higher levels of suicidal thoughts and sleep disturbances in both early-onset (<30 years) and late-onset (>50 years) MDD patients compared with those with intermediate onset (30–49.9 years) (28). Patients recruited in our study had not been previously treated with antidepressants, which may affect suicide attempt. Whereas the above studies have different inclusion criteria. Other factors, such as differences in clinical characteristics, data collection, and measurement instruments, could also explain these inconsistent results in different studies. At the same time a uniform definition is necessary for future in-depth studies on the onset of age-related diseases and mechanisms.

TABLE 2 Risk factors of suicide attempts in MDD with early onset.

	B	*W*	*D*	*p*	OR	95%CI lower	95%CI upper
Duration of disease	0.127	4.558	1	0.033	1.136	1.01	1.277
TSH	0.257	7.486	1	0.006	1.293	1.076	1.554
Fating blood glucose	0.213	0.641	1	0.423	1.237	0.735	2.084
SBP	0.016	0.518	1	0.472	1.017	0.972	1.063
HAMD	0.127	2.053	1	0.152	1.135	0.954	1.35
HAMA	0.197	6.845	1	0.009	1.218	1.051	1.411
PANSS	−0.039	0.753	1	0.386	0.962	0.881	1.05

MDD, major depressive disorder; TSH, thyroid stimulating hormone; SBP, systolic blood pressure; HAMD, Hamilton Rating Scale for Depression; HAMA, Hamilton Anxiety Scale; PANSS, Positive and Negative Syndrome Scale.

Another major finding of this study was that some clinical variables associated with suicide attempts in MDD patients were the same and some are different between early-onset and late-onset subgroups. In early-onset patients, three clinical and metabolic variables (including longer duration of illness, higher TSH levels, and HAMA score) were significantly associated with suicide attempts in MDD patients, whereas in late-onset patients, four clinical and metabolic variables, including higher TSH levels, SBP, HAMA and HAMD scores, were significantly associated with suicide attempts in MDD patients. There are many studies on risk factors for suicide attempts in MDD patients, with mixed results. For example, Fang et al. reported that total duration of disease was a risk factor for suicidal ideation in a Chinese MDD patients (29). Liang et al. indicated that a

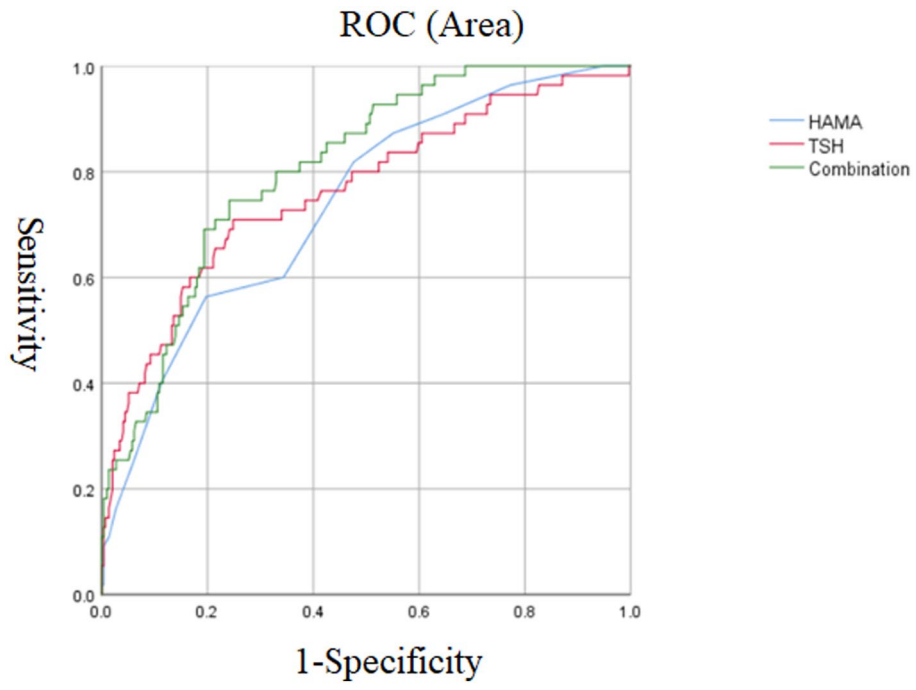

FIGURE 1
The discriminatory capacity of HAMA score, TSH and the combination of these two factors for distinguishing between patients with and without suicide attempts in early onset MDD. The area under the curve of HAMA score, TSH, and the combination of these two factors were 0.738, 0.763, and 0.808, respectively. ROC: receiver operating characteristic. HAMA: Hamilton Anxiety Scale. TSH: thyroid stimulating hormone. MDD, major depressive disorder.

higher number of depressive episodes increase the risk of suicide attempts in patients with MDD (30). A database study of 13 major psychiatric hospitals or psychiatric departments of general hospitals in China showed that previous suicide attempts and depressive episodes with melancholic features were independently associated with recent suicide attempts in patients with MDD (31). The difference of risk factors for suicide attempts in MDD patients may be due to differences in inclusion exclusion criteria, the parameters included and the statistical strategy. The finding of our study can only represent those first-episode, untreated Chinese MDD patients, and the generalization of our results to other populations requires careful interpretation.

TABLE 3 Risk factors of suicide attempts in MDD with late onset.

	B	*W*	*D*	*p*	OR	95%CI lower	95%CI upper
Duration of disease	−0.004	0.082	1	0.774	0.996	0.966	1.026
TSH	0.13	12.012	1	0.001	1.129	1.058	1.226
Fating blood glucose	−0.007	0.003	1	0.957	0.993	0.778	1.269
SBP	0.021	5.726	1	0.017	1.021	1.004	1.039
HAMD	0.086	5.724	1	0.017	1.089	1.016	1.169
HAMA	0.257	68.089	1	<0.001	1.293	1.217	1.375
PANSS	−0.03	2.355	1	0.125	97	0.934	1.008

MDD, major depressive disorder; TSH, thyroid stimulating hormone; SBP, systolic blood pressure; HAMD, Hamilton Rating Scale for Depression; HAMA, Hamilton Anxiety Scale; PANSS, Positive and Negative Syndrome Scale.

Our study is the first to compare suicide attempts in untreated and first-episode MDD patients at different ages of onset. We demonstrated that TSH was associated with suicide attempts in both subgroups, but we only found a significant association for the duration of disease in late-onset MDD patients, but not in early-onset MDD patients. We hypothesize that the longer duration of illness may be physically and mentally disruptive to patients and a cause of suicide attempts. Long-term disease or duration of untreated depression was associated with worse outcomes (32). However, this is only our speculation, and further investigation of this factor may help guide future treatment.

It is important to note some limitations of this study. Firstly, a causal relationship between suicide attempts and onset age and associated risk factors cannot be inferred, as this is a cross-sectional study design. Secondly, in this study, our MDD patients are from the clinical setting of the psychiatric outpatient clinic of a large general hospital, which may lead to selection bias and limit generalization to the broader Chinese population. In addition, the patients in our study were first-episode MDD patients who had not yet received medication, so the results may not be generalized to other MDD patients, such as inpatients or community patients. Thirdly, multiple variables that may also contribute to suicide attempts, such as environment, job, income, relationship with family members, and type of treatment, were not collected. Also, many antipsychotics can affect the incidence of suicide attempt. However we did not provide detailed information about antipsychotics (such as name, dosages and duration). Fortunately, as we only include patients of first episode MDD patients, so the results

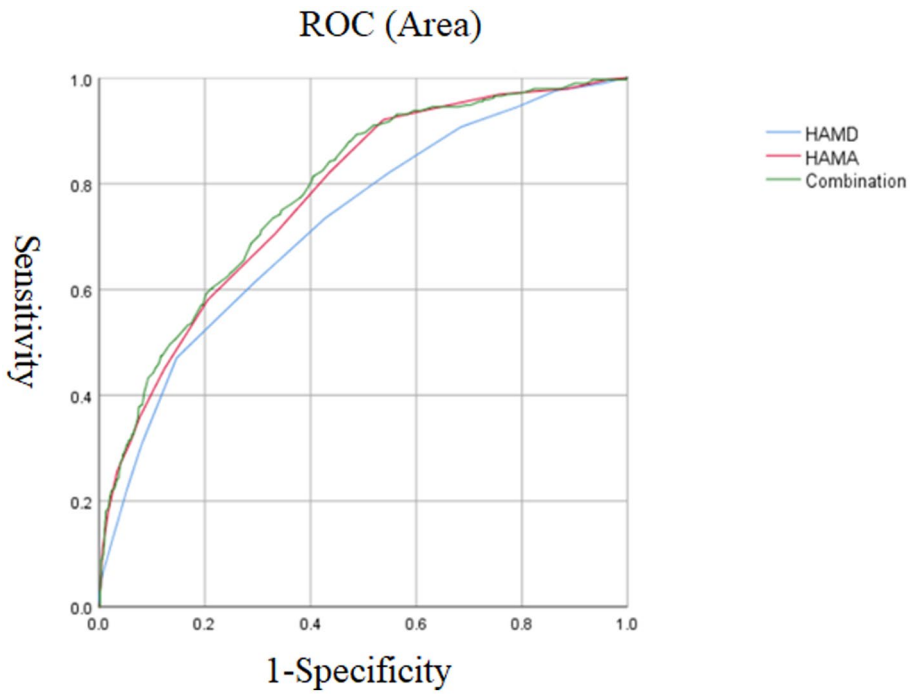

FIGURE 2
The discriminatory capacity of HAMD score, HAMA score and the combination of these two factors for distinguishing between patients with and without suicide attempts in late onset MDD. The area under the curve of HAMD score, HAMA score, and the combination of these two factors were 0.724, 0.775, and 0.784, respectively. ROC, receiver operating characteristic. HAMD, Hamilton Rating Scale for Depression. HAMA, Hamilton Anxiety Scale. MDD, major depressive disorder.

of this study may not be significantly affected. Finally, we did not adopt a structured assessment tool to define suicide attempts. In future studies, we will use more convincing tools to compensate for the methodological limitation of this study. Therefore, due to methodological limitations, our findings should be interpreted with caution.

In conclusion, the prevalence of suicide attempts was not higher in patients with early-onset MDD than in those with late-onset MDD. Considering the high rates of suicide attempts in both onset age groups, regular screening of suicide attempters and related psychoeducation should become a routine practice of outpatient care in general hospitals, with particular attention to outpatients aged ≥22 years. Further, the main findings of this study have significant clinical importance. A longitudinal observation of the TSH and HAMA in both early and late onset MDD will provide the necessary help to prevent suicide. And it is time to work on finding a well-rounded severity index for suicide of MDD, which can reflect the main symptoms accurately. Our study focused on the suicide attempts in early- and late-onset MDD in the Chinese Han population to minimize the potential confounding effects. Therefore, for the above two specific groups, our results are more likely to be accurate in clinical practice. It may be meaningful to predict the severity of suicidality in MDD at different ages of onset, and allow for the conduction of appropriate evidence-based clinical prevention or intervention. However, due to the limitations of our study, such as cross-sectional design, outpatients only, and lack of some factors possibly associated with suicide attempts, our findings should be considered preliminary, which should be confirmed in a longitudinal study with a large sample in the future.

Data availability statement

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

Ethics statement

The study was approved by the Institutional Review Board of the First Hospital of Shanxi Medical University (no. 2016-Y27). The patients/participants provided their written informed consent to participate in this study.

Author contributions

XZ designed the study. XH and YS collected the data and performed the analyses. XH wrote the first draft of the manuscript. XZ and AW provided language help and writing assistance. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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Socio-demographic and mental health correlates of internet addiction amongst Hong Kong university students under COVID-19

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Introduction: Regarding the problem of Internet addiction (IA) amongst university students under the pandemic, there are several research gaps. Firstly, few studies have examined IA of university students in Hong Kong, which is a Chinese society heavily influenced by Western values. In addition, findings on the socio-demographic correlates and psychological well-being predictors of IA in university students are unclear. Finally, researchers have not systematically examined the interaction effects of socio-demographic factors (particularly gender and personal infection of COVID-19) and psychological morbidity on IA. This pioneer study aimed to investigate the predictive role of socio-demographic factors and psychological morbidity in IA, and the moderating effects of gender and personal infection of COVID-19 on the relationship between psychological morbidity and IA.

Methods: We conducted an online survey ($N = 1{,}020$ university students) during the ending phase of Wave 5 of the pandemic in Hong Kong (late 2022 to early 2023). Socio-demographic correlates included age, gender, living status, personal and family financial situation, student status, personal and family infection of COVID-19. Participants responded to validated measures of psychological morbidity, including depression, suicidal behavior, and hopelessness. Hierarchical regression and simple slope analyses were used to examine the predictive role of socio-demographic variables and psychological morbidity in IA and the interactive effect of gender and personal infection of COVID-19 with psychological morbidity on IA.

Results: Personal financial difficulty was a significant socio-demographic predictor of IA. Depression, suicidal behavior, and hopelessness positively predicted IA. We also found a significant interaction effect of gender and psychological morbidity on IA. While the predictive relationship between depression and IA was stronger in males than in females, hopelessness was more strongly related to IA in females than in males. Finally, there was a significant interaction effect of personal infection of COVID-19 and suicidal behavior on IA.

Conclusion: Personal financial difficulty was a socio-economic correlate of IA. Psychological morbidity also predicted IA. Gender and personal infection of COVID-19 moderated the linkage between psychological morbidity and IA. The findings of the study enhance our understanding of individual differences in IA in university students during the pandemic, particularly concerning different ecological risk factors.

KEYWORDS

internet addiction, socio-demographic correlates, psychological morbidity, university students, COVID-19 pandemic, Hong Kong

1. Introduction

During COVID-19, the Internet becomes the primary source of information, entertainment, and communication. Since March 2020, nearly all modes of entertainment, social services, academic learning, and career have transitioned online (Shek, 2021). As a result, many people, particularly university students, have become increasingly dependent on Internet usage. Some students may engage in problematic and excessive use of the Internet as a coping mechanism for emotional stress from the pandemic (Tomczyk and Lizde, 2023), which may predispose them to develop Internet addiction (IA). IA refers to excessive involvement in using the Internet, leading to maladaptive behavior such as impairment of psychosocial functioning (Shek et al., 2023a, 2023b).

However, not all students using the Internet develop IA problems. There are individual differences in IA, potentially due to risk factors (i.e., factors that increase the chance of IA such as negative mental health and other developmental disorders; Sulla et al., 2023; Zhao et al., 2023), and protective factors (i.e., factors that reduce the chance of IA occurrence such as resilience; Shek et al., 2023b) in different ecological systems. In this paper, we examined socio-demographic and mental health correlates of IA in university students in Hong Kong. Although there are negative impacts of the pandemic on young people, there are few studies on university students in Hong Kong (Shek, 2021; Shek et al., 2022a, 2022b). As such, the present study examined the socio-demographic correlates (gender, age, living status, international versus local student, economic challenges, and infection of COVID-19) and psychological morbidity (depression, hopelessness, and suicidal behavior) correlates of IA in university students in Hong Kong. Identifying socio-demographic and psychological morbidity correlates of IA is important for devising appropriate prevention and intervention programs for vulnerable groups during the pandemic (Shek, 2021; Shek et al., 2023c).

1.1. Socio-demographic factors related to IA

Researchers have identified some socio-demographic correlates of IA. First, the relationship between gender and IA among students during the COVID-19 pandemic is complex. Gavurova et al. (2022) revealed significant gender difference in IA among Slovak college students ($N = 1,677$), with males showing higher levels of overall IA and its subdomains including neglect of work and social life, and lack of control. Similarly, compared to female secondary school students in Nigeria, males showed a roughly 2-fold higher likelihood of being Internet addicted (N = 851; Onukwuli et al., 2023). These findings are consistent with research prior to the pandemic indicating higher rates of IA among male students (Liang et al., 2016; Vigna-Taglianti et al., 2017). However, Mengistu et al. (2023) revealed an opposite trend by showing that only females were positively associated with problematic smartphone use during the pandemic. Besides, Shek et al. (2023a) showed that gender was not related to IA in university students during the pandemic. In short, research findings on the relationship between gender and IA during the pandemic remain unclear.

Second, research showed that age is related to IA, with younger college students being more susceptible to IA than older students during COVID-19 (Gavurova et al., 2022). Malůš and Ciencialová (2021) found that age was negatively related to both smartphone addiction and IA under COVID-19 in 988 female undergraduate students. Shek et al. (2023b) also reported that younger students showed a higher level of IA than did older students. The "Strength and Vulnerability Integration" (SAVI) model (Charles, 2010) suggested that older individuals use regulation skills like "attentional strategies, appraisals, and behaviors" (p. 2) to manage daily emotional experiences and mitigate adverse events, which can reduce their risk of IA. However, some studies have shown no association between age and IA (Chi et al., 2020; Olawade et al., 2020).

Third, studies have shown that international students exhibit more psychological problems (Chen et al., 2020; Ahorsu et al., 2021; Maleku et al., 2021) and higher IA (Kaur and Chowdhury, 2023) during the pandemic than local students, likely due to the additional challenges they face, such as cultural adjustment (Kaur and Chowdhury, 2023). However, in Hong Kong, local students were found to be more stressed, anxious, and depressed (Shek et al., 2022a, 2022b) than international students during the pandemic, possibly due to the psychological trauma of the "social event" in 2019 (Shek, 2020).

Fourth, studies showed that living alone (Achab et al., 2011; Chi et al., 2020; Savolainen et al., 2020) is a risk factor for IA during the pandemic. For example, a study on 1,477 youth in Vietnam showed that living alone was associated with a higher risk of IA (Nguyen et al., 2023). In addition, compared to those living with family or roommates, Hong Kong university students who lived alone experienced more severe stress, anxiety, and depression during the epidemic (Shek et al., 2022a), which might trigger their higher IA. This observation can probably be explained by the social support hypothesis, which suggests that living with others can provide social support that can help young people to cope with the stress of the pandemic, reducing psychological problems and problem behavior such as IA.

Fifth, studies also showed that economic challenges are related to IA. Before COVID-19, studies on the relationship between family income and IA showed inconsistent findings: while some studies have shown a positive relationship (Ak et al., 2013; Lai and Kwan, 2017), others have shown a negative relationship (Islam and Hossin, 2016; Faltýnková et al., 2020) or a U-shaped relationship (Ahmadi, 2014). Studies conducted during the pandemic seem to find a general trend indicating a negative relationship between family income and adolescents' IA or problematic computer use (Ripon et al., 2022; Sayeed et al., 2023). Additionally, financial loss and difficulty were also positively correlated with IA during the pandemic (Shek et al., 2023a).

Finally, infections of the COVID-19 in adolescents and their family members were also related to IA. Oka et al. (2021) found that

being infected with the COVID-19 virus increased an individual's risk (5.67 times greater risk) of developing Internet gaming disorder, probably because of greater stress and using the Internet as a coping. Besides, studies have shown that family members' COVID-19 infection or loss of family members because of COVID-19 (Ripon et al., 2022) had a significant association with an individual's addictive behaviors (Kamaşak et al., 2022). As infection in oneself or family members can be regarded as a traumatic event, it can be argued that infection would lead to addictive behavior such as IA among adolescents who had dysfunctional coping abilities (Brasso et al., 2022).

1.2. Psychological morbidity and IA

There are studies showing that psychological morbidity is positively related to IA. First, depression has been widely identified as a key risk factor for IA. There are several accounts of how depression is linked to IA. According to the Cognitive and Behavioral Model (CBM) of pathological Internet use, maladaptive cognitive and behavioral patterns contribute to the development of IA (Davis, 2001). Individuals with depressive symptoms may be more prone to developing IA due to cognitive distortions and biases closely related to depression, such as a ruminative cognitive style and negative self-appraisal. Besides, according to the Mood Enhancement Hypothesis (Liang et al., 2016), individuals with depression tend to engage more in leisure activities such as surfing the Internet and playing online games to deal with stress. Finally, the "Interaction of the Person-Affective-Cognition-Execution" (I-PACE) Model (Brand et al., 2016) posits that depression can impair attention, executive functioning, and decision-making, which would predispose individuals to IA.

In line with the theoretical propositions, empirical studies have shown a significant positive relationship between depressive symptoms and IA (Ali et al., 2021; Rachubińska et al., 2021; Zhao et al., 2022). Such a relationship also occurs among university students during COVID-19 (Fawaz and Samaha, 2021; Gavurova et al., 2022; Mengistu et al., 2023). With particular reference to Hong Kong, findings showed that depressive symptoms were positively related to IA among university students during the pandemic (Shek et al., 2023a, 2023b).

Another risk factor of IA during the pandemic is loss of hope (i.e., hopelessness). Hope is an important protective factor among university/college students under COVID-19 because it is an internal force that helps people to cope when facing pain and stressful events (Öztunç et al., 2013; Madani et al., 2018). Having hope is fundamental to life satisfaction (Shek, 2010) and acts as a protection from developing IA since it consists of positive thoughts regarding our future which motivates and develops our adaptive skills when encountering any stressful situations (Shek et al., 2023a). In contrast, hopelessness consists of a negative perception of the future which would intensify an individual's addictive behaviors such as IA, particularly during the pandemic which is a chronic stressor. Regarding the relationship between hopelessness and IA, there are three observations. First, there are few studies in this area particularly during the pandemic. Second, as hopelessness is a form of psychological morbidity, we can argue that hopelessness would be positively associated with IA during the pandemic. Third, there are conflicting findings on the relationship between hopelessness and IA. While studies showed that hopelessness was an antecedent of IA (Chen et al., 2021), Yu and Shek (2018) found that IA was a predictor of hopelessness, not a consequence of IA over time.

Suicidal behavior is also a form of psychological morbidity closely related to IA. Existing studies have shown a significant correlation between IA and suicidal ideation where IA is regarded as a potent risk factor for suicidal behavior (Steinbüchel et al., 2018; Arrivillaga et al., 2020). Several studies indicated that students with IA experience more culturally defined failures in their real lives (Yee, 2006), such as lower academic achievements, which make them more prone to engaging in suicidal behavior (Platt et al., 2013). Besides, students with IA are more likely to access harmful information and develop suicidal thoughts (Baker and Fortune, 2008; Biddle et al., 2008). However, limited studies have focused on the relationship between IA and suicidal behavior among Hong Kong university students. In addition, fewer studies have examined the predictive role of suicidal ideation in IA, where those who are suicidal may turn to IA to cope with the pain.

1.3. Interaction effects of socio-demographic factors and psychological morbidity

Regarding gender differences in IA, the basic picture is that men have significantly higher rates of IA than women (Anand et al., 2018; Onukwuli et al., 2023), although there are minor exceptions (Yang et al., 2021). Obviously, it is important to ask whether gender would interact with other factors to shape IA. Theoretically, the I-PACE model (Brand et al., 2019) highlights the moderating role of gender in the development of IA. This model contends that the emergence of addictive behaviors results from the interaction of personal core characteristics (e.g., gender) and internal and/or external stressors (e.g., the COVID-19 pandemic). Therefore, gender may interact with psychological morbidity as an internal stressor to trigger IA.

Empirically, some studies showed that gender moderated the relationship between psychological issues and IA, with a stronger relationship between these constructs found in males than females. According to Liang et al. (2016), there are gender variations in the causal link between depression and IA among Chinese adolescent students ($N = 1{,}715$) where depression did only significantly predict IA in male adolescents but did not in female adolescents. Likewise, Li et al. (2021) revealed that the interaction of gender and well-being significantly predicted smartphone addiction in adolescents. Compared with boys, girls' smartphone addiction scores decreased more when there was an improvement in well-being. However, some studies did not show a significant interaction effect of gender and depressive symptoms on IA (Masaeli and Farhadi, 2021; Son et al., 2021; Liu and Lu, 2022). Hence, there is a need to further explore the interaction effect of gender and psychological morbidity (such as depression, hopelessness, and suicidal behavior) on IA.

1.4. Personal infection of COVID-19 as a moderator of the relationship between psychological morbidity and IA

A review of the literature (Oka et al., 2021; Sultana et al., 2021) shows that there are limited studies on the moderating role of personal

infection of COVID-19 on the relationship between psychological morbidity and IA. Logically speaking, it can be reasoned that infection of COVID-19 would intensify the relationship between psychological morbidity and IA because of the stressful nature of COVID-19. Based on the Compensation Theory of IA, individuals may use the Internet excessively to reduce negative emotions caused by negative life events in their lives (Kardefelt-Winther, 2014). Wang et al. (2015) applied the theory to examine the moderating effect of stress on the association between escapism and problematic smartphone use in university students. There are also studies on the significant association between adolescents' stress and problematic behavior (Liu et al., 2005; Xing et al., 2010). Studies on the mental health of COVID-19-infected individuals highlighted that the infection was a significant factor contributing to mental distress (Mazza et al., 2020; Ochnik et al., 2021; Sultana et al., 2021). These findings indicate that infection with COVID-19 would be a significant stressor for university students. As both the I-PACE model and the Compensation Theory of IA emphasize the influence of the interaction between individuals' mental status (internal stressors) and stressful life events (external stressors) on the development of IA, infection with COVID-19 may interact with psychological morbidity to predict IA.

1.5. The present study

To address the research gaps identified in the above literature review, this study aimed to investigate the predictive role of socio-demographic factors and psychological morbidity in IA, and the moderating effects of gender and personal infection of COVID-19 on the relationship between psychological morbidity and IA. we framed several research questions in this study as follows:

Research Question 1: What are the socio-demographic correlates of IA in university students under COVID-19? Particularly, with reference to financial difficulty, we hypothesized a positive relationship between financial difficulty and IA (Hypothesis 1).

Research Question 2: What is the relationship between psychological morbidity and IA? We hypothesized a positive relationship between psychological morbidity and IA (Hypothesis 2).

Research Question 3: What is the interactive effect between gender and psychological morbidity on IA? We hypothesized that gender would moderate the association between psychological morbidity and IA (Hypothesis 3).

Research Question 4: What is the interactive effect between infection with COVID-19 and psychological morbidity on IA? We proposed that infection with COVID-19 would intensify the association between psychological morbidity and IA (Hypothesis 4).

2. Methods

2.1. Participants and procedure

We conducted an online survey during the ending phase of the fifth wave of the pandemic in Hong Kong (i.e., from late 2022 to early 2023) to collect data from first-year undergraduates at a university. During this period, the pandemic in Hong Kong was in its early stages of recovery (Bala, 2023). The Government of the Hong Kong Special Administrative Region (2022) had adjusted its local epidemic prevention policy to allow citizens to gradually resume normal life. It has also announced policies to promote economic recovery after the pandemic and incentive measures to support businesses and residents. Along with the mitigation of the pandemic, the university resumed face-to-face teaching and learning in September 2022, requiring undergraduate students to attend all courses on campus.

Quota sampling was employed, with faculty as the stratifying factor. For participant recruitment, part-time student helpers were recruited from undergraduate students in different faculties to invite first-year students to participate in the study through different means such as email, personal contacts, and peer recommendation. Initially, 1,043 first-year students completed the online survey questionnaire. Among these, 23 students did not pass the "attention checking" test designed to improve the data validity of the online survey (Aust et al., 2013). This test gauged respondent conscientiousness by instructing them to select a specified option (e.g., "This is an attention check, please choose 'strongly agree'"). Following this, we had a total of 1,020 valid questionnaires. The questionnaire was conducted in English, which is the primary medium of instruction at this institution. Prior to their participation, students were informed about the study purpose, confidentiality, anonymity, and the voluntary nature of their participation. Students were given the option to withdraw their participation at any time during or prior to the completion of the questionnaire. We offered a supermarket coupon (HK$100 ≈ US$12.74) to each participant who completed the survey. The institutional review board of the University granted ethical approval for this study.

2.2. Measure

2.2.1. Internet addiction (IAT-10)

We employed the Chinese version of "Young's 10-item Internet Addiction Test (IAT-10)," which was developed based on the original English version (Young, 1998), to assess the presence of IA among student participants. The IAT-10 consists of ten items that measure addictive symptoms related to Internet use, such as preoccupation with the Internet, loss of control over Internet use, and negative consequences of Internet use. The students needed to indicate whether they had experienced the ten listed symptoms in the past year using a binary reporting scale ("Yes" or "No"). A sample item is "*Do you feel a need to spend more and more time online to achieve satisfaction?*" This scale has demonstrated adequate psychometric properties in previous research (Shek et al., 2008) and has been widely used in the population of adolescents (Fioravanti et al., 2013) and college students (Samaha et al., 2018; Shek et al., 2023a). The scale also showed good internal consistency with Cronbach's alpha = 0.83 and mean inter-item correlation = 0.32 (see Table 1) in the present investigation.

2.2.2. Depression (CESD-R)

The "Centre for Epidemiologic Studies Depression Scale Revised (CESD-R)" was utilized as a self-report measure to assess depression. CESD-R is a 20-item measure originally developed by Radloff (1977) and subsequently revised by Eaton et al. (2004), which evaluates the symptoms of major depressive disorder as specified in the fifth edition of the "Diagnostic and Statistical Manual of Mental Disorders" (DSM-V) criteria. Respondents were instructed to indicate how frequently they experienced each symptom in the past week on a scale

TABLE 1 Descriptive analysis of variables.

	Mean	Std. Deviation	Cronbach's α	Mean inter-item correlation
Internet addiction (IA)	0.360	0.291	0.826	0.321
Depression (CESD-R)	0.763	0.642	0.947	0.477
Suicidal behavior (SB)	0.090	0.208	0.597	0.409
Hopelessness (HL)	3.125	0.959	0.867	0.565

of five points, ranging from "0 = Not at all or less than 1 day" to "4 = nearly every day for the last 2 weeks." A sample item is "*I lost interest in my usual activities.*" The composite score was the sum of all item scores. The CESD-R has revealed desirable psychometric properties in various cultural contexts, including the Chinese context (e.g., Ip et al., 2016; Dou et al., 2021; Zhu et al., 2021). In this study, the internal consistency of the CESD-R was high, with Cronbach's alpha being 0.95 and mean inter-item correlation being 0.48 (see Table 1).

2.2.3. Suicidal behavior

The Suicidal Behavior Scale (SB) was used to measure suicidal behavior (Shek and Yu, 2012), which consists of three items, namely "suicidal thoughts," "suicidal plans," and "suicidal attempts." Respondents were required to indicate their experience of the aforementioned items during the past year by answering on a binary scale ("Yes" or "No"). A sample item is "*In the past year, have you ever had suicidal thoughts?*" The reliability of SB has been established in previous research (Shek and Yu, 2012; Law and Shek, 2013). In the present study, Cronbach's alpha for the three items was 0.60 (see Table 1). The relatively lower alpha value may be due to the small number of items (3 items) in this measure (Streiner, 2003). However, different research reported different acceptable values of Cronbach's α for a scale, ranging from 0.61 to 0.95 (Bland and Altman, 1997). So, the Cronbach's α value of 0.60 is close to the acceptable value and the scale could be regarded as internally consistent. In addition, three items were positively correlated with each other with the mean inter-item correlation = 0.41, slightly greater than the ideal interval of 0.2–0.4, suggesting that while the items are reasonably homogeneous and measure the same construct, they do contain sufficiently unique variance that they cannot be isomorphic to each other (Piedmont, 2014).

2.2.4. Hopelessness (C-HOPE)

The level of hopelessness in university students was assessed by the modified Chinese version of the "Hopelessness Scale" (C-HOPE; Shek, 1993) which showed good psychometric properties (Kwok and Shek, 2010; Shek and Li, 2016; Zhou et al., 2020). The respondents were asked to indicate to what degree they agree with each item using a six-point rating scale, ranging from "1 (strongly disagree)" to "6 (strongly agree)." A sample item is "*I could foresee that my future is miserable.*" Reliability analysis showed that the scale is internally consistent (Cronbach's alpha = 0.87 and mean inter-item correlation = 0.57, see Table 1) in the present investigation.

2.2.5. Socio-demographic variables

We collected socio-demographic data from the respondents, including age (continuous values), gender (male vs. female), student status (local vs. international), living status (living with family and roommates vs. living alone), "Comprehensive Social Security Assistance (CSSA) Scheme" status (receive vs. not receive), family financial difficulty (yes vs. no), personal financial difficulty (yes vs. no), family member(s) unemployment (yes vs. no), personal infection with COVID-19 (yes vs. no), and family infection with COVID-19 (yes vs. no).

2.3. Data analysis strategy

We utilized SPSS 26.0 for data analysis. Descriptive analyses were first performed which included the socio-demographic characteristics of the sample and descriptive statistics of all major variables (mean scores, standard deviation, Cronbach's alpha and mean inter-item correlation). We also conducted correlation analyses to examine the inter-correlations among all related variables. To examine the predictive role of socio-demographic variables and psychological morbidity in IA and the interactive effect of gender and personal infection with COVID-19 on psychological morbidity in IA, hierarchical regression analyses were conducted with socio-demographic variables included in the model in the first step, psychological morbidity variables included in the second step and interaction between gender, personal infection with COVID-19 and psychological morbidity entered in the model in the third step. Finally, to further explore the significant interaction effects, simple slope analyses were performed.

3. Results

Table 2 shows the socio-demographic characteristics of the sample participants. The mean age of the participants was 18.7 years (SD = 1.46), and around half of the participants were female (50.7%). The majority of the participants were local students (84.1%), and most were living with their family (84.0%). A small proportion of the students were living with their roommates (14.6%) or living alone (1.4%). Besides, most of the students were not recipients of CSSA (88.4%), which is a government financial subsidy for low-income Hong Kong residents. Regarding the financial difficulty during the COVID-19 pandemic, 18.0% and 24.3% of the students reported experiencing family and personal financial difficulty, respectively. A small proportion of students had unemployed family members during the pandemic (14.2%). Around half of the students were infected with COVID-19 (46.6%) or had infected family member(s) (58.8%).

The correlations amongst all the variables were shown in Table 3. Results showed that the four major variables (IA, CESD-R, HL and SB) were positively correlated with each other ($rs = 0.18–0.47$, $ps < 0.01$). In addition, the four major variables were correlated with

TABLE 2 Socio-demographic characteristics of the sample.

	N	%
Gender of the participant		
Male	451	44.2%
Female	517	50.7%
Local or international student		
Local student	858	84.1%
International student	162	15.9%
Living status during COVID-19		
Live with family	857	84.0%
Live with roommates	149	14.6%
Live alone	14	1.4%
Recipient of CSSA		
No	902	88.4%
Yes	40	3.9%
Family financial difficulty		
No	684	67.1%
Yes	184	18.0%
Personal financial difficulty		
No	682	66.9%
Yes	248	24.3%
Family member(s) unemployed during COVID-19		
No	810	79.4%
Yes	145	14.2%
Personal infection of virus		
No	508	49.8%
Yes	475	46.6%
Family member(s) infection of virus		
No	369	36.2%
Yes	600	58.8%
	Mean	SD
Age	18.7	1.46

some of the socio-demographic variables. Particularly, the four major variables were all positively correlated with family and personal financial difficulty ($rs = 0.09–0.19$, $ps < 0.05$ and $ps < 0.01$). IA and CESD-R were also positively correlated with family member(s) being unemployed ($rs = 0.09–0.10$, $ps < 0.05$).

Hierarchical multiple regression analyses were performed to examine the predictive effect of the socio-demographic variables, the three psychological morbidity variables (CESD-R, SB and HL), and the interaction between socio-demographic variables (i.e., gender and personal infection of COVID-19) and psychological morbidity on IA (see Table 4). In the first step, the socio-demographic variables were put in the model as independent variables. Among all the socio-demographic variables, only personal financial difficulty significantly predicted IA ($\beta = 0.13$, $p < 0.01$). Therefore, Hypothesis 1 was supported. In the second step, all three variables of psychological morbidity (CESD-R, HL, SB) were put in the model as predictors. The three psychological morbidity variables all significantly and positively predicted IA ($\beta = 0.09–0.26$, $p < 0.001$ and $p < 0.05$), which supported Hypothesis 2. In the third step, the interaction between the two demographic variables (gender and the personal infection of COVID-19) and the three psychological morbidity variables (CESD-R, SB and HL) were analyzed, respectively. For the moderating role of gender, gender negatively moderated the association between CESD-R and IA ($\beta = -0.30$, $p < 0.05$), with the association being stronger in male students than in female students. In contrast, gender positively moderated the association between HL and IA ($\beta = 0.31$, $p = 0.01$), with the association being stronger in female students than in male students. Besides, there was no moderating effect of gender on the association between SB and IA. Therefore, Hypothesis 3 was partially supported. For the moderating effect of personal infection of COVID-19, it positively moderated the association between SB and IA ($\beta = 0.13$, $p < 0.01$) but did not moderate the association between the two other psychological morbidities and IA. Hypothesis 4 was partially supported.

Table 5 shows the simple slope analyses on the above significant interaction effects. First, for the regression of IA on CESD-R, male students ($\beta = 0.45$, $p < 0.001$) had a higher regression coefficient than did female students ($\beta = 0.35$, $p < 0.001$). Figure 1 illustrates the moderating effect graphically. Second, for the regression of IA on HL, female students ($\beta = 0.23$, $p < 0.001$) had a higher regression coefficient than did male students ($\beta = 0.22$, $p < 0.001$). Figure 2 graphically illustrates this moderating effect. Third, for the regression of IA on SB, simple slope analyses showed that the regression coefficient of the relationship was higher among students who were previously infected with the virus ($\beta = 0.39$, $p < 0.001$) than students who were not ($\beta = 0.23$, $p < 0.001$). Figure 3 graphically illustrates this moderating effect.

4. Discussion

This study examined the association between socio-demographic factors, psychological morbidity and IA in university students in Hong Kong during the pandemic. The study is significant in several aspects. First, there are limited studies examining socio-demographic factors and psychological morbidity as predictors of IA in university students during the COVID-19 pandemic, particularly in the context of Hong Kong which is very densely populated with both Chinese and Western cultural influences. Second, the study promotes our understanding of the role of socio-demographic factors in IA during the pandemic, particularly the relevance of personal infection and financial difficulty. Third, consistent with existing studies, the present study reiterated the crucial role of psychological morbidity as a risk factor for IA. Finally, this study contributes to our understanding of the interaction effects of some socio-demographic factors (i.e., gender and infection of COVID-19) and some psychological morbidity conditions during the COVID-19 pandemic on IA. The present findings are important for understanding individual differences in IA because there are very few studies looking at the interaction of different ecological factors on IA.

Existing literature highlights individual differences in IA. Particularly, the literature indicates the prevalence and severity of IA differ in individuals with different socio-demographic characteristics (e.g., Chi et al., 2020; Gavurova et al., 2022) and psychological morbidity (e.g., Arrivillaga et al., 2020; Fawaz and Samaha, 2021). While research studies suggest that university students

TABLE 3 Correlation analysis.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. IA	-												
2. CESD-R	0.381**	-											
3. HL	0.247**	0.471**	-										
4. SB	0.314**	0.321**	0.182**	-									
5. Age	−0.020	−0.001	−0.103**	−0.007	-								
6. Gender	0.012	−0.010	−0.055	0.016	−0.072*	-							
7. Local vs. International	0.046	−0.027	−0.231**	0.063	0.022	0.004	-						
8. Living status	0.001	0.004	−0.117**	0.038	0.047	0.098**	0.471**	-					
9. CSSA	−0.014	0.021	0.082*	0.087*	−0.016	0.016	0.169**	0.065	-				
10. Family financial difficulty	0.113**	0.175**	0.087*	0.184**	0.047	0.033	−0.009	0.075*	0.154**	-			
11. Personal financial difficulty	0.135**	0.161**	0.112**	0.185**	0.110**	0.000	−0.021	0.119**	0.058	0.636**	-		
12. Family member unemployed	0.095**	0.090*	0.043	0.062	0.096**	−0.018	−0.062	0.038	0.079*	0.383**	0.332**	-	
13. Personal infection of virus	0.002	0.007	0.008	−0.002	−0.021	−0.012	−0.086*	−0.052	0.035	0.099**	0.118**	0.114**	-
14. Family infection of virus	−0.032	−0.056	0.017	0.01	0.072*	−0.034	−0.175**	−0.113**	−0.065	0.007	0.095**	0.031	0.464**

*$p < 0.05$, **$p < 0.01$; IA = Internet addiction, CESD-R = Depressive symptoms, HL = Hopelessness, SB = Suicidal behavior.

are vulnerable to IA, students with some attributes are more vulnerable than others if risk factors are operating. During the pandemic, some individual factors such as financial difficulty and infection with the virus may have a unique impact on IA. Furthermore, students' psychological morbidity would be intensified during the pandemic, which may also promote IA.

4.1. Socio-demographic predictors of IA

The present study showed that personal financial difficulty during the pandemic significantly predicted IA after controlling for the effects of other socio-demographic factors. This highlights the important risk role that personal financial difficulty plays in IA during the pandemic. While the general literature suggests an association between economic status and IA, it mainly focuses on adolescents and the findings are inconclusive (Ak et al., 2013; Wu et al., 2016; Lai and Kwan, 2017). A recent study on 1,648 university students in Hong Kong showed that personal financial difficulty rather than family financial difficulty predicted IA during the pandemic (Shek et al., 2023a). The finding of the present study aligns with this finding and the conjecture that economic problems are closely linked with adolescent developmental outcomes (Leung and Shek, 2011). Compared to adolescents who mainly rely on their families for economic support, many university students would find part-time work to financially support themselves or even to shoulder family financial burdens (Richardson et al., 2009; Shek et al., 2022a). Unfortunately, during the pandemic, university students face difficulties in finding part-time work due to the economic downturn (Adams-Prassl et al., 2020), which may lead to increased stress and subsequent problem behaviors such as IA.

Regarding gender, results of the present study showed that gender did not predict IA. While some studies found that male students showed higher IA than female students (Gavurova et al., 2022; Kożybka et al., 2023), some studies showed the reverse pattern (e.g., Shehata and Abdeldaim, 2021; Mengistu et al., 2023). Some studies also showed no significant gender effect on IA in university students (e.g., Truzoli et al., 2016; Shek et al., 2023a). The observation of no gender difference may be due to the wide accessibility of the Internet, the diversification of functions of the Internet, and the long time spent on the Internet by both males and females during the pandemic (Seyrek et al., 2017; Talwar et al., 2019). In other words, while gender differences may exist under "normal" circumstances before COVID-19, gender differences may disappear under "non-normal" conditions such as the pandemic because both males and females spend more time on the Internet.

4.2. Psychological morbidity predictors of IA

The present study showed that psychological morbidity including depression, suicidal behavior and hopelessness positively predicted IA. This is in line with the extant literature. For depression, a body of research showed a positive relationship between depression and IA including studies conducted during the pandemic (Ali et al., 2021; Chen et al., 2021; Fawaz and Samaha, 2021). Findings of this study provide further evidence to the literature. In addition, findings of this study advance our understanding of the relationship between some specific psychological morbidity such as suicidal behavior and IA. While

TABLE 4 Predictive effects and interactions.

Predictor	*B*	*SE*	*β*	*F* change	R^2 change
Step 1 demographic variables				2.26*	0.03
Age	−0.05	0.07	−0.03		
Gender	0.05	0.21	0.01		
Student status	0.49	0.35	0.05		
Living status	−2.18	1.31	−0.06		
Recipient of CSSA	−0.52	0.52	−0.04		
Family financial difficulty	−0.02	0.36	−0.003		
Personal financial difficulty	0.86**	0.33	0.13		
Family member(s) unemployed	0.55	0.33	0.07		
Personal infection of virus	0.00	0.24	0.00		
Family infection of virus	−0.17	0.25	−0.03		
Step 2 independent variables				53.05***	0.18
Depressive symptoms (CESD)	0.06***	0.01	0.26		
Suicidal behavior (SB)	1.00***	0.16	0.22		
Hopelessness (HL)	0.27*	0.12	0.09		
Step 3a interaction with gender[a]				3.05*	0.01
CESD×gender	−0.54*	0.22	−0.30		
SB × gender	−0.04	0.20	−0.02		
HL × gender	0.57[b]	0.22	0.31		
Step 3b interaction with COVIDP[a]				2.53[ms]	0.01
CESD×COVIDP	−0.15	0.22	−0.04		
SB × COVIDP	0.55**	0.20	0.13		
HL × COVIDP	−0.09	0.22	−0.02		

[a]interactions between each demographic variable and all psychological morbidity were examined.
[ms]marginal significance ($p = 0.06$).
[b]$p = 0.01$.*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. COVIDP = Personal Infection with COVID-19.

TABLE 5 Simple slope analyses.

Path	Moderator	Category	*B*	*SE*	*β*
CESD to IA					
	Gender	Female	0.08***	0.01	0.35
		Male	0.10***	0.01	0.45
HL to IA					
	Gender	Female	0.71***	0.13	0.23
		Male	0.65***	0.14	0.22
SB to IA					
	COVIDP	Yes	1.49***	0.20	0.39
		No	1.09***	0.21	0.23

***$p < 0.001$.

previous studies mainly suggest IA as a predictor of suicidal behavior (Arrivillaga et al., 2020), findings of the present study indicate that suicidal behavior may be a potential risk factor for IA. This conjecture is consistent with the Compensation Theory that IA may be a coping response to stress (e.g., stress created by suicidal ideation). Besides, individuals with suicidal intentions may use IA to distract themselves to delay the suicidal act. This novel insight merits further investigation in longitudinal studies.

Regarding hopelessness, a few studies examined the risk role of hopelessness in IA. For example, a study found that hopelessness predicted Internet abuse in college students (Velezmoro et al., 2010). Another study showed that hopelessness mediated the relationship between attention deficit/hyperactivity disorder and Internet gaming disorder (Chen et al., 2021). In a recent study on Hong Kong university students, hopelessness was positively correlated with IA (Shek et al., 2023a). Results of the present study echo these findings and suggest that hopelessness may be a risk factor for IA. Overall, the findings on the predictive effects of these three domains of psychological morbidities on IA provide support to the Compensation Theory and the I-PACE model of IA which highlight that psychological morbidity or mental illness is a major stressor leading to IA (Brand et al., 2016).

4.3. Gender as a moderator in the predictive relationship between depression and IA

While gender did not have a main effect on IA, it moderated the association between psychological morbidity (depression and

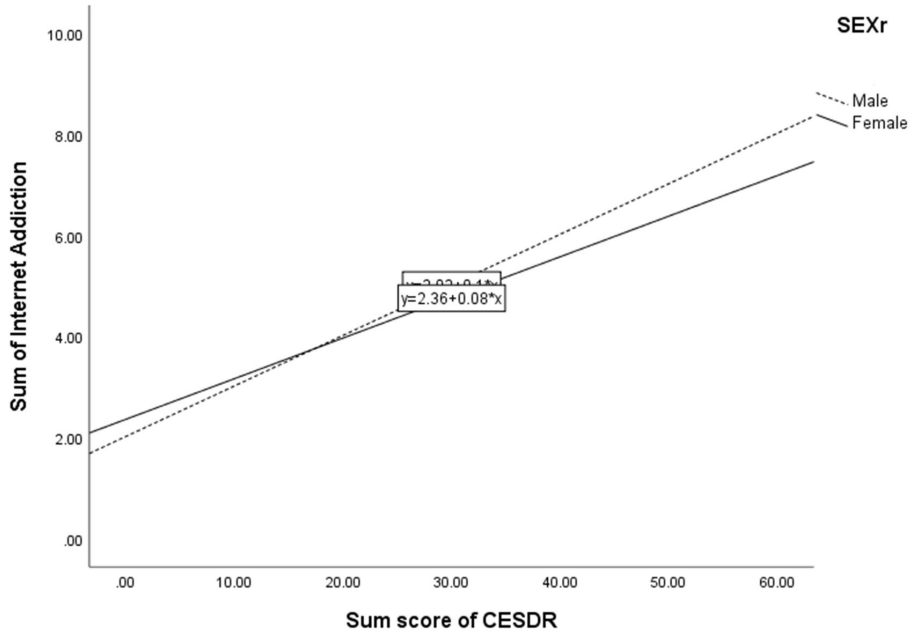

FIGURE 1
Interaction between symptoms of major depressive disorder (CESDR) and gender.

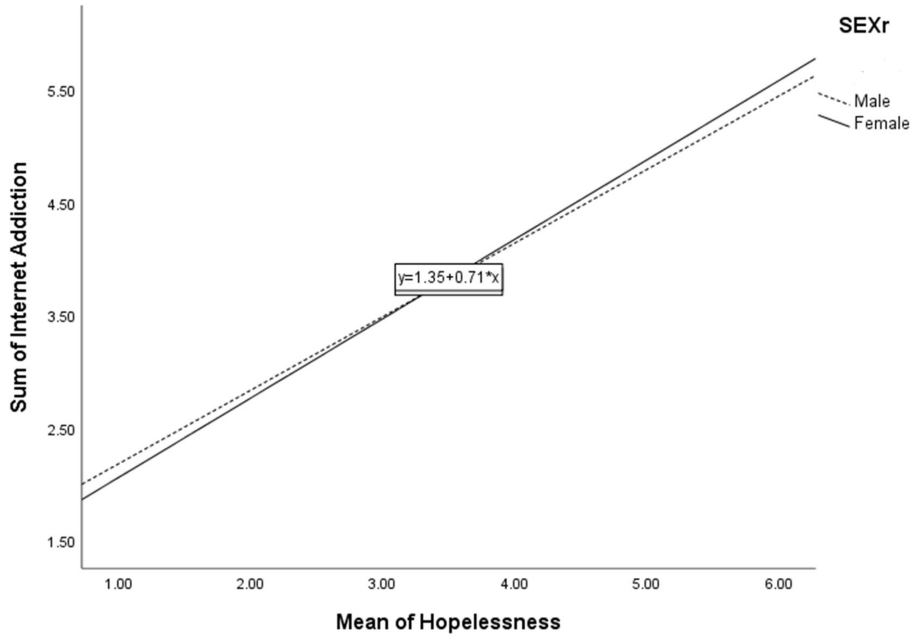

FIGURE 2
Interaction between hopelessness and gender.

hopelessness) and IA in the present study. For depression, results of this study showed that compared to female students, depressive symptoms had a stronger impact on IA in male students. This contributes to the existing yet inconclusive literature. While some studies showed that depressed male students were more likely to have IA or Internet gaming disorder than depressed female students (Liang et al., 2016; Gan et al., 2022), other studies revealed that depression predicted smartphone addiction only in female students (Koh and Kim, 2017) or gender did not moderate the association between early social media disorder (a specific type of IA) and depressive symptoms (Bos, 2018). Conceptually, male and female students may have different motivations for Internet use due to their different gender

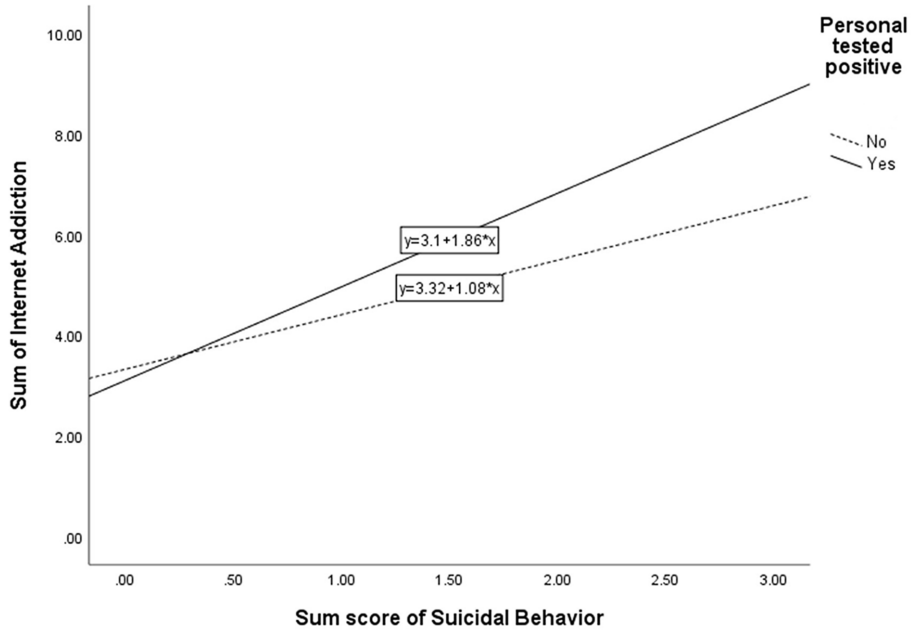

FIGURE 3
Interaction between suicidal behavior and personal infection of virus.

identities formed under diverse societal expectations (Chen et al., 2017), which may influence the relationship between their mental health problems and behavioral outcomes (Gan et al., 2022). For male students, societal and cultural expectations shape their gender roles to emphasize social status, accomplishments, and power (Chen et al., 2017). Failing to meet these expectations may result in feelings of depression. Through the Internet, especially online games, males could gain a "false sense of power and achievement" which helps them to regulate or reduce the negative feelings associated with depression (Kwon, 2007, p. 231). Consequently, they may be more likely to use the Internet when feeling depressed.

4.4. Gender as a moderator in the predictive relationship between hopelessness and IA

Different from the moderating effect of gender on the association between depression and IA, we observed a novel finding that the link between hopelessness and IA was stronger in girls than did boys. It indicates that the moderating function of gender might be different for the linkage between different forms of psychological morbidities and IA. As suggested by the existing literature, while hopelessness is associated with depression (Polanco-Roman and Miranda, 2013; Horwitz et al., 2017), they are distinctive constructs (DeLisle and Holden, 2009) and hopelessness may only be associated with certain types of depression (Alloy and Clements, 1998; Joiner et al., 2001). Scholars also pointed out that there were hopeless but non-depressed individuals (Young et al., 1996) and depressed but non-hopeless individuals (Greene, 1989). As such, the underlying mechanisms might be different for the moderating function of gender in the association between these constructs and IA. For example, one study found that hopelessness rather than depression was a significant predictor of interpersonal stress (Joiner et al., 2005) or was an outcome of negative interpersonal events (Abela and Seligman, 2000). As girls tend to use social media or social networks for social connection and boys tend to play video games in their Internet behaviors (Dufour et al., 2016; Leonhardt and Overå, 2021), hopeless female students with interpersonal problems may resort to social media to compensate for their interpersonal handicaps, thus leading to higher IA. The finding is also consistent with the meta-analytic review that the moderating role of gender in the relationship between different psychological morbidities and IA would be different (Cai et al., 2023).

4.5. Personal infection as a moderator in the predictive relationship between suicidal behavior and IA

The present study showed that personal infection moderated the association between suicidal behavior and IA. While the finding is novel, some existing studies may imply the possible moderating role of personal infection in the suicidality-IA link. For example, research showed that COVID-19 infection was an important risk factor for suicidal behavior during the pandemic (Raj et al., 2020; Shi et al., 2021). COVID-19 patients may have neurological problems or disorders such as "ischemic stroke and headaches" and have increased fear which would increase their risk for suicidal behavior (Raj et al., 2020, p. 4). Based on this background, COVID-19 infection may enhance the existing level of suicidal behavior which then strengthens its association with IA. In fact, both the I-PACE model (Elhai et al., 2020) and the Compensation Theory of IA (Kardefelt-Winther, 2014) highlight the association between external stressors (COVID-19 infection in this case) and internal stressors (suicidal behavior) in the development of IA. According to these views, the infection of COVID-19 may interact with suicidal behavior to increase the related

physical symptoms and negative mood which then leads to higher IA behavior.

4.6. Implications and limitations of the study

In addition to the theoretical implications mentioned above, the study also has practical implications. Firstly, understanding the risk role of personal financial difficulty and psychological morbidity would help university mental health practitioners and policymakers in identifying student groups who are more vulnerable to IA during the pandemic for targeted service provision, prevention and intervention. Secondly, the risk role of psychological morbidity in IA suggests that the treatment of IA should involve assessment and treatment of psychological morbidity. Thirdly, the moderating roles of gender and personal infection of COVID-19 in the relationship between psychological morbidity and IA indicate that treatment of IA that involves addressing psychological morbidity should account for the different moderating roles of gender in the relationship between specific types of psychological morbidity and IA. Furthermore, the treatment of IA that involves addressing psychological morbidity should pay special attention to the student group who have personal experience with infection of COVID-19.

Despite the novel nature of the study, several limitations of this study should be noted. First, a cross-sectional design was employed in this study which cannot infer any causal relationship. Hence, longitudinal research should be conducted in future to examine the related issues. Second, due to difficulties in data collection under COVID-19, the study adopted the method of non-probability quota sampling which was commonly adopted in other studies (Chaabna et al., 2022). Third, although many studies under COVID-19 were also based on students from a single university (e.g., Ismail et al., 2021; Shehata and Abdeldaim, 2021), future research should be based on students from different universities. Despite these limitations, the study contributes significantly to the area of individual differences in IA particularly the role of socio-demographic factors and psychological morbidity, as well as their interaction, in IA in university students during the pandemic.

Data availability statement

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

Ethics statement

The studies involving humans were approved by the Institutional Review Board (or its Delegate) at the Hong Kong Polytechnic 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.

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Author contributions

DS obtained the research grant, conceived the research, contributed to all stages of the research work, and critically revised all versions of the manuscript. WC conducted data analyses, drafted parts of the manuscript, and revised and checked the manuscript. DD contributed to the research design, and revised, checked and proofread the manuscript. LT drafted parts of the manuscript and checked the manuscript. TW drafted parts of the manuscript and checked the manuscript. KZ drafted parts of the manuscript. All authors contributed to the article and approved the submitted version.

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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The habitual characteristic of smart phone use under relevant cues among Chinese college students

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Excessive smartphone use may be habitual behavior induced by cues associated with the phone. Habitual behavior occurs outside of awareness and is characterized by lack of control. It is not like problematic smartphone use (PSU) (Brand et al., 2016), which is used to either limit behavior or produce pleasure and relieve feelings of pain, stress, and failure despite significant harmful consequences. 62 college students participated in experiments to test the effects of visual cues and self-control, which are the important characteristic of habitual behavior in smartphone-related behavior. The results showed that a significantly larger amount of cue-related phone use behavior occurred in the setting where participants (a) had their smartphones in sight and (b) were given no instructions to exert self-control, compared to when neither of the two conditions was imposed. The habitual model is a useful framework for understanding PSU and can help people avoid it with less stress. The results provide substantial implications for reducing the frequency and duration of smartphone use among college populations.

KEYWORDS

habitual smartphone use, problematic smartphone use, cue induced behavior, self-control, HSUS

1. Introduction

Smartphones provide convenience and efficiency, and at times are seen as an indispensable aspect of people's professional and personal lives today (Zangbar et al., 2014). However, there is concern about young adults who spend extended periods of time every day using their smartphones (Lee et al., 2014). One study found that 80% of college students use smartphones for more than 4 h a day, while 44% of this population use smartphones for more than 8 h a day (Duan et al., 2021). This behavior increases the risk of problematic smartphone use (PSU) variety of dysfunctional manifestations (Rosen et al., 2013), where individuals become overly immersed in the virtual world of their smartphones, including excessive or uncontrollable use, preoccupation (Panova and Carbonell, 2018), and neglect of other activities (Fischer-Grote et al., 2019; Sohn et al., 2019), leading to serious consequences including sleep disturbances or depression (Thomée et al., 2011). In recent years, more and more young people were suspected to have PSU, however, can excessive smartphone use really be classified as PSU, or could it be categorized as a type of habitual behavior?

Habitual behavior is defined as an automatic behavior triggered by both external cues (e.g., sound, objects, places, people, and preceding actions) and internal cues (e.g., emotional state, urge) (Verplanken and Melkevik, 2008; Kurz et al., 2015). There is overlap in the characteristics of PSU and habitual smartphone use, with habitual smartphone use appearing to be an important contributor to PSU (Shaffer, 1996; Huisman et al., 2000; Van Deursen et al., 2015). However, unlike PSU, habitual behavior does not necessarily lead to negative consequences, nor does it necessarily produce pleasure or relieve pain or stress. Furthermore, although habitual behavior is learned outside of one's awareness and may be experienced as uncontrollable, the individual may be aware of the behavior once it has begun or after it has stopped. Once the person is aware of the habitual behavior, it can be changed or less easily induced (Hall and McDonnell, 1999).

In substance addiction research, it was found that exposure to substance-associated cues, instigates physiological, behavioral and subjective reactions. This is a phenomenon of cue-induced reactivity, including craving (craving can be triggered by cue-reactivity) and automatic substance using behavior (Zeng et al., 2018), in which behavior becomes autonomous and can be performed with little attention, intention, or cognitive effort, constituting a "habit" (Knowlton, 2013). For smart phone use behavior, there is some similarity with substance use.

In daily life, when people use smart phone, whether it is for internet gaming, watching micro-video, social networking, or visiting shopping sites, it normally brings people a sense of pleasure and help them escape from bad emotion. During this process, the smartphone itself or smartphone-related clues, such as notification ringtones, which is often associated with the feeling of pleasure, then become the stimulus clues that trigger the use of smart phone (Tiffany et al., 2000). Once the individual is exposed to these stimulus clues, it would trigger the use of smart phone use, forming cue induced reactivity or stimulus–response behavior, overall forming a conditioning processes (Carter and Tiffany, 1999).

Therefore, cue reactivity is developed on the basis of associative learning mechanism (Carter and Tiffany, 1999; Loeber and Duka, 2009), which is mostly unconscious, similar to the characteristic of habitual behavior. When people are under the stimulation of phone cues, they might then increase the average frequencies and extend the durations of their smartphone. In this way, although smartphone overuse in daily life may simply be habitual use that does not satisfy the criteria of PSU, it may nonetheless occur automatically in the presence of smartphone-related cues when there is little conscious effort being made self-control.

Previous studies state an involvement of the ventral striatum in the experience of craving when being confronted with related cues were observed in subjects with Internet-gaming disorder (Ahn et al., 2015; Liu et al., 2017), hypersexual behavior (Klucken et al., 2016), and Internet-pornography use problems (Brand et al., 2016). Ventral striatum is the reward center of the brain- an important neuro-basis of conditioning. It also suggests that cue-induced behavior including craving play an important role in excessive smartphone use, whether it is defined as PSU or not.

Based on the aforementioned features of habitual behavior, then, it seems reasonable to speculate that the phone related cues might lead to automatic smart phone use on a daily basis such as unlocking the smartphone to check for notifications (Oulasvirta et al., 2012). When people are under the stimulation of phone cues, they might then increase the average frequencies and extend the durations of their smartphone. So, although smartphone overuse in daily life may simply be cue induced behavior that does not satisfy the criteria of PSU, it is just a kind of habitual behavior. It may nonetheless occur automatically in the presence of smartphone-related cues when there is no conscious effort being made self-control.

Smartphone overuse does not necessarily equate PSU then– it may merely enhance PSU (Van Deursen et al., 2015), and, as simply habitual behavior, it may be less harmful overall than PSU. However, it is important to be aware of the unnecessary stress that such habitual behavior may generate if people's habitual phone use is arbitrarily labeled as being PSU. Therefore, it is essential to maintain a framework in which the two types of smartphone usage can be distinguished, to allow people to adjust their phone use accordingly. Such a framework would thus help those overusing their smartphones to understand the cue-induced mechanism behind their behavior, and adopt simple methods to decrease their phone use.

We conducted two experiments to test whether frequent use of smart phones can be affected through cued responses, and whether those responses would decline once the relevant cues are removed or as the individual becomes aware of their habitual use.

We hypothesized the following:

> There will be more cue-induced smartphone use behavior in the group exposed the phone cues, which is reflected in their frequency and duration of smartphone use.
>
> Awareness of phone use and attempts to control it can decrease the frequency and the duration of smartphone use.

2. Methods

2.1. Participants

The study sample comprised 62 college students (32 females and 30 males; mean age of 20.36 ± 1.68). They were randomly assigned to either the relevant cue group or the cue isolated group (1, 1). Two students completed the experiment quicker than expected and their results were therefore not included in the analysis. 34 students accepted the invitation to take part in the second experiment (17 females and 17 males, mean age of 20.27 ± 1.69). One participant who left early and three participants who used smart phone throughout the course, their data were excluded.

2.2. Study design

The study consist of two experiments. In the first experiment, Participants were randomly assigned to either the relevant cue group or the cue isolated group, and both groups completed the task under uncontrolled conditions. After 7 days, the second experiment were conducted, which is A 2 (control vs. no control) × 2 (cues vs. no cues) design. All participants in the first experiment were invited to be involved in the second one, which was conducted under

self-controlled and no control two conditions with cue group and the cue isolated group.

2.3. Procedure

The experiment took place in the university library study room with a high-resolution indoor IP dome camera. All participants were told that they were taking part in a comfort survey in the library study room, where they were about to study with the camera on for 1 h and report on their experienced levels of comfort at the end of the hour; their smartphones needed to be set to silent mode to avoid disturbing others; there should be no conversation or discussion; and computers, MP3 players, and other electronic devices were not allowed. Participants' behavior was recorded on camera for later analysis, and all of them were told that there are cameras in the library to record their behaviors. There were 17 trials in the experiment in total, with 5–7 participants from the same group (all from the cue group or all from the cue isolated group) assessed in each trial. Two types of behavior were coded and used as the dependent measures: Behavior 1, unlocking the smartphone but not sliding the screen, then turning off the screen quickly; and Behavior 2, unlocking the smartphone and slide screen, then continuing to use the phone.

Two postgraduates were trained in coding. In the training sessions, the coder coded the video data independently. The results were compared with the codes given by the more skilled coder (i.e., researcher) to examine the coding consistency. The kappa coefficient was used to evaluate inter-rater reliability. The consistency of the two coders in this study was 0.795, which shows that the coding results of the two coders had excellent consistency (Fleiss, 1981). Both coders were kept blinded during the allocation.

In the formal experiment, participants were randomly assigned to either the relevant cue group or the isolated cue group. In the relevant cue group, the participants were asked to place their smartphone on the desk, and the smartphone was always present in their visual field. In the cue isolated group, the participants were asked to place their smartphone in their bag or pocket, meaning that the smartphone was always absent in the visual field. There were no instructions given to either of the two groups to abstain from using the phone. Participants were asked to study while being recorded by the video camera for 1 h, but were given no directions as to whether they could use their smartphone or not. At the end of the hour they reported on their level of comfort during the session. The video content was coded for duration and frequency of smartphone use. The effect of the relevant cues was assessed by comparing the duration and frequency of smartphone use in the two groups.

Seven days later, those who had participated in the first experiment (in either of the relevant cues or no cues group) were invited to participate in the second experiment. The second experiment was similar to the first experiment, but this time the experimental group was asked to abstain from using their phone during the 1 h of videotaped study time. Before the session began, participants in the experimental condition were asked: "Could you try to be aware of your phone use behavior and attempt to not use your smart phone for the next hour?" The effect of asking the participants not to use their phone was assessed by comparing the duration and frequency of smartphone use in the two experiments.

2.4. Statistical analysis

A chi-square test and independent sample t test were used to measure and compare the frequency and the duration of smartphone use Behavior 1 and Behavior 2 between the experimental and control groups. Repeated measures ANOVA was then used to test the interactive effect of relevant cues and self-control on the duration of smartphone use.

3. Results

Participants in the relevant cue group displayed significantly more Behavior 1 than those in the cue isolated group ($\chi^2 = 4.62$, $df = 1$, $p < 0.05$), there was no significant group difference in frequencies of Behavior 2 ($\chi^2 = 3.58$, $df = 1$, $p > 0.05$). However, the duration of Behavior 2 was significantly longer in the relevant cue group than in the cue isolated group ($t = 2.44$, $p < 0.05$; see Table 1).

Both control intentions showed more Behavior 2 than Behavior 1. There was no significant difference between the two groups with regards to Behavior 1 ($\chi^2 = 0.34$, $df = 1$, $p > 0.05$). During the 1 h of observation, the occurrence rates for touching the phone (Behavior 1) were 81.1 and 79.2% in each group, respectively. However, the duration of Behavior 2 was significantly shorter in the self-control group than in the no self-control group ($t = 2.44$, $p < 0.05$; See Table 2).

For behavior 2, the results showed a main effect for cues [F (1, 28) = 29.64, $p < 0.05$, $\eta^2 = 0.34$] and intention of self-control [F (1, 28) = 5.678, $p < 0.05$, $\eta^2 = 0.09$], with a significant interaction effect [F (1, 28) = 4.45, $p < 0.05$, $\eta^2 = 0.07$]. For behavior 1, Simple effects analysis found that the self-control intention was significant only in the relevant cue [F (1, 28) = 10.01, $p < 0.05$], and not in the no-cue condition [F (1, 28) = 0.037, $p > 0.05$]. The relevant cue effect was significant in both the non-control intention group [F (1, 28) = 19.03, $p < 0.05$] as well as the self-control group [F (1, 28) = 9.68, $p < 0.05$]. For the behavior 1, there is no significant difference between two groups and two conditions.

4. Discussion

In this study, two behavioral experiments were conducted to explore whether cues (i.e., the presence or absence of a smartphone in participants' visual field) would induce more frequent or longer periods of distraction. The results suggest the smartphone use can be induced by relevant cues, demonstrated by the fact that the relevant cue group exhibited more smartphone use behavior and used it for

TABLE 1 Smartphone use frequencies and length for cue-induced group and no cues group ($N = 60$).

	Behavior 1		Behavior 2	
	Frequency	Length	Frequency	Length
Cue-induced group	18	39	44	9,003
No cues group	1	3	15	1,550

TABLE 2 Smartphone use frequencies and length for conditions with will to control smart-phone use and without one for cues and cue isolated group ($N = 30$).

		Control condition		No control condition		Cue	Control	CuexControl
		Frequency	Length	Frequency	Length	*F*	*F*	*F*
Behavior 1	Cue-induced group	5	17	7	25			
	No cues group	1	3	1	3			
Behavior 2	Cue-induced group	19	3,168	30	7,385	29.64*	5.68*	4.45*
	No cues group	3	462	12	1,150			

*$p<0.05$.

longer durations than the group without phone relevant cues. This may underlie daily smartphone overuse, in that a large part of smartphone use on a daily basis may be triggered by relevant cues, rather than being an example of PSU, and it is just habitual behavior learned through stimulus–response learning. The implication of these results is that excessive smartphone use could potentially be decreased by reducing phone-related cues.

Smartphone usage frequency is higher when the smartphone is in sight compared to when it is out of sight, even if people do not consciously intend to use it, suggesting that phone use is more likely to occur in response to the visual cue (i.e., seeing the phone) (Aarts and Dijksterhuis, 2000); response behaviors (i.e., using the smartphone) may then be automatic and occur unconsciously (Chou and Hsiao, 2000; Wood and Neal, 2007; Lopez-Fernandez et al., 2014).

This phenomenon is consistent with the characteristics of conditioned reflex behavior (Mulligan et al., 2000; Felisoni and Godoi, 2018). This model has been confirmed in research on problematic substance use (Zeng et al., 2018), for example, in the context of alcohol abuse, the stimulus of being in a bar is seen to evoke the response of drinking alcohol and using substances (LaRose and Eastin, 2004). Based on the results of the current study, this phenomenon may also inform smartphone use.

The effect of the relevant cues on frequency was not affected by the instruction to use deliberate self-control. This result was different than our expectation. It appears that regardless of whether an individual consciously intends to control their smartphone use, the presence of cues makes smartphone use (e.g., unlocking the smartphone) more likely to occur. This further suggests that smartphone use under relevant cues may be to a large extent unconscious, and therefore difficult to acknowledge and control. In this way, if relevant cues could be reduced, the frequency of smartphone usage might also be reduced.

However, our results also demonstrated that when participants entered a conscious state after being unaware of their actions, intentional self-control could reduce the duration of usage, meaning that self-control can be useful for reducing the phone use.

Furthermore, both groups displayed more of Behavior 2 (Unlocked and used smartphone) than Behavior 1 (Unlocked smartphone but did not use it), which suggests that once an individual touches their smartphone screen due to relevant cues, they are more likely to spend time on their smartphone and less likely to merely activate the screen before turning it back off, indicating that the content appearing on the phone screen may potentially play a role in cue-induced smartphone use and result in longer periods of smartphone use.

All the above results suggest that the use of phones in response to relevant cues may simply be conditioned habitual behavior, and is consistent with the characteristics of habitual behaviors in line with Oulasvirta who found that habitual behavior is automatic behavior triggered by situational cues (Oulasvirta et al., 2012). Our findings are also consistent with the results of LaRose and Eastin's study (Whang et al., 2003), which established that habitual behavior is also behavioral acts that occur without conscious thought or self-instruction.

Overall, we believe that while the majority of smartphone overuse might be induced by cues, the behavior should not necessarily be classified as indicative of PSU. Smartphone use under the relevant cues is not so much PSU as habitual behavior. It is easy to impose psychological burden on people to be labeled PSU, particularly toward younger populations. Habitual smartphone use might be reduced by putting phone related cues out of sight or consciously paying attention to one's smartphone use behavior in an effort to try to control it (i.e., reduce the duration of phone use). This would be useful in avoiding increasingly problematic behaviors which might even further lead to PSU. Huisman et al. have pointed out that Internet or other digital addictions are often an outcome of habitual behavior. If people try to reduce relevant cues at the stage of habitual behavior, this may help decrease the risk of PSU. Indeed, this is the focus of the current research, that simply reducing cues that trigger smartphone use may help people decrease their risk of developing PSU.

This study contributes to the growing body of literature on smartphone use by examining the role of visual cues and self-control in daily phone use, behavior. Furthermore, it indicates that much of daily smart-phone use may simply be habitual behavior spurred by relevant cues, rather than problematic smartphone use. By understanding the underlying factors contributing to excessive smartphone use, our findings can help inform more effective approaches for reducing the frequency and duration of smartphone use among college populations, ultimately promoting healthier digital habits.

4.1. Limitations

Smartphone use under relevant cues might be automatic behavior triggered by a variety of both external/situational and internal cues. The current study limited its focus to only a visual cue. There could be individuals whose habitual smartphone use has been formed through internal cues (e.g., boredom, loneliness, etc.), rendering the presence or absence of a visual cue irrelevant. The effect of internal cues on daily smartphone use should also be explored. In addition, we did not calculate the number of participants who did not use their smartphones at all under the relevant cues. This information might also help us better understand cue induced smartphone use.

5. Conclusion

This study investigated the role of visual cues and self-control in smartphone-related behavior among college students. Our findings revealed that the presence of smartphones in sight and the absence of instructions to exert self-control significantly increased cue-related phone use. These results suggest that visual cues and self-control may be important factors in driving excessive smartphone use, which may drive the daily smart phone use in the context of habitual behavior.

Data availability statement

The original contributions presented in the study are included in the article/supplementary materials, further inquiries can be directed to the corresponding author/s.

Ethics statement

The studies involving humans were approved by the Department of psychology, Guangzhou University, Guangzhou, China. 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. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

HZ made a substantial contribution to the concept and design of the work, also revised draft critically for important intellectual content. ML, JD, and JZ made a contribution to the acquisition, analysis, and interpretation of data. XY drafted the article and revised it critically. YL made a contribution to the data analysis and English language review. All authors have read and agreed to the published version of the 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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Mobile phone addiction and mental health: the roles of sleep quality and perceived social support

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As a global phenomenon, mobile phone addiction has become an increasingly common issue among Chinese university students. Although previous research explored the link between mobile phone addiction and mental health, the possible mechanism underlying the above association is unclear. We administered a cross-sectional survey to 585 participants from two universities in Kunming, southwest China, from October 2021 to January 2022. Our results suggested that mobile phone addiction was negatively associated with mental health, and sleep quality partially mediated the relationship between mobile phone addiction and mental health. Furthermore, perceived social support positively moderated the direct effect of sleep quality on mental health, as well as the indirect effect of mobile phone addiction on mental health. These findings provide a new insight into the underlying mechanism by which mobile phone addiction affects university students' mental health. The results emphasize a necessary task for administrators, health workers, and family members to attach importance to the overuse of mobile phones among university students.

KEYWORDS

mobile phone addiction, sleep quality, perceived social support, mental health, university students

1. Introduction

In recent years, mobile phones have rapidly gained popularity because of the practicability and convenience that these technologies offer. The 49th statistical report on internet development in China revealed that the total number of mobile phone users stood at 1.64 billion as of December 2021. These ubiquitous innovations are increasingly integrated into individuals' lives, thereby bringing about consequences. Although mobile phones are prevalent for all age groups, adolescents are the most common users (Gangadharan et al., 2022; Huang et al., 2022). Mobile phone overuse among adolescents may be closely related to psychological health problems, including sleep disturbance, technostress, low self-confidence, social isolation, and depression (Jun, 2016; Tao et al., 2017; Mahmoodi et al., 2018; Thomee, 2018; Park et al., 2019). Mobile phone addiction may therefore result in various health-related issues among teenagers and young adults, as recognized by scholars from different disciplines (Thomee, 2018; Dowran, 2020).

Although some empirical research has explored the linkage between mobile phone addictions and mental health, the mechanisms by which mobile phone addiction influences

adolescents' mental health have received little attention. That is, scholars have not fully explained the intermediate variables that potentially influence the association between mobile phone addiction and mental health. To date, only a few researches have inquired into possible determinants of the aforementioned association among young adults (Tao et al., 2017; Yang et al., 2019; Ivanova et al., 2020). Therefore, to clarify the contradictions in previously derived findings, the current work examined the effects of mobile phone addiction on mental health on the basis of a sample of college students in China. This study also casts light on the mechanisms that may play a crucial role in such a link by introducing two new intermediate variables, namely sleep quality and perceived social support (Figure 1).

2. Literature review and hypotheses

2.1. Mobile phone addiction and mental health

Mobile phone addiction, which originated with the development of communication technology, is defined as "a behavioral addiction, characterized by the basic symptoms of addictive behaviors" (Ivanova et al., 2020, p. 656). As a subset of behavioral addiction, it is an impulse control disorder that may have the same outcome as substance use and pathological gambling (Dowran, 2020). Although scholars remain in dispute about whether mobile phone overuse is considered a behavioral addiction (Billieux et al., 2015; Yang et al., 2019), this condition is widely believed to be a kind of uncontrollable and impulsive desire to use mobile phones (Liu et al., 2018; Hao et al., 2019).

The prevalent view is that mobile phone addiction leads to consequences such as psychological health problems, loneliness, depression, and psychiatric disorders (Yang et al., 2019; Dowran, 2020; Augner et al., 2023). Recently, some empirical research has explored the association between mobile phone addiction and mental health (Tao et al., 2017; Mahmoodi et al., 2018; Thomee, 2018; Zhang et al., 2020). A case in point is Seo et al. (2016), who confirmed the close association between mobile phone dependence and adolescents' negative moods. This finding is supported by more recent empirical evidence that mobile phone overuse significantly and negatively affects adolescents' psychological problems, such as loneliness, mental health, depression, and social anxiety (Elhai et al., 2017; Calpbinici and Tas Arslan, 2019; Li et al., 2020; Zhang et al., 2020). Furthermore, the findings by Zhang et al. (2020) also indicated that mobile phone dependence is closely related to individual adjustment and mental health status. Based on these results, we formulated the following hypothesis:

> *Hypothesis 1*: Mobile phone addiction is negatively associated with mental health.

2.2. The mediating effect of sleep quality

Sleep quality can be defined as "difficulty falling asleep and/or maintaining sleep" (Buysse et al., 1989, p. 1), a definition that was reframed by Yi et al. (2006, p. 3) into "the degree of excellence in sleep." On the basis of the resource model of self-control (Baumeister et al., 1994), when individuals' psychological resources are in a state of self-depletion, they fail to control themselves. The self-regulatory resources of individuals are diminished by sleep deprivation, thereby stimulating potentially risky behaviors (Barnes et al., 2011; Christian and Ellis, 2011). Consequently, sleep-deprived individuals are more strongly predisposed than their well-rested counterparts to addiction to the internet or mobile phones and even suffer from a high risk of mental health problems (Reis et al., 2019, 2021). Previous empirical research confirmed that individuals with poor sleep quality are more vulnerable to mental diseases than others with good sleep quality (Al-Khani et al., 2019; Suna and Ayaz, 2022). To date, scholars have agreed that poor sleep quality remarkably brings about low levels of mental well-being among university students (Ghrouz et al., 2019; Clement-Carbonell et al., 2021; Cramm et al., 2021).

Poor sleep quality is reported to be closely related to mobile phone addiction (Shin et al., 2017; Friedrich and Schlarb, 2018; Cheng and Meng, 2021). Some empirical research, such as those carried out by Adams et al. (2013) and Kang et al. (2020) have shown that human melatonin secretion will be inhibited if individuals are chronically exposed to the light emitted by mobile phones, and then impairs sleep quality. Put differently, mobile phone overuse may disturb the sleep of individuals and delay the interval within which they fall asleep (He et al., 2020). These results find support in other empirical investigations (Körmendi et al., 2016; Bartel et al., 2019; Haripriya et al., 2019; Sanusi

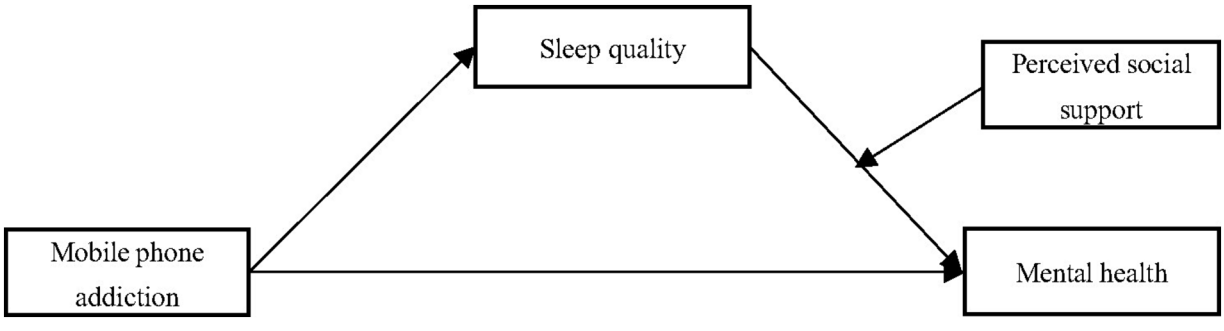

FIGURE 1
Hypothesized research model.

et al., 2022; Zhang et al., 2022), such as that of Haripriya et al. (2019), who demonstrated that young adults have minimal sleep times and potential sleep disorders because they are addicted to social networking and information sharing through mobile phones at night. This evidence is extended by the latest studies, which corroborated that mobile phone addiction has significant and negative effects on university students' sleep quality (Sanusi et al., 2022; Zhang et al., 2022).

The literature also indicated that the association between mobile phone use and mental health is significantly affected by sleep quality (Xie et al., 2018; Zou et al., 2019; Ho, 2021). This is illustrated in Xie et al.'s (2018) work, which revealed that the association between smartphone overuse and clinical health symptoms is mediated by sleep quality. Similarly, Ho (2021) confirmed the mediating role of sleep quality in the link between addiction to Facebook and depression. To sum up, mobile phone overuse negatively affects university students' sleep quality, which in turn leads to mental health problems (Zou et al., 2019). Accordingly, we put forward the supposition below:

> *Hypothesis 2*: Sleep quality mediates the negative association between mobile phone addiction and mental health.

2.3. The moderating effect of perceived social support

Social support refers to "the functions performed for the individual by significant others (including family members, relatives, and friends) and people from extended relationships" (Thoits, 2011, p. 3). Extensive research has confirmed the significant impact of perceived social support on health-related problems, such as psychological well-being and depressive symptoms (Heerde and Hemphill, 2018; Xu et al., 2018; Hirsch et al., 2019; Seon et al., 2019). Previous studies also considered perceived social support as a significant predictor of mental health (Xu et al., 2018; Lee, 2020; Litwiller et al., 2022). In other words, perceived social support is advantageous in maintaining psychological health (Xu et al., 2018; Lee, 2020; Chu et al., 2021). Hu et al. (2020), for instance, asserted that perceived social support can ensure that university students adapt more effectively to independent life, improve their mental health, and protect themselves from risk factors. The findings by Chu et al. (2021) also demonstrated that university students should acquire perceived social support and effective protection from their social networks when they suffer from aggressive bullying.

Given the significant influence of sleep quality on mental health, its interaction with perceived social support may affect university students' psychological welfare. Previous research has revealed that perceived social support can advance efforts to cope with stress and shield individuals from the consequences of traumatic events (Berg et al., 2021). That is, when social support is perceived as available to them, university students may be less likely to suffer from sleep disorders and a high risk of health-related diseases. In contrast, those with a low level of perceived social support possibly experience poor sleep quality and then run greater risks of suffering from mental illnesses. On the basis of these arguments, we expected university students who perceive having adequate perceived social support to exhibit better sleep quality and thereby enjoy better mental health, as put forward in Hypothesis 3.

> *Hypothesis 3*: The negative association between sleep quality and mental health is moderated by perceived social support.

Based on the above-mentioned moderation, we also anticipated that perceived social support may moderate the indirect impact of mobile phone addiction on mental health. Specifically, a high perception of the availability of social support among university students may mitigate the detrimental impact of mobile phone overuse on health-related problems through diminished sleep quality. That is, when university students perceive considerable social support from their families, relatives, and friends, they may experience high levels of sleep quality, which subsequently promotes their mental health. By contrast, university students may suffer from low levels of sleep quality and even worse mental health when they regard perceived social support as missing. In line with such reasoning, we expected the indirect effects of mobile phone addiction on mental health through sleep quality to vary across levels of perceived social support. We therefore posit the following:

> *Hypothesis 4*: The mediation effect of mobile phone addiction on mental health through sleep quality is moderated by perceived social support.

3. Methods

3.1. Participants

We recruited participants from two universities in Yunnan, southern China, after which we administered a cross-sectional survey to five randomly chosen classes in each university from October 2021 to January 2022. We distributed 600 questionnaires and received 592. After excluding incomplete and invalid questionnaires, we obtained a final valid sample of 585 university students (97.5% response rate). Of the participants, 55.9% were male and 44.1% were female, aged between 18 and 25 years ($M_{age} = 20.33$). The participants spent 4.23 h on their mobile phones per day and made or received an average of 3.41 calls per day.

3.2. Measures

To ensure the consistency of scales in the present study, we translated validated original scales into Chinese. All items were rated using a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

3.2.1. Mobile phone addiction

Mobile phone addiction was measured using Leung's (2008) 17-item scale. Sample items included "You have used your mobile phone to make yourself feel better when you were feeling down" and "Your productivity has decreased as a direct result of the time you spend on the mobile phone." The Cronbach's alpha of this scale was 0.959.

3.2.2. Sleep quality

We measured sleep quality adopting a seven-item scale developed by Bastien et al. (2001). Sample items include "How satisfied are you with your current sleep pattern?" and "To what extent do you consider your sleep problem to interfere with your daily functioning?" The Cronbach's alpha of the scale was 0.806.

3.2.3. Perceived social support

Perceived social support was assessed using a 12-item scale developed by Zimet et al. (1988). Sample items included "I have a special person who is a real source of comfort to me" and "There is a special person in my life who cares about my feelings." The Cronbach's alpha in the present study was 0.957.

3.2.4. Mental health

Mental health was measured using the 12-item General Health Questionnaire developed by Gelaye et al. (2015). Sample items are "Enjoy day-to-day activities" and "Feel reasonably happy." The Cronbach's alpha of this scale was 0.959.

3.3. Data analysis

We first used SPSS version 26 to conduct the descriptive statistical and correlational analyses. As suggested by Hayes and Preacher (2014), we then tested mediating and moderating effects by running the Process macro (version 3.0) for SPSS (model 14). The indirect, moderating, and conditional indirect effects in relation to mobile phone addiction and mental health were analyzed using the biased-corrected bootstrapping method.

4. Results

4.1. Descriptive statistics and correlations

Table 1 presents the descriptive, correlation, and reliability results with respect to the variables of interest. Mobile phone addiction was positively associated with sleep quality ($r = 0.872$, $p < 0.01$), but it was negatively related to mental health ($r = -0.886$, $p < 0.01$) and perceived social support ($r = -0.770$, $p < 0.01$). Sleep quality was negatively correlated with mental health ($r = -0.875$, $p < 0.01$) and perceived social support ($r = -0.707$, $p < 0.01$). Finally, perceived social support was positively associated with mental health ($r = 0.740$, $p < 0.01$).

4.2. Hypothesis testing

Table 2 shows that mobile phone addiction negatively affected mental health ($B = -0.881$, $p < 0.001$), supporting Hypothesis 1. The table also indicates that mobile phone addiction was significantly related to sleep quality ($B = 0.543$, $p < 0.001$) and that sleep quality was significantly related to mental health ($B = -0.657$, $p < 0.001$). Moreover, the bootstrap-derived indirect impact of mobile phone addiction on mental health were significant ($B = -0.357$, 95% confidence interval [CI]: [−0.438, −0.269]). Thus, sleep quality partially mediated the negative association between mobile phone addiction and mental health, supporting Hypothesis 2.

The interaction between sleep quality and perceived social support affected the university students' mental health significantly and positively ($B = 0.192$, $p < 0.001$; Table 3). We drew an interaction plot (Figure 2) to further explain the results. Figure 2 shows that the effect of sleep quality on mental health was weaker among those students who perceived receiving more perceived social support. This finding supports Hypothesis 3.

Finally, to test the hypothesized moderated mediation, we determined the conditional indirect impact of mobile phone addiction on mental health through sleep quality (the mean level, one standard deviation above the mean level, and one standard deviation below the mean level). Table 4 reflected that mobile phone addiction had significant indirect effects on mental health across all levels of perceived social support. The indirect effects were significant but weakened as perceptions progressed from low perceived social support ($B = -0.433$, 95% CI: [−0.529, −0.337]) to high perceived social support ($B = -0.262$, 95% CI: [−0.356, −0.163]). These findings are supported by the index of moderated mediation ($B = 0.095$, 95% CI: [0.043, 0.149]), which in turn translates to support for Hypothesis 4.

TABLE 1 Means, standard deviations and correlations among variables.

Variables	1	2	3	4	5	6	7	8
1. Gender	1							
2. Age	−0.053	1						
3. Time using MP	−0.014	−0.101*	1					
4. Frequency using MP	−0.057	0.058	−0.153**	1				
5. MPA	0.088*	−0.274**	−0.344**	0.133**	(0.959)			
6. SQ	0.098*	−0.226**	−0.387**	0.147**	0.872**	(0.806)		
7. PSS	−0.031	0.332**	0.300**	−0.088*	−0.770**	−0.707**	(0.957)	
8. MH	−0.054	0.253**	0.391**	−0.123**	−0.886**	−0.875**	0.740**	(0.959)
Mean	1.441	20.327	4.226	3.564	3.120	2.585	2.167	2.880
SD	0.497	1.652	2.684	5.125	1.095	0.716	0.818	1.145

$N = 585$. Boldface values indicate Cronbach's alpha. MP, mobile phone; MPA, mobile phone addiction; SQ, sleep quality; PSS, perceived social support; MH, mental health.
*$p < 0.05$, **$p < 0.01$.

TABLE 2 Results of mediating hypotheses.

Variables	Sleep quality	Mental health	
	Model 1	Model 2	Model 3
Constant	1.014 (0.220)***	4.895 (0.332)***	5.561 (0.305)***
Gender	0.035 (0.029)	0.055 (0.044)	0.078 (0.040)*
Age	−0.004 (0.009)	0.023 (0.014)	0.020 (0.013)
Time using MP	−0.026 (0.006)***	0.045 (0.009)***	0.028 (0.008)***
Frequency using MP	0.003 (0.003)	0.001 (0.004)	0.003 (0.004)
Mobile phone addiction	0.543 (0.015)***	−0.881 (0.022)***	−0.031 (0.002)***
Sleep quality			−0.657 (0.057)***
Total effect [95% CI]		−0.881 [−0.926, −0.837]	
Direct effect [95% CI]		−0.525 [−0.597, −0.453]	
Indirect effect [95% CI]		−0.357 [−0.438, −0.269]	
R^2	0.770***	0.794***	0.833***

Bootstrap size = 5000. CI, confidence interval. *$p < 0.05$, ***$p < 0.001$.

TABLE 3 Results of moderating hypotheses.

Variables	*B*	SE	*p*	Boot LLCI	Boot ULCI
Outcome variables: mental health					
Constant	3.854	0.306	0.000	3.253	4.455
Gender	0.072	0.039	0.062	−0.004	0.148
Age	0.014	0.013	0.261	−0.011	0.039
Time using MP	0.012	0.009	0.154	−0.005	0.029
Frequency using MP	0.003	0.004	0.442	−0.005	0.010
Mobile phone addiction (X)	−0.433	0.041	0.000	−0.513	−0.353
Sleep quality (M)	−0.640	0.056	0.000	−0.750	−0.531
Perceived social support (W)	0.199	0.041	0.000	0.117	0.280
M × W	0.192	0.049	0.000	0.097	0.287
$R^2 = 0.841$***, *F*-value = 380.399					

Bootstrap size = 5000. Boot SE, bootstrapping standardized error; LL, low limit; UL, upper limit; CI, confidence interval. ***$p < 0.001$.

5. Discussion and conclusion

This study investigated the linkage between mobile phone addiction and mental health, as well as the underlying mechanisms that influence the aforementioned relationship. Our findings are summarized as follows. To begin with, our results indicated that mobile phone addiction affected mental health significantly and negatively. That is, university students who indulge in mobile phones are more vulnerable to psychological disorders. This finding is in line with those of previous empirical studies (Jun, 2016; Desouky and Abu-Zaid, 2020; Ivanova et al., 2020; Ophir et al., 2020; Perilli et al., 2021; Sümen and Evgin, 2021), most of which confirmed a negative relationship between mobile phone addiction and mental health, giving rise to problems such as anxiety, well-being, depression, and other psychological disorders. Thus, our research adds to the empirical evidence on mobile phone addiction leading to mental health problems (Cheng and Meng, 2021).

Second, our study revealed that sleep quality partially mediated the association between mobile phone addiction and mental health. In line with prior studies (Adams et al., 2013; Xie et al., 2018; Zou et al., 2019), the current work confirmed the mediating effect of sleep quality on the link between mobile phone addiction and mental health in the Chinese context. According to technology addiction theory (Chen et al., 2016), technology addiction disrupts university students' normal sleep patterns, which then poses a high risk to their mental health. The university students with considerable addiction to mobile phones or the internet generally had lower levels of sleep quality, thereby giving rise to depressive symptoms and affective disorders (Lauren et al., 2017; Carlin, 2018). On this basis, the current work strengthens the empirical evidence on sleep quality's partial mediation of the linkage between mobile phone addiction and mental health among Chinese university students.

Third, perceived social support moderated the association between sleep quality and mental health. To wit, the university students who perceived the availability of substantial social support had better sleep quality, thereby bringing about greater levels of mental health. As can be seen, perceived social support can mitigate the harmful impacts of inferior sleep quality on mental health given that it protects and promotes university students' psychological well-being (Watson et al., 2016; Fang and Lung, 2022). Although scholars have generally regarded perceived social support as an antecedent of mental health, our research confirmed the moderating effects of such support in the association between sleep quality and mental health for the first time.

5.1. Theoretical implications

The present study has made certain theoretical contributions to the literature on mobile phone addiction. First, our findings confirmed the adverse effect of mobile phone addiction on mental health among Chinese university students. Although the direction of causality between mobile phone addiction and mental health remains disputed (Augner et al., 2023), the present study extends scholarship on mobile phone addiction based on a Chinese sample. Given that previous research presented mixed and inconsistent results regarding the linkage between mobile phone addiction and mental health across nations (Jun, 2016; Park et al., 2019; Dowran, 2020), the present research offers new insights into the aforementioned relationship from a cross-cultural perspective. Second, this research uncovered the mechanism that mediates the relationship mobile phone addiction and mental health. To date, only a few empirical studies have focused on the significant effects of sleep quality on mobile phone addiction and health-related issues (Tao et al., 2017; Xie et al., 2018; Zou et al., 2019; Ho, 2021). The majority of these endeavors paid attention to the various directions in which the above-mentioned link occurs (Jun, 2016; Park et al., 2019; Augner et al., 2023), but little attention has

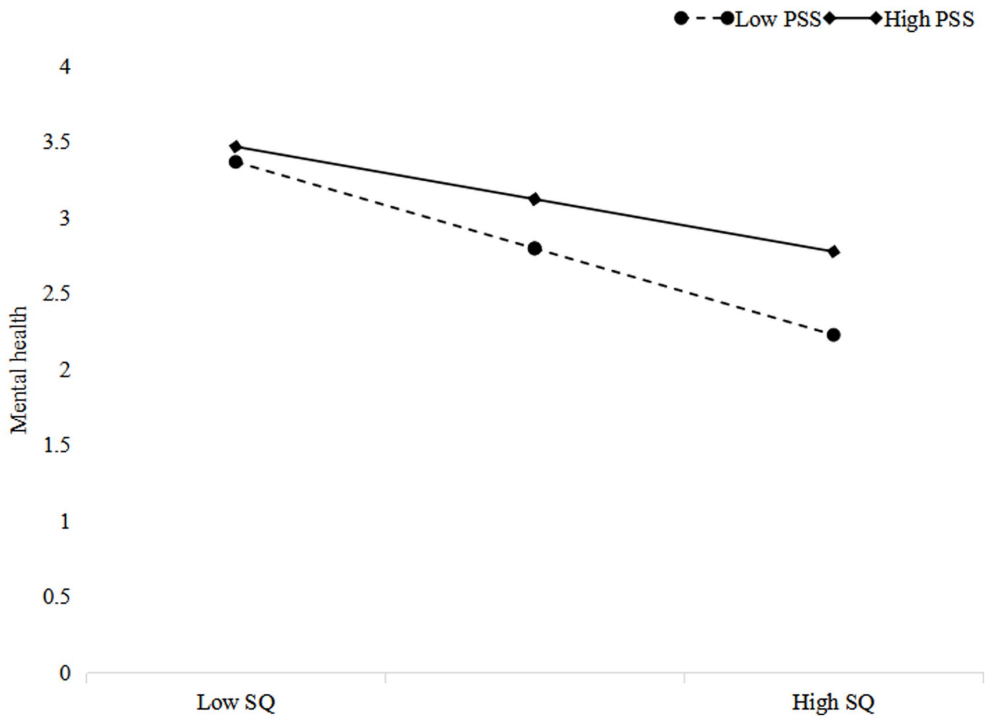

FIGURE 2
Interaction plot of sleep quality (SQ) and perceived social support (PSS) predicting mental health.

TABLE 4 Results for the index of moderated mediation and conditional indirect effects.

Moderator: perceived social support	Effect/ Index	Boot SE	Boot LLCI	Boot ULCI
Conditional indirect effects [95% CI]				
M − SD (−0.818)	−0.433 (0.049)		−0.529	−0.337
Mean	−0.348 (0.042)		−0.429	−0.264
M + SD (+0.818)	−0.262 (0.049)		−0.356	−0.163
Index of moderated mediation [95% CI]				
Perceived social support	0.104 (0.030)		0.048	0.167

Bootstrap size = 5000. Boot SE, bootstrapping standardized error; LL, low limit; UL, upper limit; CI, confidence interval.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

been paid to the potential mediators of this relationship. Our study extends existing efforts by proposing sleep quality as a mediator. Third, the research also broadens the application of social support theory by highlighting the protective role of perceived social support for university students with extensive mobile phone addiction. Whereas previous studies primarily considered perceived social support a mediator in research models related to mobile phone addiction (Guo et al., 2021; Lin et al., 2021), the present work is the first to explore the moderating effects of perceived social support in the relationships of mobile phone addiction and sleep quality with mental health. By doing so, our study extends the application and generalization of social support theory to the Chinese context (Wang et al., 2018; Zhou et al., 2021).

5.2. Practical implications

Our research also provides some practical implications for students and administrators at Chinese universities. First of all, in view of the significant effects of mobile phone addiction on mental health, mobile phone use can be regarded as a key criterion for assessing levels of self-reported mental health. University administrators should prevent mobile phone addiction among students through various effective and accessible early intervention programs, such as traditional classroom education, keynote speeches, and brochure distribution. For their part, university students should acutely realize that their physical and psychological health will be influenced by mobile phone addiction negatively. A necessary task is for them to focus on real life by reducing mobile phone use. Second, administrators should also realize the urgency of taking effective measures to improve students' sleep quality. Most sleep-deprived university students suffer from serious mobile phone addictions. Therefore, administrators should distinguish such students from the rest of the student body by conducting a sleep quality epidemiological investigation and then providing effective consultation and intervention, as well as periodically carrying out psychological tests. Additionally, administrators can establish mutual aid dormitory groups to help students get into the habit of going to bed on time. Third, our results stressed the positive effect of perceived social support in mitigating the risk of health-related problems resulting from poor sleep quality. Administrators should encourage students to

secure part-time work or provide such employment for them because extracurricular activities potentially increase the perceived social support received by students (Lee, 2020). Because perceived social support can enhance students' mental health significantly (Xu et al., 2018), university students should have access to increased social assistance from parents, teachers, and peers. Specifically, parents should offer high-quality emotional attention and support to their children. Continuing extensive perceived social support from teachers in school can help university students complete their studies. More importantly, emotional sharing and information acquisition among significant peers can guarantee that university students experience increased understanding, concern, and love.

5.3. Limitations and future research directions

Our research is encumbered by several limitations. To begin with, the cross-sectional research design precluded us from clarifying the causal relationships between the variables. Although our findings revealed a negative association between mobile phone addiction and university students' mental health, the results should be explained with caution. Given that our findings based on a cross-sectional design may be changeable and become uncertain with time, researchers should exploit experimental designs, longitudinal data, or panel data to test causal claims in the future. Second, we collected self-reported data from the respondents, potentially resulting in common method bias, which may drive artificially inflated correlations (Crampton and Wagner, 1994). Hence, other researchers should collect data through different types of surveys. For instance, perceived social support can be ascertained through self-reports from students, while other variables, such as mental health and sleep quality, should be measured by doctors. Third, the study was conducted in one region, southwest China, thus preventing the findings from being generalized to universities in other regions, particularly developed eastern coastal areas. Previous research confirmed the negative impacts of mobile phone addiction on mental health across different groups or regions (Park et al., 2019; Dowran, 2020; Ivanova et al., 2020). Future explorations should therefore look into the factors influencing mobile phone addiction among university students in other regions of China.

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

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 patients/participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

L-LY: Conceptualization, Formal analysis, Investigation, Writing – original draft. CG: Conceptualization, Investigation, Writing – original draft, Formal analysis. G-YL: Conceptualization, Formal analysis, Investigation, Writing – original draft. K-PG: Conceptualization, Investigation, Writing – original draft, Project administration, Writing – review & editing. J-HL: Conceptualization, Formal analysis, Investigation, Writing – original draft.

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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.

Publisher's note

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Latent profile analysis of gambling

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Early age of gambling onset, ease of gambling with technological developments and lack of controlling online gambling games have led to unmanageable risk of gambling. Individual-centered approaches play a significant role in managing the risk that gambling poses on public health and discerning the heterogeneity of gambling addiction. Therefore, this study employed Latent Profile Analysis (LPA), one of the individual-centered approaches, to model the interactions across the psychosocial characteristics of gamblers. The study aims to reveal the latent profiles of gambling addiction. Unlike variable-centered approaches, LPA is a contemporary technique that provides objective information regarding individual psychological processes and behaviors. The profile indicators of the study involve psychosocial characteristics such as resilience, motives to gamble (excitement/fun, avoidance, making money, socializing), purposefulness, responsibility and worthiness. Data were collected from 317 volunteers (M = 68.9%; *F* = 31.1%; mean age = 25.16 ± 6.46) through the Brief Resilience Scale (BRS), Gambling Motives Scale (GMS) and Personal Virtues Scale (PVS). The emerging profiles were defined as adventurous players (14.2%), social gamblers (9.8%), professional gamblers (32.8%), problem gamblers (24.6%) and avoidant gamblers (18.6%). The individual-centered modeling is congruent with the literature on gambling and provides a complementary perspective to understand the heterogeneous structure of gambling. The results are expected to assist mental health professionals in developing educational and clinical intervention programs for gambling behavior. Finally yet importantly, it is recommended that new LPA models be offered through the use of different indicators related to gambling addiction.

KEYWORDS

gambling, gambling motives, latent profiles analyze, personal virtues, resilience

Introduction

Considered as a behavioral addiction, gambling has become more prevalent with technological developments. Besides, individuals' tendency toward gambling has increased during crisis periods. People mostly engage in online gambling during and after the pandemic (Emond et al., 2021). Numerous public authorities [WHO, 2017; Gambling Commission, 2022; General Directorate of Security (GDS), 2022; Green Crescent, 2022] and academic studies (Grant and Potenza, 2006; Çakıcı, 2019) reveal that gambling is a common behavior. Technological advances (accessibility) that facilitate gambling and the decrease in the age of meeting with gambling (Welte et al., 2008; Erdoğdu, 2017) demonstrate that gambling behavior has become a social risk. Online gambling games (e.g., scratchcards, lottery, bet on sports) where the age requirement is not controlled (Gambling Commission, 2022) reveal that this risk has reached unmanageable dimensions for the younger generation. It is evident that the increasing gambling behavior, the difficulty of monitoring online gambling and easy access to gambling games (scratch cards, etc.) on the streets by those under the age of 18 (Erdoğdu, 2017) will obstruct the controllability of gambling behavior and interventions. Besides, the strong relationship between gambling and alcohol addiction (Emond et al., 2021) proves that people

who gamble may experience different problems (substance addiction, depression). Gambling behavior includes some psychological motives (e.g., avoidance, socialization, excitement; Lee et al., 2007; Clark, 2014). Different psychological motives result in differentiation across the individuals' gambling profiles. Understanding the differences between the profiles of individuals who gamble may contribute to the fight against gambling (Faregh and Leth-Steensen, 2011). In this regard, it is vital to investigate the triggers of gambling habits, the reasons for starting gambling and the characteristics (profiles) of individuals who gamble in terms of reducing gambling addiction.

The characteristics of individuals who gamble (e.g., personality) are mostly associated with the etiology of gambling (Strømme et al., 2021). However, there is a dominant view that risk factors (e.g., negative characteristics such as avoidance, compensatory, socialization, making money, amusement, negative social environment) and protective factors (e.g., positive characteristics such as resilience, personal values and durability) determine the direction of problematic behaviors like gambling (Dowling et al., 2009; Hing and Gainsbury, 2013; Jang et al., 2019). The risk factors-based view claim that gambling is characterized by sensation seeking, crime, liveliness, anti-social behaviors, psychological distress (Steel and Blaszczynski, 1996) and impulsive behaviors (Lawrence et al., 2013; Dowd et al., 2020). For instance, impulsive behaviors often co-occur with addictive behaviors such as internet gaming disorder. Therefore, it is highly probable that gambling behavior has similar psychological mechanisms as internet gaming disorder and digital gaming behaviors (Iacolino et al., 2019). In addition, the etiology of gambling behavior involves a biopsychosocial structure similar to other types of addiction (Yau and Potenza, 2015). These are genetic predispositions, neurotransmitters (activation of the brain's reward center), socio-economic factors (living in a gambling environment, desire to make easy money, entertainment, opportunities to access gambling, lack of legal restrictions) and psychological mechanisms (e.g., seeking excitement, avoiding distress, desire to socialize, cognitive assumptions such as making money in a short time, definitely winning; Lee et al., 2007; Clark, 2014; Çakıcı, 2019). In this vein, it is most probable that the symptom and problem-oriented (psychopathological) perspective of traditional psychology is dominant in seeking gambling behavior. Although studies carried out from a problem-oriented perspective eliminate the problems in a sense, the treatment and explanation levels for some disorders are considered insufficient (Jiménez-Murcia et al., 2007; Dowling et al., 2009; Merkouris et al., 2016). These evaluations have led researchers to seek answers to the question of what else can be done in cases where multidimensional psychological mechanisms such as gambling play a role. In other words, researchers have focused on positive psychology, which aims to develop the positive aspects of these individuals rather than eliminate the problems (Seligman, 2002). Therefore, the researchers should focus on identifying and developing the strong characteristics of the gambler instead of only the variables and risk factors (neuroticism, anxiety, stress, negative environment) that lead the individual to gamble. Thus, it is of great significance to determine the profiles of individuals who gamble through evaluating gambling behavior within the context of positive characteristics (e.g., resilience, values, hope, etc.) rather than psychopathological concepts (e.g., hopelessness, risk factor, anxiety, anti-sociality, neuroticism). This study is an attempt to reveal the reasons for individuals to gamble through concepts such as resilience, purposefulness, responsibility and worthiness, which are the basic concepts of positive psychology.

The causes of gambling addiction spread to a wide range within the framework of social environment, emotions, thoughts and behaviors (Buran, 2021). Cognitions (reducing stress, avoidance, desire to socialize), emotions (excitement) and behavioral variables (making money, having fun) play a critical role in individuals' gambling behavior (Lee et al., 2007). Furthermore, individuals' resilience skills are regarded as a protective factor on gambling behavior (Goldstein et al., 2013). Given that low self-efficacy beliefs make people more vulnerable to risky situations (gambling; Grall-Bronnec et al., 2016), it is fundamental to investigate gamblers' resilience levels. In addition, researchers focus on positive psychology assumptions regarding the empowerment of people and their ability to adapt to changing life conditions due to the multidimensional nature of the causes that initiate and maintain gambling behavior (Lee et al., 2007; Clark, 2014) as well as the lack of the problem-focused perspective (Jiménez-Murcia et al., 2007; Dowling et al., 2009; Merkouris et al., 2016). Because resilience (Sapienza and Masten, 2011) is expected to reflect growing focus on reducing the risk factors that individuals are exposed to, adapting to changing living conditions and strengthening them. In this regard, examining the profiles of gamblers with regard to their resilience skills is predicted to shed light onto preventing gambling addiction and reducing its effects.

Current literature demonstrates that resilience skills are characterized by seeing oneself as competent, being hopeful, feeling valuable, and making decisions (e.g., taking responsibility, setting goals, making analysis; Li et al., 2018; Pinar et al., 2018). Likewise, happiness, feeling valuable, being hopeful and problem solving (being purposeful, responsible, making choices) skills aim at empowering the individual (Savi-Çakar, 2018). Purposefulness is related to the individual's ability to make a choice in order to be happy. Values determine how an individual will behave when encountering an event/situation (Tatlıoğlu, 2014). To exemplify, individuals may act according to the instant pleasure they feel, or they may prefer the peace/pleasure as a result of their long-term behaviors (Seligman, 2002). Similarly, responsibility requires being purposeful and determined (Tatlıoğlu, 2014). Besides, feeling valuable not only contributes to mental health, but also strengthens against risky situations (Saygın, 2008). Namely, purposefulness, responsibility and worthiness have a strong effect on people's happiness (Aydın, 2018). Hence, it may be wise to mention that positive skills such as being happy, feeling valuable, feeling responsible, being hopeful and making decisions strengthen individuals against risky behaviors like gambling addiction (Maddi et al., 2013). People seek happiness in gambling instead of in their normal lives (Lester, 1994; Wood and Griffiths, 2007), which supports these views. Therefore, investigating the positive characteristics such as responsibility, purposefulness and worthiness in terms of the profiles of individuals who gamble may provide reliable information in identifying gamblers.

Studies aiming to determine the characteristics of individuals who gamble mostly seem to have a problem-oriented perspective (Grant et al., 2014; WHO, 2017; Buran, 2021; Emond et al., 2021; Brazeau and Hodgins, 2022). These studies examined the relationships and etiological structure between gambling and excitement (Kjome et al., 2010), avoidance (Vaughan and Flack, 2021), making money, having fun (Flack and Morris, 2015), anti-sociality and risk-taking behaviors (Mishra et al., 2017). Mammadov et al. (2016) concluded that these studies are insufficient to explain the multidimensional structure of gambling behavior since they generally reflect gambling addiction in

terms of problem-based variables. Since a variable-centered approach does not allow to discover the relationships across any variable and the levels of other variables, this method provides no information about individual psychological processes and behaviors (Mammadov et al., 2016). In addition, it is burdensome to distinguish precisely and effectively the heterogeneity of the target group of gamblers. Thus, studies on gambling are insufficient to reveal the problem in the literal sense (Ribeiro et al., 2021). There is a need for studies investigating gambling behavior in terms of positive psychology approach (protective factors). The relevant literature involves only two studies that explain gambling addiction within the framework of protective factors such as resilience, flexibility and positive social environment (Lussier et al., 2007; Goldstein et al., 2013). One of these studies determined subtypes of individuals who gamble through latent class analysis (CFA; Faregh and Derevensky, 2011; Goldstein et al., 2013). Hence, there is a dearth of studies identifying gambling subtypes. Moreover, more attention should be paid to the participants' demographic differences across studies on gambling behavior. Mental disorders defined in DSM-5 are classified into types based only on the number of diagnostic criteria. The limitations of the categorical classifications adopted in the DSM-5 have been questioned by various empirical studies (Widiger et al., 2009). A mental disorder cannot be separated from others with absolute limits (Widiger and Samuel, 2005). Therefore, model-based (e.g., LPA) approaches are required to predict and distinguish the latent heterogeneity of the working group (Wang et al., 2017).

Latent Profile Analysis (LPA) is a contemporary person-centered technique used to model the characteristics of an individual (Ferguson and Hull, 2018). This method warrants that individuals in the sample belong to a unique profile–without any distinction across possible latent subgroups. Thus, the method reveals individual differences that emerge through profile membership with an individual-centered approach (Eshghi et al., 2011). Considered as a powerful technique, the latent profile suggested in the LPA enables the results to be more objective and precise by means of a set of fit indices to predict the goodness of the model (Wang and Wang, 2020). The research is unique in this respect.

Studies on gambling behavior heavily focused on factors that increase the likelihood of gambling or contribute to gambling problems; however, few studies were conducted on the probability of gambling. Therefore, there is a need for studies that examine gambling behavior in terms of positive psychology within the scope of strong statistical analyses. On the other, there is no such a study specifically published on examining individuals' reasons for gambling and their positive characteristics (virtues such as resilience, responsibility, purposefulness, and worthiness). In this respect, this study is expected to decipher a different perspective on the subject. Herewith, it is critical to understand the profiles of individuals with gambling problems with the aim of identifying those who are most in need of gambling addiction prevention, defining the needs of individuals most at risk, and adapting early intervention strategies. This study aims at investigating the latent profiles of individuals who gamble in terms of resilience levels, reasons for gambling and positive characteristics (responsibility, purposefulness and worthiness) through the latent profile analysis method (LPA). This study aims to explore potential hidden profiles (distinct subgroups) within gambling behavior. The examination of diverse gambling profiles will enhance a better understanding of the relevant variables and existing inconsistencies in addictive behaviors such as gambling. Likewise, this study may shed light onto understanding the heterogeneity of gambling addicts and related psychological mechanisms (e.g., problem/developmental). The research hypotheses (questions) addressed in this study are as follows:

1. Do the variables affecting gambling exhibit interrelationships?
2. What are the hidden profiles within gambling behavior?

Methods

Participants and procedure

The study involved 415 participants selected using the criterion sampling method, which required participants to be over 18 years old and actively engaged in at least one gambling game (Ary et al., 2010). Forms completed by individuals with incomplete or incorrect information, those under the age of 18, and those not currently involved in gambling were excluded from the study. As a result, the research was conducted with a total of 317 participants. Since the data were collected from those who actively gamble, the data collection process was quite long (June 2020–December 2022). After the approval of the ethics committee (Decision dated 09 March 2020 and numbered E-2000077272), data were collected ($n = 252$) through the Google Forms link address created for potential participants and the interaction forums of online gambling and betting sites via social media (WhatsApp, Instagram, Facebook).

Besides, some of the data were collected ($n = 65$) through face-to-face interviews ith gamblers on a voluntary basis (with their consent). The ages of the participants varied across 57 to 18, and the majority of them were males (M = 68.9%; $F = 31.1\%$; mean age = 25.16 ± 6.46). 39.4% of the participants were secondary education graduates, 37.1% university graduates and 25.5% primary education graduates, respectively. The participants pointed out that they gamble on platforms such as national lottery games (e.g., national lottery, sports betting), card and stone games (e.g., online poker, okey, etc.), machine games (including online), and crypto exchange (leveraged transactions). This variable was omitted from the study due to participants' reluctance to disclose information about their professions during the pilot interviews.

Data collection tools

Socio-demographic information form

Socio-demographic information form includes questions regarding age, gender, educational level and types of gambling games. This form was prepared by the researcher within the framework of the literature review on gambling addiction (Grant et al., 2014; WHO, 2017; Emond et al., 2021; Green Crescent, 2022).

The brief resilience scale

The tool was developed by Smith et al. (2008) to determine the participants' resilience levels. The scale was adapted into Turkish by Doğan (2015). Being a 5-point Likert-type, the scale has a unitary construct with a total of 6 items, 3 positive and 3 negative. The results of the factor analysis performed within the scope of the validity in the Turkish adaptation study showed that the scale has a single factor structure that explains 54% of the total variance. Besides, the factor

loads of the scale items were identified to differ between 0.63 and 0.79. The Cronbach alpha coefficient was found to be 0.83 (Doğan, 2015).

The Cronbach's alpha coefficient of brief resilience scale (BRS) was determined as 0.80 in the present study. Although the Turkish version of the scale has a unitary construct, the current study determined two factors. This result is congruent with the finding that inverse items created two factors in the sample group in which low socio-economic participants were included in the study on resilience skills (Hidalgo-Rasmussen and González-Betanzos, 2019). Considering the CFA results for BRS in terms of fit indices, the factor structure for this study sample was confirmed (χ^2/df = 0.345, RMSEA = 0.006, TLI = 0.99, CFI = 0.99; Tabachnick and Fidell, 2013). The factor loads of the items related to the scale varied between 0.56 and 0.80.

Gambling motives scale

The 35-item scale, designed to assess motivation underlying gambling behavior, was originally developed by Lee et al. (2007). Arcan and Karanci (2014) adapted this scale to Turkish culture. During the adaptation process, Arcan and Karanci (2014) proposed a four-subdimensional scale model for Gambling motives scale (GMS; the Turkish adaptation). Each statement were rated on a 3-point Likert type as "I agree," "I partially disagree" and "I disagree." The score obtained from the whole scale determines the participants' total motivation scores regarding gambling.

The internal consistency coefficients of the factors were $\alpha = 0.83$ for socialization, $\alpha = 0.78$ for fun/excitement, $\alpha = 0.90$ for avoidance, and $\alpha = 0.87$ for monetary. The internal consistency coefficient was $\alpha = 0.92$ for the whole scale. This study determined the internal consistency coefficient as $\alpha = 0.94$ for the overall scale. As regards the internal consistency coefficients of the factors, $\alpha = 0.90$ for socialization, $\alpha = 0.93$ for fun/excitement, $\alpha = 0.91$ for avoidance, and $\alpha = 0.87$ for monetary. The results of CFA suggested that the scale structure was confirmed (χ^2/df = 2.94, RMSEA = 0.01, TLI = 0.89, CFI = 0.89; Tabachnick and Fidell, 2013).

Personal virtues scale

The scale developed by Demirci and Ekşi (2018) consists of three factors-responsibility, purposefulness and worthiness and a total of 15 items. Each factor is scored in itself, and as the scores increase, the relevant feature also increases. The Cronbach Alpha coefficient of the whole scale was 0.86. As for the factors, the coefficients were 0.82 for responsibility, 0.77 for purposefulness and 0.75 for worthiness. The internal consistency coefficients of the scale were found to be 0.91 for the whole scale, 0.84 for the responsibility, 0.86 for the purposefulness and 0.84 for the worthiness in the present study. In addition, the fit indexes of CFA results (χ^2/df = 3.15, RMSEA = 0.00, TLI = 0.91, CFI = 0.93) confirm the scale structure for this study (Tabachnick and Fidell, 2013).

Data analysis

Data analysis started through examining missing data and extreme values. Of the 415 sets, missing data and the forms filled by participants under the age of 18 and those who do not currently gamble were excluded from the dataset, and analyses were conducted on the dataset, which included 317 participants. Data were examined for normality of distribution, multicollinearity, multivariate normality and linearity. In this regard, all assumptions were met. Afterwards, confirmatory factor analysis was performed to reveal the structure of the measurement tools. Latent profile analysis (LPA) was conducted via the R program related to the variables of resilience, reasons for gambling, responsibility, purposefulness and worthiness.

Latent profile analysis is a statistical procedure in which latent indicators are used continuously while performing latent class analysis (Rosenberg et al., 2018). LPA analyses were made by determining which models (EEI, EEE, VVI, VVV…) defined the best profile memberships. In this context, the analyses made via the R programming language (Mclust) demonstrated that the VVV (varying volume, varying shape, varying orientation) model defines the best profile memberships (Wardenaar, 2021). Hence, five profile memberships were identified within the framework of the criteria (BIC, AIC, BLRT, Entropy) obtained from the analyses made through the use of TidyLPA and Mclust packages (Rosenberg et al., 2018).

Thereafter, the number of latent profiles within the working group was determined in LPA. BIC, AIC, LMR-LRT, entropy value and posterior probabilities were used to determine the participants' latent profile number. Smaller values for AIC and BIC indicate a better fitting model. Entropy is an index for predicting the quality of class assignments, and a higher entropy refers to a higher classification precision (Rosenberg et al., 2018). Besides, a nonsignificant ($p > 0.05$) LMR-LRT value signifies that adding more profiles to the model does not improve the model. Moreover, a value close to 1.0 for entropy values points a better decision on the number of profiles to include (Wang and Wang, 2020). Finally, the differences across the variables and latent profiles were examined through ANOVA and Chi-square analyses.

Findings

Normality tests were initially performed on the data (Skewness and Kurtosis), and hence the data showed a normal distribution (+1; −1; Tabachnick and Fidell, 2013). The relationship across the variables was examined ([$r \geq 0$, low, $r \geq 0.3$ medium, and $r \geq 0.5$] Cohen, 1994). Table 1 displays the correlation summary for the research variable.

The presence of a relationship between resilience and personal virtues (responsibility, purposefulness and worthiness) is an unexpected situation since the sample consists of those who still report gambling, and GMS does not determine the level of gambling, but aims to identify the types of gambling motives of current gamblers. For instance, it is experiential and theoretically unlikely that an increase in resilience will increase one's motivation to gamble for socialization. The relevant literature suggests that risky behavior is expected to decrease as resilience increases (Sapienza and Masten, 2011). Therefore, this study did not analyze the relationship across the variables representing the positive characteristics of individuals and the reasons for gambling as the severity of gambling was not measured. However, all variables were analyzed together and displayed below. Accordingly, no relationship was identified between resilience and the factors of excitement/entertainment, making money and socializing, while a negative relationship was found across avoidance factor. A positive correlation was determined between resilience and responsibility, purposefulness and worthiness ($p \leq 0.001$). While a relationship was noted between responsibility, avoidance and making money, excitement/entertainment and socialization were free from

TABLE 1 Correlations, means (m), and standard deviations (sd) related to variables.

Variable	1	2	3	4	5	6	7	8	M	SD
Resilience	-								19.41	4.75
Excitement/fun	0.76	-							45.67	12.70
Avoidance	−0.35**	0.29**	-						17.80	7.23
Making money	−0.01	0.45**	0.48**	-					22.10	7.91
Socialization	0.02	0.46**	0.40**	0.41**	-				16.51	6.60
Responsibility	0.32**	0.96	−0.22**	0.16**	0.05	-			19.58	3.84
Purposefulness	0.33**	0.19**	0.17**	0.16	0.13*	0.54**	-		18.66	4.34
Worthiness	0.35**	0.16**	−0.20**	0.05	0.11*	53**	0.65**	-	18.16	4.20

*$p < 0.05$; **$p < 0.01$.

TABLE 2 EEI model fit statistics for determining the optimal number of classes.

Model	LL	BIC	AIC	BLRT	BLRT (*p*)	Profile comparisons	Entropy
1	−3,651	7,334	7,395	340.18361	0.001	1 vs. 2	1
2	−3,481	7,012	7,107	171.10886	0.001	2 vs. 3	0.787
3	−3,396	6,859	6,987	147.10182	0.001	3 vs. 4	0.817
4	−3,322	6,730	6,892	64.46335	0.001	4 vs. 5	0.876
5	−3,290	6,684	6,880	106.14946	0.001	5 vs. 6	0.866
6	−3,237	6,595	6,826	53.70494	0.001	6 vs. 7	0.867

TABLE 3 EEE model fit statistics for determining the optimal number of classes.

Model	LL	BIC	AIC	BLRT	BLRT (*p*)	Profile comparisons	Entropy
1	−3,240	6,568	6,734			1 vs. 2	1
2	−3,229	6,565	6,765	20.61364	0.199	2 vs. 3	0.676

any significant relationship. A relationship was found between purposefulness and worthiness and excitement/fun, avoidance ($p \leq 0.001$) and socialization ($p \leq 0.05$); whereas no relationship was determined across making money. Besides, a positive relationship was found between excitement/entertainment, avoidance, making money and socializing ($p \leq 0.001$).

LPA was performed after the correlation analysis for the main variables for providing a much more detailed description of the profiles of gamblers (Wang et al., 2017). Findings regarding the analyzes and model fit of the LPA analysis are depicted in Tables 2, 3 (EEI) and (EEE).

All psychosocial variables (resilience, responsibility, purposefulness, worthiness) and reasons for gambling (excitement/fun, avoidance, making money, socializing) were included in the analysis. Analyses were conducted via TidyLPA and Mclust packages over the R program (Rosenberg et al., 2018). LPA determined which models identified the best profile memberships. Akaike information criterion (AIC), Bayes information criterion (BIC), adjusted Bayes information criterion (aBIC), entropy and bootstrap likelihood ratio test (BLRT) were accepted as the basic criteria of model fit (Wang and Wang, 2020). EEI, EEE, VVI, VVV models (Fraley et al., 2012) defining good profile memberships were tested for gradual inclusion of latent profile memberships. All models (except for EEE) except for the VVV (varying volume, varying shape, varying orientation) model have consistently offered to add a new profile membership to the model. The EEE (equal volume, equal shape, and equal orientation) model offered only three profile memberships. The VVV model, on the other, suggested the five-profile structure and the LMR-LRT values ($p > 0.05$) showed that adding more than five profiles to the model did not improve the model fit. Other models do not meet these criteria. In addition, entropy values (closer to 1.0), AIC and BIC values (preferring a smaller value) confirm the fit of this model (Masyn, 2013; Wang and Wang, 2020).

The number of profiles was determined according to BIC, AIC, BLRT and entropy value in the final model. Information on model fit information is summarized in Table 4.

The AIC value is the smallest for the five-profile solution (6052), while the BIC is the smallest for the two-profile solution (6734). The smallest BIC value after the two-profile model was observed within the five-profile model. Likewise, the highest entropy value (0.95) refers to the three-profile model. However, BLRT values [BLRT(p)=0.068] indicate that adding a profile to the model with five profiles will increase the model fit and adding a profile to the model when the sixth profile membership is added does not increase the fit (Ramaswamy et al., 1993). Thus, the five-profile was chosen as the most appropriate model based on all indices.

The profiles were entitled as descriptors to increase the readability of the data in Table 4. Figure 1 presents these profile memberships.

Based on these definitions, Profile 1 defines people with the highest level of resilience and purposefulness, and medium level of

TABLE 4 Final model (VVV) fit statistics for determining the optimal number of classes.

Model	LL	BIC	AIC	BLRT	BLRT (*p*)	Profile comparisons	Entropy
1	−3,240	6,734	6,568	323.5066	0.001	1 vs. 2	1
2	−3,078	6,970	6,334	148.3214	0.001	2 vs. 3	0.958
3	−3,004	6,782	6,276	142.6273	0.004	3 vs. 4	0.907
4	−2,933	6,899	6,223	261.5832	0.001	4 vs. 5	0.872
5	−2,802	6,897	6,052	108.0877	0.068	5 vs. 6	0.923

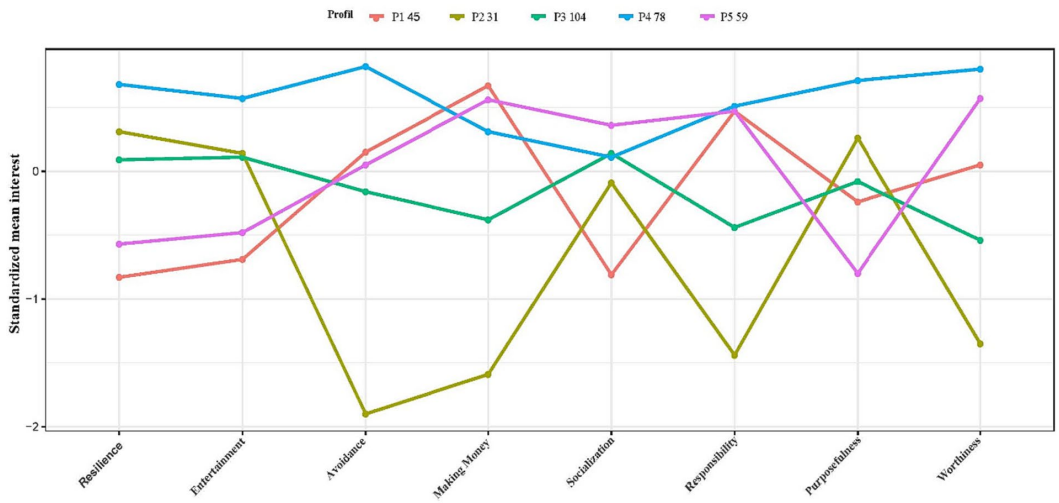

FIGURE 1
The latent profile model of gamblers.

responsibility and worthiness. These people also gamble for entertainment, socialization, and winning money at a very high level (compared to other profiles), yet they have low levels of avoidance (together with profile 2). This profile ($n = 45$, 14.2%) was defined as adventurous players. Profile definitions were established by drawing upon relevant literature (Ciarrocchi, 2002; Faregh and Leth-Steensen, 2011; McCormack and Griffiths, 2012; Weinstock et al., 2013; Çakıcı, 2019) and incorporating the researcher's observations.

Profile 2 is similar to profile 1 and has lower scores ($n = 31$, 9.8%). This profile includes individuals with a medium level of resilience and purposefulness scores and the lowest scores for responsibility and worthiness. They also gamble with high levels of entertainment and socialization ($n = 31$, 9.8%; low by profile 1, high by others), whereas the lowest level of avoidance and money-making gamblers. This profile was called social gamblers.

Those in Profile 3 have the lowest scores for resilience skills and purposefulness (along with profile 5) and those with high responsibility and worthiness scores (lower than Profiles 1 and 5). They also have the lowest entertainment (along with profile 3), average avoidance and socialization, the highest money-making gambling scores. This profile ($n = 104$, 32.8%) was conceptualized as professional gamblers.

Profile 4 has an average score in terms of resilience, worthiness and responsibility skills, while individuals in this profile have higher scores related to purposefulness (lower compared to profile 1). These individuals have average gambling scores due to entertainment, making money, avoidance and socializing. This profile ($n = 78$, 26.6%) was categorized as problem gamblers.

Similar to Profile 3, individuals in Profile 5 have the lowest scores for resilience and purposefulness, while the highest scores for responsibility and worthiness. They also have the lowest entertainment (along with profile 1), average money-making and socializing gambling scores, and the highest avoidance (lower than profile1) gambling scores. This profile ($n = 59$, 18.6%) was defined as avoidant gamblers.

Table 5 depicts the comparison across the profiles in terms of age, gender and educational level. Analyzes regarding profile memberships are presented as follows.

ANOVA results revealed no significant difference across the age profiles of the individuals. Besides, chi-square tests of independence showed no significant difference between profile membership and gender ($\chi 2(4) = 6.18$, $p < 0.018$; Cramer's $V = 0.201$) and educational status [$\chi 2(8) = 11.20$, $p = 0.019$; Cramer's $V = 0.13$]. Upon examining Table 5 in terms of all variables (age, gender, educational level), the problem gambler profile membership (profile 4) was found to have a higher probability.

Discussion

Based on a person-centered perspective (LPA), this study investigated different gambling profiles by including psychosocial indicators such as reasons for gambling, resilience, responsibility,

TABLE 5 Descriptive data and analysis of variance across profiles.

Variable	M (SD)						ANOVA			
	Profile 1	Profile 2	Profile 3	Profile 4	Profile 5	Overall				
	n = 45	*n* = 31	*n* = 104	*n* = 78	*n* = 59	*n* = 317	*F*(6,47)	*p*	η^2	Scheffe
	(14.2%)	(9.8%)	(32.8%)	(24.6%)	(18.6%)	(100%)				
Resilience	23.83	20.29	17.96	18.43	19,65	19.45	12,48	0.000	0.14	2 = 3 = 4 = 5 < 1
	(5,80)	2.92	2.22	5.47	2,91	4.68				
Excitement	53.03	37.31	42.65	45.13	52,44	45.57	15,77	0.000	0.17	2 = 3 < 4 < 5 = 1
	13.03	12.64	5.58	13.29	9,67	12.67				
Avoidance	14.40	13.17	21.52	17.94	19,80	17.68	13,92	0.000	0.15	2 = 1 < 4 < 5 = 3
	8.99	4.63	2.68	8.18	4,86	7.15				
M. money	23.11	15.17	23.73	21.84	27,13	22.11	20,41	0.000	0.21	2 < 4 = 1 = 3 < 5
	10.17	5.33	3.04	8.31	5,42	7.87				
Socialization	17.23	10.06	18.62	17.22	18,87	16.57	20,41	0.000	0.20	2 < 1 = 3 = 4 = 5
	7.94	2.99	2.68	7.08	5,23	6.51				
Purposeful…	24.66	18.65	16.52	18.79	17,07	18.75	31,47	0.000	0.29	2 = 3 = 5 < 4 < 1
	0.68	4.18	1.94	4.08	4,09	4.23				
Responsible…	24.37	20.02	17.00	20.82	15,44	19.54	79,48	0.000	0.50	3 = 5 < 2 = 4 < 1
	0.84	3.06	2.43	2.82	2,99	3.78				
Worthiness	24.63	19.02	16.31	17.62	16,35	18.18	41,88	0.000	0.35	3 = 4 = 5 < 2 < 1
	0.69	3.29	1.66	3.85	4,30	4.14				
Age	24.14	26.58	25.10	25.59	23.73	25.20	1,67	0.015	0.02	1 = 2 = 3 = 4 = 5
	5.05	7.14	5.93	7.34	4.34	6.46				
Female	2.20%	6.20%	3.70%	12.40%	6.50%	31.10%	-	-	-	-
Male	8.70%	9.90%	12.40%	27.30%	10.60%	68.90%	-	-	-	-
S. school	4.00%	3.10%	5.60%	8.40%	4.30%	25.50%	-	-	-	-
H. school	3.70%	5.90%	5.30%	16.10%	8.40%	39.40%	-	-	-	-
University	3.10%	7.10%	5.30%	15.20%	4.30%	35.10%	-	-	-	-

*$p < 0.05$.

purposefulness and worthiness. The results are congruent with those in the current literature (Ciarrocchi, 2002; Ögel, 2010; McCormack and Griffiths, 2012; Weinstock et al., 2013; Çakıcı, 2019). The study identified seven different gambling profiles. Although there is no such a study specifically published on profile definitions made through LPA, the relevant literature involves definitions based on LCA (eight-class structure; Faregh and Leth-Steensen, 2011). The study conducted by Raybould et al. (2022) defined four to six different classes. Likewise, some studies defined gambling addicts as adventurous, avoidant, social and problem gamblers (Ciarrocchi, 2002; Çakıcı, 2019). The literature also includes studies that associate gambling addiction with personality structures (Vaddiparti and Cottler, 2017). The inadequacy of variable-centered approaches in explaining the multidimensional structure of gambling reveals the power of the results of this study and these profiles may provide ideas regarding individual gambling behavior (Mammadov et al., 2016). Considering the results of the study, different groups of gambling may be defined and new insights may be provided for gambling behavior.

Profile 1, in which gambling behavior was first defined, refers to individuals with the highest levels of resilience and purposefulness, but with medium level of perceptions toward responsibility and worthiness. They gamble at a very high level of fun, socialization and making money and low level of gambling for avoidance. The finding that resilient people are more optimistic and have strong self-efficacy beliefs (Folkman and Lazarus, 1985) suggested that people with high resilience gamble more for entertainment and money. Because people who are self-confident and have positive expectations may feel that they can earn more money. Similarly, it is unexpected for a person with high self-efficacy to engage in avoidance behavior (Bond and Flaxman, 2006). In addition, low level of addictive behaviors (e.g., alcohol) in individuals with high resilience points that people with this profile may also play gambling games for entertainment (Green et al., 2014). In this regard, the first profile was defined as adventurous gamblers (Ciarrocchi, 2002; Ögel, 2010; Çakıcı, 2019). Overall, the educational and clinical implications underline the need for holistic diagnostics that will allow the individualization of intervention approach (Orbach and Fritz, 2022). Thus, a different intervention focus can be used for each profile. To illustrate, emotion regulation strategies can be used to reinforce feelings of responsibility and worthiness for the adventurous profile. In particular, Positive Cognitive Behavioral Therapy strategies (e.g., benefit-harm analysis) based on taking responsibility and self-evaluation can be used (Leahy,

2010). Such studies may help people determine their potential and make them feel better (Bannink and Jackson, 2011). Behavior experiments may be planned in line with alternative purposes to change the excitement/entertainment motives such as making money. As people's conscious awareness and sense of worthiness increase, their tendency toward dysfunctional experiences (making money, gambling for excitement) may decrease (Beck, 2020).

Similar to the adventurous gamblers (profile 1), those in profile-2 were identified to have a medium level of resilience and purposefulness, but low level of responsibility and worthiness. Even though gambling addiction is risky, individuals continue to gamble. This may be explained by the ability to recover and adapt (resilience) as resilience also provides easy adaptation to mistakes despite risky experiences such as money losses (Sapienza and Masten, 2011). Likewise, the ability to be purposeful reduces their risk of inclining to pathological gambling (Derevensky, 2012). They were also determined to gamble for socialization at a high level, exhibit avoidance at the lowest level and play games for the purpose of winning money. People with low worthiness beliefs may join risky social groups for socialization and exhibit submissive behaviors to group members (Verheul, 2001). Given that individuals in this profile gamble with the motivation of being in social environments and making friends (Yip et al., 2011), they should be conceptualized as social gamblers (Ciarrocchi, 2002; Yip et al., 2011; Çakıcı, 2019). The lack of motivation for financial gain (Macit, 2021) supports the structure of the profile of social gamblers (Lee et al., 2006). When the level of resilience and purposefulness are high, the possibility of pathological gambling may decrease. Because individuals with low self-efficacy may develop motivation to gamble (avoidance, socialization, etc.) to meet multiple psychological needs (Weinstock et al., 2013). Besides, childhood abuse, neglect or trauma may trigger gambling (McCormick and Taber, 1987) since neglect and abuse can often develop worthlessness in people (Matthews, 2013). When people do not feel themselves as valuable, they compensate for their social anxiety by choosing experiences/situations that they feel approved by other people (gambling, internet gaming) through games (Verheul, 2001). Besides, they may gamble because of their friends or loneliness (Trevorrow and Moore, 1998). Not belonging to a community or being excluded from society and feeling alone as well as the desire to socialize with others may increase gambling behavior (Bullen and Onyx, 1998). Individuals who display gambling behavior were identified to have self-discipline problems related to stopping these habits, and they attempted to create a social environment through gambling in order to compensate for their decision-making problems and low self-esteem (low sense of worthiness; Derevensky, 2012, p. 70). The reflection of low responsibility skills in gamblers to life may be through cognitive distortions such as personalization. Considering that people avoid taking responsibility due to their social anxiety (Beck, 2020), the definition of social gamblers is in line with the current literature. Therefore, various studies on responsibility skills and worthiness beliefs may be carried out while preparing individual-centered prevention and intervention programs for people in the profile of social gamblers. To exemplify, assignments may be provided for collaborative work or behavior experiments may be created to increase responsibility-taking skills (Türkçapar, 2021). Besides, studying on cognitions such as worthlessness (e.g., reconstructing, generating alternative thinking, seeking evidence) may help reduce individuals' psychopathological susceptibility (Dozois et al., 2009). Social gamblers' self-confidence increases thanks to successful assignment since the probability of performing homework or behavior experiments will increase thanks to high endurance skills (Fennell et al., 2004). Hence, the sense of responsibility and worthiness may be strengthened.

Unlike social gamblers, those who are defined as Profile-3 had low resilience and the ability to act purposefully, yet medium level of responsibility and worthiness. They were identified to mostly gamble with the aim of making money. These results indicated that individuals in this group do not consider gambling as a means of entertainment. Moreover, people in this profile gamble for socialization and avoidance, albeit limited. Those with high motivation to gamble for money making are defined as professional gamblers in the relevant literature (Ögel, 2010; McCormack and Griffiths, 2012; Weinstock et al., 2013). People who gamble for winning money attempt to gamble in order to regain their possible money losses (Morehead, 1950). Because those with high worthiness are expected to feel valuable, to be forgiving and understanding toward themselves, and not to criticize themselves ruthlessly. They can be understanding and forgiving especially in situations such as losing money in gambling or having an argument with their social environment (mother/father, spouse) due to gambling (Demirci and Ekşi, 2018). Since these self-evaluations will make people happy, they are likely to continue gambling. Even if they achieve their goal of winning money, they make more attempts to earn more (Weinstock et al., 2013). They cannot adapt to new conditions (low resilience) in serious money losses, and may engage in impulsive behaviors (suicide, fight, leaving home, etc.; Cenan, 2008). It is conceptually consistent to define the people in Profile-3 as professional gamblers. In addition, their self-perceptions of efficacy (worthiness) may increase their belief that they gamble well and may trigger more gambling behavior. The fact that professional gamblers prefer games that require certain skills and proficiency rather than gambling games where the luck factor is at the forefront may be an indicator of the high level of self-efficacy perceptions (Hing et al., 2015). That responsibility is generally characterized by competence (worthiness; McCrae and Costa, 1991) and mostly observed in success-oriented people (Vollrath, 2001) may explain the finding in regards to a high level of responsibility in profile characteristics. Therefore, they are not expected to blame themselves when they lose money (responsibility), and this process can increase their motivation to gamble for money (Weinstock et al., 2013). This may also explain the low level of gambling behavior for entertainment and socialization. The relation between responsibility and happiness (McCrae and Costa, 2003, p. 164–179). is in conjunction with gambling for avoidance. Despite a limited extent, avoidant gambling behavior may be related to the possible stress experienced after losing money (Jacobs, 1986). Considering the relationship between the discipline, commitment and coping skills of professional gamblers (Rosecrance, 1988, p. 221) with resilience (Kasapoğlu, 2020), profile definitions are considered to be consistent with the literature. Their preference for skill-based games (Hing et al., 2015) may also be related to their sense of worthiness. Although these competencies of professional gamblers seem positive, they may increase the risk of gambling addiction (Monaghan et al., 2008). Professional gambling is promoted by celebrities and the media as a legitimate profession, and hence motivating young people to be a professional gambler (Monaghan et al., 2008). Therefore, prevention and intervention studies are of great importance for professional gamblers. It would be useful to create a framework for prevention and intervention studies by taking the profile characteristics of professional gamblers into account (Barnicot et al.,

2012). In this regard, motivational interviewing techniques can be used on the basis of the high value and responsibility levels of professional gamblers (Ögel, 2009). In cases where shame and stigmatization thoughts are dominant, self-help-based intervention studies may be preferred by conducting awareness studies on the problems caused by gambling (Hodgins et al., 2001). Alternative ways of making money and benefit-harm analyses of gambling may be sought by considering such individuals' competencies (Ögel, 2009). For individuals interested in recreational gambling, enhancing their motivation for future endeavors can be achieved by developing effective leisure activities. This approach may help counter potential resistance to treatment (Mannino and Caronia, 2017). Leisure activities may be planned against the possibility of increasing resistance to treatment in individuals who gamble for fun. As people's boredom tendencies increase, their tendency toward also increases (Yang et al., 2020). The most significant challenge in the prevention and intervention studies of people with this profile may result from the society's positive acceptance of the concept of professional gambler (Hing et al., 2015). Informative public health studies may be conducted on gambling problems and the pathological transformation of gambling in cases where professional gambling is welcomed positively by the society (Monaghan et al., 2008). This study revealed that profile-4 held the characteristics of problem gamblers. This habit of professional gamblers is likely to turn into a gambling addiction problem (Monaghan et al., 2008). Profile-4 consists of those who have average resilience, responsibility, purposefulness and worthiness scores. In addition, they gamble for entertainment, making money, avoiding and socializing. It may be wise to mention that these people possess many sources of motivation to gamble, which makes them likely problem (heavy) gamblers (Petry et al., 2005; Nowak and Aloe, 2014) since having many motives for gambling can make it difficult for people to control their daily life activities. Losing control of daily life activities indicates that the individual is a problem gambler (Ögel, 2010). Individuals in this profile can be defined as problem gamblers because this type of gambling is considered to weaken their psychosocial functions (Weinstock et al., 2013). Likewise, the low self-efficacy of problem gamblers (Weinstock et al., 2013) is in line with profile characteristics. Similarly, problem gamblers with low self-efficacy may exhibit increased susceptibility to risky behaviors. Moreover, individuals who engage in gambling activities are driven by various motivations, including financial gain (Weinstock et al., 2013), escapism, enjoyment (Cenan, 2008), excitement, risk-taking, and competition (Nowak and Aloe, 2014). These factors contribute to the characterization of profile-4 as a problem gambler. This alignment between profile-4's attributes and the existing literature underscores the accuracy of the profile definition (Weinstock et al., 2013). Considering that problem gamblers have a medium level of resilience, responsibility, purposefulness and worthiness beliefs, prevention and intervention studies, which are at the center of positive psychology (e.g., Positive CBT), may be carried out along with the problem-focused approaches used in the treatment of problem gamblers. The high level of purposefulness skills, albeit limited, may contribute to the planning and completion of new daily life activities. Because individuals with high purposefulness skills set new goals for themselves and have high motivation to work for these goals (Tatlıoğlu, 2014). In addition, other prevention and intervention programs that are considered to have an impact on the development of individuals may be analyzed (Cowlishaw et al., 2012; Yakovenko et al., 2015). Given problem gamblers are the most risky group (Hing et al., 2015), individual-centered prevention and intervention studies are believed to become much more necessary. As problem gamblers tend to show themselves as professional gamblers and feel ashamed of their treatment, their motivation toward prevention and intervention options is low (Hing et al., 2015). As regards the high probability of being a member of the problem gambler profile, it suggests that the problem gambler profile is more common among individuals (Steel and Blaszczynski, 1996; Weinstock et al., 2013; Nowak and Aloe, 2014). Hence, it is evident that it poses a risk to public health. Individual-centered planning of prevention and intervention studies is required especially when the high rate of withdrawal from treatment by problem gamblers (Melville et al., 2007) and other risky behaviors accompanying these individuals (Weinstock et al., 2013) are taken into account (Barnicot et al., 2012). The results highlighted that profile-5 involves those who have low level of resilience and purposefulness and who have the highest sense of responsibility and worthiness. The present study also revealed that people in profile-5 mostly gamble for avoidance and the least for entertainment. Participants in Profile-5 reported an average level of socializing and money-making gambling. This profile encompasses avoidant gamblers whose gambling motives are to release tension and anxiety in their lives (Clarke, 2008; Çakıcı, 2019). Mental procrastination is provided by focusing on a specific issue for cognitions that cause anxiety and stress in avoidance behavior (Freeston et al., 1996). Situations such as the sounds of slot machines when they reach a high profit level, satisfying social activity hunger or spending time increase avoidance gambling (Jacobs, 1986). Poor coping skills in people who gamble for avoidance (Gupta et al., 2004) can be explained by low resilience. People with high anxiety tend to turn to a negative process as they cannot trust their problem-solving skills. Thus, they tend to avoid problems (Davey, 1994; Iacolino et al., 2019). Since the lack of resilience will result in the inadequacy of coping skills (e.g., coping with guilt), it is most probable that avoidant gambling elicits pathological gambling (Yi and Kanetkar, 2011). Those who gamble for avoidance also reported that they gamble for monetary purposes and socializing, meaning that the profile structure is defined correctly (Case and Olino, 2020). Besides, avoiding people due to unfortunate situations or believing in one's own luck and competence (worthiness) indicates the high level of control (responsibility) in this profile (Wood and Griffiths, 2007). The high level of control feelings may provide information about the level of individuals' responsibility and worthiness beliefs (Pekrun, 2006). Therefore, profile characteristics conceptualized as avoidant gamblers are parallel with those available in the literature (Clarke, 2008; Çakıcı, 2019; Case and Olino, 2020). Just as it is not desirable for people to gamble in order to avoid stressful situations, regret resulting from possible monetary losses and negative mood caused by avoidance as a result of repetitive gambling often transforms avoidant gambling behavior into pathological gambling (Blaszczynski and Nower, 2002; Marotta, 2002). In this vein, individual-centered prevention and intervention studies have gained significance for avoidant gamblers (Barnicot et al., 2012). In particular, avoidants' strong feelings of control (responsibility and worthiness) may be taken into the focus of activities to be carried out in prevention and intervention services. For instance; avoidant gamblers often experience the lack of social activity in their life as a means of avoiding gambling (Wood and Griffiths, 2007; Yang et al., 2020). Therefore, it may be easier for people with strong feelings of control to plan social activities. Thus, they experience an activity different from gambling as an avoidance behavior. In this regard, there may be a different way out of gambling and individuals' sense of purposefulness may develop. Different ways of avoiding, socializing,

spending time and earning money may be suggested, and benefit-harm analyses of these activities can be conducted as the opposite strategy of suppressing thought is to raise awareness (Lavender et al., 2009). In addition, increased awareness levels are effective in reducing gambling addiction for those who gamble frequently (Lakey et al., 2007). In this context, mindfulness-based stress reduction (acceptance and commitment therapy) techniques may be preferred (Hayes et al., 2006). Similarly, unhealthy coping efforts with anxiety may lead to the development of anxiety disorder in people (Orcutt et al., 2005). Currently, the most widely practiced evidence-based treatment for gambling addicts is construed as cognitive-behavioral therapy, which focuses on reconstructing gambling-related dysfunctional cognitions (Toneatto, 2002). Therefore, Positive CBT strategies (exposure against avoidance) may be used by focusing on the positive characteristics of avoidant gamblers. Although CBT seems to be effective for some individuals, the high rates of unresponsiveness and relapse to treatment reveal the need to consider alternative treatment approaches (Toneatto et al., 2007). In this sense, different individual-centered treatments can also be applied because gamblers' lack of motivation to seek help and their cognition that treatments will not help (Gainsbury et al., 2014) can put them in a vicious circle. Since the hopelessness created by this cycle (Matthews, 2013) can be overcome by individualization of treatment, it is vital to uncover gambling profiles (Barnicot et al., 2012). Gambling profiles created in this context are expected to make a serious contribution to the prevention and intervention studies of gambling addiction. Moreover, awareness-raising studies may be conducted with regard to the profiles of gamblers, to encourage the treatment process, stigma, shame, denial, and help-seeking (Gainsbury et al., 2014).

Results and limitations

This study revealed five different profiles of gambling addiction. The results demonstrated that gambling profiles were conceptualized as adventurous gamblers, social gamblers, professional gamblers, pathological and avoidant gamblers. However, this study holds some limitations. First, the study was based on voluntary self-reports since the sample consisted of individuals who gamble. Therefore, multi-method research designs that will eliminate the social acceptance created by self-report may be a useful approach in this regard. Secondly, the generalizability of the study was limited as it was conducted only with the sample in Turkey and mainly consisted of male participants. Likewise, the data consisted of only the statements of the participants. Therefore, further studies with larger sample groups may be carried out in coordination with associations working on addictions. Third, measurements were made in terms of resilience, reasons for gambling, and personal virtues via LPA. LPA models including other protective and risk factors for gambling addiction may be developed for future researchers to explore various dimensions and associated variables. Several studies that reveal cause-effect relationships across variables (e.g., longitudinal) may be planned to develop and validate individualized treatments according to gambling profiles and to reduce the limitations of gambling-related profiles. The study evaluated that the profiles obtained through LPA will transform the heterogeneous structure of gambling behavior into a more understandable phenomenon (Wang et al., 2017). Because the success level of prevention and intervention studies for gambling behavior varies depending on the heterogeneity of gamblers (Merkouris et al., 2016). Therefore, the results offer a holistic assessment in understanding gambling behavior. Individual-centered prevention and intervention approaches may be developed to reduce the limitations of existing prevention and intervention programs (Echeburúa et al., 2001; Hodgins et al., 2001) through the gambling profiles thus obtained. Diagnostic explanations (Barnicot et al., 2012) can make a significant contribution to reducing gambling behavior rather than an intervention that will allow the analysis of heterogeneous phenomenology and the customization of the intervention approach toward this structure. Besides, psychoeducational studies, educational and clinical implications for the prevention of gambling addiction can be obtained with regard to gambling profiles. Psycho-educational studies will be beneficial in terms of providing individual social support, improving resilience, ensuring responsibility to gamblers, being purposeful and feeling valuable as well as raising awareness. In addition, these results may provide significant contributions to those working in schools and university psychological counseling centers (e.g., prevention), policy makers (e.g., access to gambling) and researchers (developing individual-centered approach models on gambling).

Data availability statement

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

Ethics statement

The studies involving humans were approved by Atatürk University Rectorate: (Decision dated 09.03.2020 and numbered E-2000077272). 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

ŞÇ: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares 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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Methodological approach for an integrated female-specific study of anxiety and smoking comorbidity

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Two primary ovarian hormones that fluctuate across the female menstrual cycle—estradiol and progesterone—have been independently linked in separate literatures to nicotine reinforcement and anxiety psychopathology. We identify existing methodological limitations in these literatures, describe an example protocol that was developed to address such limitations, highlight case examples, and offer insights on the resulting advantages and challenges. This protocol was an observational, prospective, within-subjects study of female cigarette smokers who were followed over the course of a complete menstrual cycle. Non-treatment seeking, female cigarette smokers ($N = 50$), between the ages of 18–40 who have a normal menstrual cycle (25–35 days in length) were recruited from the community. Females with anxiety or mood psychopathology represented 38.0% of the sample. Salivary progesterone and estradiol were assessed each morning via at-home saliva collection methods. Self-reported within-day momentary ratings of anxiety and nicotine reinforcement were collected using ecological momentary assessment (EMA) via a mobile app. Protocol compliance was >85%. Within- and between-subjects heterogeneity was observed in the progesterone and estradiol, anxiety, and nicotine craving measures, especially in the context of anxiety psychopathology. We aimed to integrate the anxiety and nicotine dependence literatures and advance the empirical study of the role of ovarian hormones. This protocol reflects an intensive, yet feasible approach to collecting daily-level naturalistic data related to estradiol, progesterone, anxiety, and nicotine reinforcement.

KEYWORDS

menstrual cycle, progesterone, estradiol, anxiety, nicotine reinforcement, ecological momentary assessment

Introduction

Cigarette smokers are approximately twice as likely to have an anxiety disorder compared to the general population (1–3), and anxiety is associated with poorer cessation outcomes (2, 4, 5). Females are twice as likely to have an anxiety or related stress disorder compared to males (6). While the prevalence of smoking is higher in males relative to females (7), females are at greater risk for tobacco-related disease (8, 9) and are less successful in quitting smoking (10–15), perhaps because they experience greater reinforcing effects from cigarettes (i.e., nicotine reinforcement). Compared to males, females are more sensitive to the rewarding and stimulating effects of nicotine (16, 17). Females also report greater smoking for stress-relief than males (18), which may increase the (negative) reinforcing value of cigarettes (19). For example, following negative-mood induction, females (vs. males) demonstrate greater nicotine reinforcement: they report stronger craving (20), initiate smoking more quickly (21), consume more nicotine (22), and report greater cigarette "liking" (22). Identifying female-specific mechanisms underlying the anxiety-nicotine reinforcement link has the potential to address sex and mental health disparities in cessation outcomes.

Ovarian hormones, particularly estradiol and progesterone, which fluctuate throughout the menstrual cycle, have been *independently* examined as female-specific etiological factors in anxiety (23) and in cigarette smoking (24). Indeed, these research literatures have remained siloed which has limited our ability to study how ovarian hormones influence the *interplay* between anxiety and cigarette smoking. Our group has conducted initial work that is explicitly aimed at integrating these literatures, and in turn, our understanding of female-specific biological influences on anxiety and smoking. In this article, we present an initial overview of how estradiol and progesterone typically fluctuate during the menstrual cycle, and then briefly review the key literature that has been published on ovarian hormone influences in anxiety and nicotine reinforcement. Further, we discuss methodological drawbacks of the extant literature and introduce our novel experimental design to address those limitations. We provide illustrative case examples that highlight the inter- and intra-individual variability in hormonal fluctuations, anxiety, and craving. We conclude with a discussion of limitations and methodological considerations to inform future empirical inquiry.

Estradiol and progesterone during the menstrual cycle

The menstrual cycle can be characterized by phases that reflect changes in fluctuating levels of estradiol and progesterone (25, 26). The onset of menses (blood flow) marks both the beginning of the menstrual cycle and the follicular phase. During the follicular phase, progesterone is very low, whereas estradiol is low during the early phase, and increases as the follicle develops, peaking sharply in the late follicular phase prior to ovulation. The increase in estradiol causes a surge of luteinizing hormone (LH), which signals ovulation and formation of the corpus luteum, a temporary organ that primarily produces progesterone (26). The luteal phase begins with rising levels of progesterone and estradiol, with progesterone reaching its peak at the midpoint of the phase and estradiol reaching a second peak. This is followed by a late-phase, rapid, large decrease in progesterone and moderate decrease in estradiol. The median menstrual cycle length is 28 days, with a normal range between 25 and 35 days (26). Most variability occurs in the follicular phase depending on when the follicle begins to develop whereas the luteal-phase duration is more constant (lasting 10–16 days) (26).

Fluctuations in estradiol and progesterone during the menstrual cycle likely influences smoking and anxiety (and their comorbidity) through various neurobiological processes implicated in drug reinforcement (via dopamine activation) (27), which has received most attention in the addiction literature, and emotion dysregulation (via serotonin, hypothalamic pituitary adrenal (HPA) axis, gamma-hydroxy-butyric acid (GABA) (28, 29)), which has received attention in the anxiety psychopathology literature. These are described in more detail below.

Ovarian hormones and anxiety psychopathology

Periods of hormonal change have been associated with changes in emotional distress symptoms in both non-clinical (30) and clinical (23) populations. Clinically, hormonal influences have been linked to the etiology of panic disorder (31–33), social anxiety disorder (34), generalized anxiety disorder (35, 36), and anxiety-related disorders including obsessive-compulsive disorder (OCD) (37, 38) posttraumatic stress disorder (PTSD) (39), and pre-menstrual dysphoric disorder (PMDD) (40). Estradiol and progesterone contribute to the regulation of serotonin and allopregnanolone (respectively), which can have anxiolytic effects that may promote adaptive responding to stress (29). Thus, decreasing/low levels of estradiol and progesterone can increase risk for heightened negative affect, anxious arousal, and poor emotion regulation due to decreased serotonergic and allopregnanolone availability (29), which in turn results in less effective HPA axis regulation and reduced GABA activity (28, 29). Indeed, females report worsening of anxious arousal (39, 41), heightened startle and slower recovery from acute stress-induction (23), and less effective use of coping strategies (42) during the late-luteal/menstruation phase, where estradiol and progesterone are decreased, relative to other phases. Ovarian hormones may also play a role in fear extinction, thus influencing responses to certain anxiety treatments like exposure-based therapy (29). For instance, one study found that higher levels of progesterone on the day in which treatment was delivered (i.e., a single session of cognitive restructuring), was predictive of a larger response to treatment indicated by increased behavioral approach during a spider phobia task (43). Overall, these data underscore consistent links between ovarian hormones and affective experiences.

Ovarian hormones and nicotine reinforcement

Hormonal fluctuations are further implicated in nicotine reinforcement and use behaviors. Broadly, across both preclinical and clinical studies, estradiol enhances while progesterone decreases nicotine's reinforcing value (44). Preclinical data indicate that estradiol modulates the release of dopamine in the mesolimbic reward pathway

(45) and increases dopamine release following nicotine administration (46). Drug reward and self-administration in animals is heightened when estradiol levels are high while progesterone levels are lower (27). More recent imaging data provide more evidence for the role of reward processing in the link between estradiol and smoking (47). For example, ventral striatal responsivity to smoking cues was found to be elevated during the estradiol-dominant menstrual phases, like the late follicular phase and mid-luteal phase, compared to phases characterized by low estradiol (47).

While heightened estradiol appears to exacerbate nicotine reinforcement, progesterone appears to attenuate smoking-related outcomes. Progesterone administration reduces drug reward and drug seeking behavior in female rats (27, 48–50). Progesterone administration (vs. placebo) during the follicular phase also attenuates the subjective positive reinforcing drug effects (51–53). Human data indicate that lower levels of progesterone in relation to estradiol are associated with greater puff intensity and puff number (54). Additionally, nicotine-deprived females who received intravenous nicotine reported lower positive subjective effects (e.g., "liking it") when in the luteal (progesterone dominant) relative to the follicular (estradiol dominant) phase (55). As a result, studies have recommended that females may be more successful in quitting during the luteal phase (when progesterone is highest) (54, 56, 57), and have examined the use of exogenous progesterone to bolster cessation outcomes (58), though data supporting luteal phase protective factors are mixed due to inconsistencies in measurement, definition of cycle phase, and hormonal fluctuations within sub-phases.

Implications for anxiety-smoking comorbidity

Despite the relevance of ovarian hormones to both anxiety and smoking reinforcement, there is a dearth of research examining how fluctuations of estradiol, progesterone, and progesterone's metabolites throughout the menstrual cycle influence the *interplay* between anxiety and smoking reinforcement. Female smokers with anxiety may be particularly vulnerable to the emotional consequences of fluctuating ovarian hormones, resulting in maintained reliance on cigarettes. Of the limited literature, we are aware of one relevant population-based study that examines these relations. In a large representative sample of females ($N = 11{,}648$) between the ages of 18–55, the presence of past-month menstrual problems was associated with more frequent anxiety, depression, and fatigue, and those females with menstrual problems were more likely to smoke cigarettes (59). One additional relevant preliminary investigation conducted by our study team examined between-subjects differences (60) in female smokers ($N = 23$) with normal cycles not using hormonal birth control. Participants self-reported the first day of their last menstruation and completed cross-sectional self-report measures of emotion dysregulation and cigarette craving. Females who were assessed during the late-luteal phase (based on self-reported menses) reported higher levels of emotion regulation difficulties, relative to females who were assessed while in other menstrual phases (60). In addition, females who were assessed in the follicular phase reported higher levels of nicotine demand and craving relative to females assessed during other menstrual phases (60). These investigations provide preliminary evidence for the importance of considering anxiety and emotional factors more broadly in the context the menstrual cycle and smoking links.

Methodological advancements

The above-mentioned preliminary literature is promising; however, it is limited in both content and methodological approach. Not only is there limited available literature on the *integration* of the anxiety and smoking literatures as it relates to the menstrual cycle, the disparate literatures in anxiety and smoking would each be bolstered by methodological advancements. Below we outline several common methodological limitations and advancement opportunities.

Limitation 1: exclusion of individuals with anxiety psychopathology from smoking studies

Smokers with psychopathology have been *systematically excluded* from the research on ovarian hormones and smoking. For example, of the 36 studies included in a meta-analysis on smoking and ovarian hormones (24), 30 studies excluded females with psychopathology or those who were receiving psychiatric treatment, four studies did not report any information, and only two studies considered psychopathology—one examined subclinical depression symptoms in female smokers without psychopathology (61) and another considered female smokers with a *history of* depression but excluded those with current depressive symptoms (62). In fact, depression is cited as a potential confounder condition that should be considered for exclusion in biobehavioral research focused on the menstrual cycle (25). While depression and anxiety can influence the menstrual cycle and influence reproductive hormones (63, 64), exclusion of individuals who smoke and have diagnosed psychopathology lacks ecological validity and representation of "real world" smokers.

Limitation 2: lack of direct measurement of ovarian hormones

The most common method for studying ovarian hormones is through estimation of the menstrual phase based on self-reported onset of menses and forward day counting (25). With this approach, menstrual phase is used as a proxy for endogenous progesterone and estradiol levels. However, day count shows only 50% agreement with menstrual phase when determined by serum progesterone and estradiol assay (65), likely in part due to recall bias and variability in cycle length. In a review of biobehavioral studies focused on the menstrual cycle, only 18% of these studies used saliva sampling and 34% used blood as an objective measurement of ovarian hormones (25). A recent review examining anxiety symptoms across the menstrual cycle found 8 of the 14 studies use self-report or day count alone for the assessment of cycle phase (66). Continued reliance on day count methods produces unreliable menstrual cycle phase determinations (66).

Direct measurement of estradiol and progesterone via analysis of blood or saliva samples is ideal, though there are several challenges. Normative ranges for defining menstrual phase are difficult to establish in blood serum and saliva due to the significant variability of hormone levels between people (25). While blood contains both bound and unbound hormones, saliva contains only unbound hormone levels—thus, the concentration of estradiol and progesterone is lower in saliva relative to blood. However, the advantage of saliva

over blood measurement is that the concentration of hormones in saliva may better reflect the biologically available levels of these hormones (25). Another advantage of saliva sampling is that it offers a noninvasive, easily stored means to self-collect samples while mitigating the burden of in-laboratory blood draws required for serum (25). Thus, salivary sampling allows for more frequent and convenient sampling than other means of assessment and is particularly advantageous for studying the smoking-anxiety link.

Limitation 3: cross-sectional or static hormone assessments

Cross-sectional measurement of hormones can provide information about whether absolute hormone levels are related to an outcome of interest, but this approach offers limited insight on the dynamic fluctuations of estradiol and progesterone as a process-based mechanism underlying anxiety and craving. In the ovarian hormone and anxiety literature, in-lab paradigms are leveraged to look at specific associations between phase of the menstrual cycle, occasionally verified by ovarian hormone assessment, and aspects of anxiety ranging from vulnerability to panic (67) to response to treatment (68). Static assessments of ovarian hormones encompass most of the menstrual cycle and anxiety literature. In a review examining anxiety symptom fluctuations across the menstrual cycle, only 3/14 (21%) studies used more than two assessment points for the purposes of detecting hormonal changes (66). Those that used multiple assessment points did so weekly, thus, detecting overall trends in change but lacking in a comprehensive picture of fluctuations. Relatedly, in the nicotine reinforcement literature, in-lab paradigms examined acute associations between ovarian hormones and aspects of smoking including craving (69) and the effects of nicotine (55). Despite calls to include direct measurement of ovarian hormones in addiction research (44), a review of 11 studies on addictive behaviors across the menstrual cycle (70) identified only one smoking study that used an objective assessment of estradiol and progesterone. Specifically, Snively et al. (71) utilized repeated measurement of ovarian hormones (via plasma) during the menstrual cycle to confirm cycle phase status but changes in hormones were not considered. Frequent (repeated) assessment of hormones is important to understanding how *changes* in estradiol and progesterone levels may influence anxiety and nicotine craving.

Limitation 4: limited study of within-person variability

Existing work has largely focused on understanding between-person differences in both the anxiety and nicotine reinforcement literatures. Anxiety and craving are internal experiences that vary at both the between- and within-person level, are known to be influenced by person-specific factors, and are subject to recall biases when assessed retrospectively. Meaningful differences between anxiety and craving experiences are being missed through the stratification of menstrual cycle phases that are routinely grouped together in these literatures (25). This issue of overlooking variance is exacerbated by well-known person-specific factors affecting anxiety and nicotine reinforcement. Anxiety sensitivity and distress intolerance are two emotion-specific individual vulnerability factors that have been robustly linked to the risk and maintenance of anxiety and various aspects of smoking and nicotine reinforcement (72). These vulnerability factors, among others, may moderate the anxiety-smoking link and require within-person approaches to adequately address. Finally, use of within-person repeated momentary assessment allows for more valid reporting of anxiety and craving and mitigates reliance on retrospective reports (23). This "high resolution" assessment strategy provides critical information about the nature of both the ovarian hormone- anxiety and ovarian hormone- nicotine reinforcement links being elucidated. Thus, the study of intraindividual changes in anxiety and craving during the menstrual cycle will enhance our understanding of how and when hormonal fluctuations influence anxiety and craving during the menstrual cycle.

Example protocol: Project SHE

To address the abovementioned limitations, we developed Project SHE (*Smoking*, *Hormones*, and *Emotion*), a National Institute on Drug Abuse (NIDA)-funded study that explored how fluctuating estradiol and progesterone during the menstrual cycle influence anxiety and cigarette craving in female smokers. We present the protocol as an example of how to advance methodological approaches in this research area.

Participants

The sample was comprised of female smokers ($N = 50$; $M_{age} = 32.4$, SD = 5.3; 70.0% white race) who reported being daily combustible cigarette users for 14.9 (SD = 5.9) years and smoked an average of 12.2 (SD = 5.3) cigarettes per day in the past week. Participants were recruited through flyers on a university campus and in the surrounding area and through an online advertising agency which convened a sample representative of the broader population. Target sample size was determined to detect medium effect sizes. Participants were eligible for the study based on the following criteria: (a) between ages 18–40 years; (b) reported daily use of ≥5 cigarettes per day; (c) verification of smoking status via ≥10 ppm expired carbon monoxide (CO); (d) self-reported normal menstrual cycle (i.e., length of 25–35 days) that did not regularly vary in length month-to-month by ≥7 days. Exclusion criteria included: (a) current use of smoking cessation treatments; (b) pregnancy (determined by pregnancy test) or within 3-month postpartum; (c) breastfeeding within the last 3 months; (d) use of medications that influence ovarian hormone levels or the menstrual cycle [e.g., (25)], (e) history of medical conditions that effect the ovarian hormones/menstrual cycle (e.g., ovarian hypofunction, adrenal disorders), (f) social instability likely to hinder adherence to home-based study protocol (e.g., houselessness). Regarding psychiatric exclusion, we aimed to be as inclusive as possible to recruit a sample population that reflected "real world" smokers (per *Limitation 1*). Smokers with DSM-5 anxiety and related disorders (e.g., major depression, stable bipolar I/II, PTSD, OCD, PMDD) were allowed to participate in the study. We only excluded participants who presented with severe psychiatric instability, which we defined by: evidence of psychotic symptoms; current past-year unstable bipolar disorder; current past-year severe DSM-5 alcohol or substance use disorder; active suicidal or homicidal ideation; or current low-weight eating disorder (BMI < 17). These exclusionary criteria were selected to reduce potential for dangerous or protocol-interfering behaviors.

Procedures

Participants completed an initial baseline visit via HIPAA compliant Microsoft Teams video call to determine eligibility during which the Mini International Neuropsychiatric Interview [M.I.N.I. version 7.0.2; (73)] and the PMDD module from the SCID-I (74) were administered to document the presence of DSM-5 disorders. The initial visit also included the collection of demographic information, measures of smoking history and cigarette dependence, and medical history, including a past-month confirmation of menstrual cycle length. An estimated first day of bleeding for the next cycle was calculated based on the beginning date of the last menstrual cycle as a reference and was used to approximate the current cycle day (e.g., if an individual's last cycle started 10 days prior to the baseline assessment, they were considered to be on cycle day 10). Protocol initiation was not tied to cycle day or phase; natural variability in cycle start-date was designed to help to protect against order-effect biases that can occur in within-subject tests. Thus, participants were able to begin the study at any point in their menstrual cycle. Participants were oriented to the daily saliva and survey protocol and given an opportunity to practice saliva collection and momentary assessments, at which point participants were officially enrolled into the study monitoring period for one menstrual cycle. The exact length of the study monitoring period was dependent upon length of the menstrual cycle and was prospectively monitored by study staff. Menstrual status (presence of any bleeding; day of period) was assessed each evening during the study (75) and verbally confirmed at the weekly follow up appointments to ensure accuracy and accommodate for any missed reports.

Saliva collection protocol

To address *Limitations 2 and 3*, daily salivary sampling methods were utilized to objectively assess progesterone and estradiol levels every day during the cycle. Salivary sampling methods have an advantage over plasma methods in that the former is almost exclusively a measure of unbound (i.e., biologically available) hormone (76). Participants were introduced to saliva collection at the orientation visit, at which time they were provided with saliva collection kits (Salimetrics, LLC) and a portable freezer pack for transporting samples. Participants were instructed on using a saliva collection aid to facilitate whole saliva (passive drool) into the collection vial. Participants provided daily 1.8 mL samples at their home within 30 min of waking, labeled the vial with date/time of collection, stored it in the back of their home freezer, and transported back to the lab weekly. Frozen samples were stored in a −80°C freezer until being sent for assay. Salimetrics 17β-Estradiol Enzyme and Progesterone Enzyme Immunoassay Kits (Salimetrics, State College, PA) were used. Saliva sample viability was determined by: (a) clear samples with no discoloration (e.g., blood, lipstick, yellowish tinge) or observable particle contaminants (e.g., food); (b) 1.8 mL of saliva; (c) no air bubbles; (d) properly labeled; and (e) frozen solid. To bolster compliance, a push-notification was sent to participants each morning reminding them to provide a saliva sample. They were prompted to complete a brief saliva report at the time of collection that included an uploaded photo of the collected saliva sample and to indicate whether there were any problems in providing the sample.

EMA protocol

To address *Limitation 4*, we used an ecological momentary assessment (EMA) protocol to capture within-person associations between ovarian hormones, anxiety, and craving throughout the menstrual cycle. The EMA protocol was delivered through MetricWire, a HIPAA compliant platform with a mobile application, that can deliver signal-contingent, time-contingent, and event-contingent reports. Participants downloaded the application to their smartphones during the orientation visit and were given an opportunity to practice navigating through the platform and completing surveys. In this study, participants received a push-notification each morning to complete a report, in addition to three random (signal-contingent) reports throughout the day, and one bedtime report each evening. Anxiety was assessed with a single item (*"How anxious do you feel right now? [0 = not at all, 10 = highest]"*). Cigarette craving was also assessed with a single item ("*How strong is your urge to smoke right now? [0 = No urge, 10 = Extreme urge]*"). In addition, morning reports included items that assess tobacco and substance use from the previous day (e.g., *"How many cigarettes did you smoke yesterday?*") to capture substance use quantity and frequency. A hypothetical protocol day including EMA and salivary assessments is depicted in Figure 1.

Protocol compliance

Compliance with the saliva collection and EMA methods was high. A total of 94.5% of saliva samples ($n = 1{,}316$) were returned, of which 94.2% ($n = 1{,}240$) were valid. The invalid samples ($n = 76$) were due to: thawed or discolored saliva ($n = 36$), out of range PH levels per assay results ($n = 31$), recent smoking/eating ($n = 3$), or insufficient amount of saliva to assay ($n = 6$). Regarding compliance with the EMA, 86.2% ($n = 1{,}213$) of morning reports were completed; 88.4% ($n = 1{,}243$) of at least one random report/day and 67.4% ($n = 947$) of at least two random reports/day were completed; and 82.3% ($N = 1{,}159$) of bedtime reports were completed.

Illustrative case examples

We present two illustrative case examples to highlight the intra- and inter-individual fluctuations in anxiety and craving across the menstrual cycle (Figure 2). Data were transformed into standardized values for the purpose of illustration along a consistent axis. We present data from two participants—Case 1 with no history of psychopathology and Case 2 with anxiety and depression psychopathology—who were otherwise comparable in terms of demographics, cigarettes/day, and cigarette dependence. As seen in Figure 2, relatively limited variability/range in anxiety and craving were observed in Case 1 across the menstrual cycle. In contrast, ample fluctuation/variability in daily anxiety and craving across the menstrual cycle in Case 2. These data highlight the value of collecting daily data to capture anxiety and craving during the menstrual cycle, especially in females who have clinically-elevated anxiety and/or anxiety vulnerability.

Conclusion

The protocol presented here highlights feasible means of addressing limitations in these disparate literatures to date, unifying them in the process. Our protocol represents a critical first step in increasing representation among smokers with co-occurring anxiety

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FIGURE 1
Hypothetical example of the daily protocol schedule.

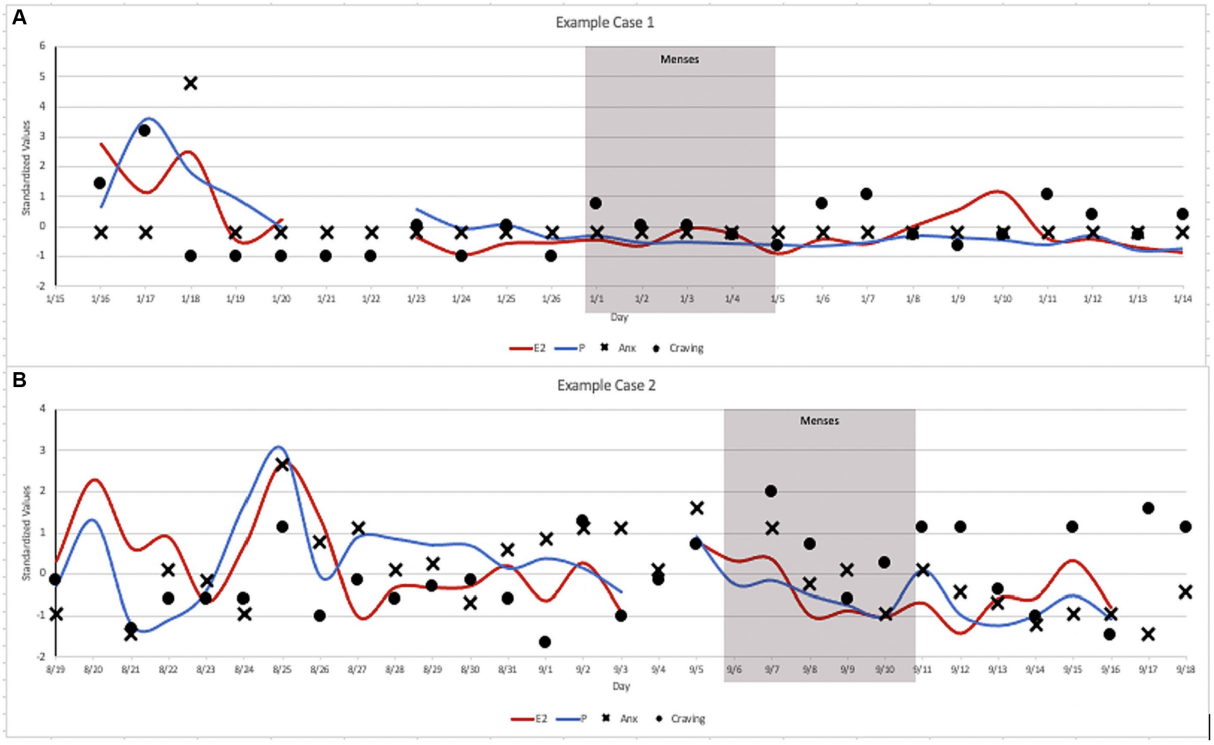

FIGURE 2
Case Illustrations: **(A)** Case 1 was a 26-year-old, White, female, who reported smoking 20 cigarettes/day with moderate cigarette dependence (FTCD = 5), with no history of psychopathology. **(B)** Case 2 was a 27-year-old, White, female, who reported smoking 20 cigarettes/day with moderate cigarette dependence (FTCD = 5), who had elevated high anxiety sensitivity (ASI-3 = 32) and met criteria for a major depressive disorder and a history of panic attacks.

psychopathology. Although we attempted to address many existing methodological limitations of the literature, we acknowledge limitations of the Project SHE protocol. First, data were collected over the course of a single menstrual cycle, thus we are unable to explore inter-cycle heterogeneity. Second, the use of alcohol was reported on 8.7% of all days sampled (across 29 participants) and the use of cannabis was reported on 3.7% of all study days sampled (across 8 participants). Although relatively infrequent, we did not examine the influence of other substance use on cigarette craving. Lastly, we opted to not measure luteinizing hormone (LH) as an attempt to limit additional participant burden, precluding assessment of anovulatory cycles. LH assessment would enable indexing of ovulation timing and should be considered in future extensions of this work.

Continued work in this area is necessary to better understand the dynamic covariation in hormonal changes, anxiety, and negative reinforcement-precipitated craving and smoking over the course of female's menstrual cycles. Given the significant prevalence of comorbid psychopathology among female smokers, future studies might specifically *recruit*, rather than *exclude*, individuals with a range of diagnoses, including anxiety, mood, and substance use disorders.

Data availability statement

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

Ethics statement

The studies involving humans were approved by Rutgers University Institutional Review Board. 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

SF: Conceptualization, Funding acquisition, Writing – original draft, Writing – review & editing. JS: Writing – original draft, Writing – review & editing. DS: Writing – original draft, Writing – review & editing. BA: Writing – original draft, Writing – review & editing. GL-M: Funding acquisition, Writing – review & editing. SD: Funding acquisition, Writing – review & editing. DW: Funding acquisition, Writing – review & editing. MS: Funding acquisition, Writing – review & editing. AA: Funding acquisition, 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.

Publisher's note

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The effect of short-form video addiction on undergraduates' academic procrastination: a moderated mediation model

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Background: Short-form videos have become one of the most popular ways for people to entertain and relax. However, the intense interest in short-form videos has given rise to short-video addiction, which poses risks to both physical and mental health of individuals. Undergraduates are one of the important users for short-form videos, and the influence of short-form video addiction calls for more attention. This study aimed to investigate the association between short-form video addiction and academic procrastination among undergraduates, exploring the role of executive functions (i.e., attentional control) and personality traits (i.e., boredom proneness) in the association.

Methods: Using stratified random cluster sampling method, the data of 1,047 college students were used in the study. All variables were measured by empirical instruments, and all instruments were highly reliable. Mediation and moderation analysis was conducted using Model 4 and 7 in PROCESS macro powered by SPSS.

Results: Results revealed that short-form video addiction not only directly impacted academic procrastination but also placed indirect effect on academic procrastination through attentional control. Furthermore, the mediating effect of attentional control was contingent upon individuals' boredom proneness. Higher levels of boredom proneness weakened the impact of short-form video addiction on attentional control.

Conclusion: The findings expand our knowledge of the negative effects of short-form video addiction and the underlying mechanisms, providing implications for mitigating undergraduates' academic procrastination.

KEYWORDS

short-form video addiction, academic procrastination, attentional control, boredom proneness, college students

1 Introduction

The rapid development of technology and the Internet has transformed people's lives, and short-form video applications (apps) such as TikTok have swept across the world. Short-form videos are typically less than 15 min in length, mostly between 1 and 5 min, with concise content and a clear theme (Yang et al., 2022). According to GWI (2023), TikTok has attracted 4 billion

global downloads from January 2018 to November 2022, becoming the social media platform with the highest download numbers (Chen et al., 2020). As the pioneer of short-videos, Chinese short-form video apps (e.g., Douyin, Kwai) have massive domestic impact. Until 2022, users of short-form videos have reached 962 million, which included 91.5% of the overall Internet users (China Internet Network Information Center, 2022). However, the high impact of short-form videos brought both considerable advantages and potential risks (Chen et al., 2020). It has been found that the overuse of the Internet and other various Internet-based applications (such as online gaming and social networking services) poses a real threat to individuals' mental health, interpersonal relationships, and quality of life. Corresponding to the phenomenon, broad Internet addiction has gradually attracted attention from the mass media and researchers (Marin et al., 2021). Yet, the impact of specific Internet addictions, including short-form video addiction (SFVA), grant a closer examination (Chen et al., 2021).

Due to the technological design, short-form videos are prone to excessive use and addiction, especially for students and adolescents (Wang et al., 2023). For content creators, the short-form video platforms offer a variety of autonomous functions, including taking, editing, and posting short-form videos. Although content of the videos can be highly varied, most videos are intended to be entertaining for more followers and "likes" to satisfy the emotional need of content creators (Zhang et al., 2019). For audiences, the short-form video apps are often designed to continue playing related videos before manually stopping, which could keep the individuals watching for a long time. As a relatively novel type of mental health problems, short-form video addiction poses a new risk to people's mental health and social life. Physically, short-form video addiction can cause poor vision, decreased physical fitness, and possibly chronic diseases and other disorders (Liu et al., 2021). In terms of mental health, it can result in emotion regulation problems (Liu et al., 2021; Ye et al., 2022), reduced feelings of well-being (Miron et al., 2019; Ye et al., 2022), and even problematic behaviors such as suicide (Miron et al., 2019; Chalermchutidej et al., 2023). Furthermore, among students, it has been found that short-form video addiction can also lead to poor sleep quality and academic burnout (Chalermchutidej et al., 2023; Vansoeterstede et al., 2023).

Academic procrastination is one of the negative constructs that could be detrimental to academic success. To be specific, academic procrastination is defined as the act of failing to complete academic tasks that should be done properly, often accompanied by emotions such as stress and anxiety (Caroline et al., 2010). However, academic procrastination is a common issue for college students, with some studies report incidence of academic procrastination as high as 70% (Cheng and Xie, 2021; Ma et al., 2022). Continuous academic procrastination not only hinders students' academic achievement (Bytamar et al., 2020), but also prevents them from effectively regulating emotions and experiencing fulfillment (Balkis, 2013). Studies have shown the relationship between various forms of internet addiction and academic procrastination (Hayat et al., 2020), yet little is known about the impact of short-form video addiction on academic procrastination. Based on the existing evidence, we aimed to examine the direct and indirect effect (attentional control) of short-form video addiction on academic procrastination and explore how personality traits (boredom proneness) might affect this relationship.

1.1 Short-form video addiction and academic procrastination

Since short-form video addiction is a type of specific internet addiction, short-form video addition might have similar effects as internet addiction on academic procrastination (Aznar-Diaz et al., 2020). According to the temporal motivation theory, people tend to prefer tasks that offer quicker rewards when time is limited, and postpone those with more distant rewards (Steel, 2007). Using analytical algorithms of massive user database, short-form video apps can provide personalized and engaging content (Yeh et al., 2017; Krivonogova et al., 2022; Hongying and Christian, 2023). The student audience can experience immediate satisfaction and entertainment rewards in a relatively short amount of time (Yeh et al., 2017). Thus, short-form videos afford students to procrastinate in high-demanding tasks, such as academic assignment and self-regulated learning (Miyake and Kane, 2022).

Moreover, short-form video addiction has been shown to be positively associated with various mental health problems, such as symptoms of depression, anxiety, and stress (Sabir et al., 2020). These mental health problems have been identified as significant factors contributing to academic procrastination (Steel, 2007). Meanwhile, previous studies have revealed that short-form videos addiction can diminish people's motivation to learn (Ye et al., 2022). Overusing short-form videos can foster a short-term oriented mindset, which seeks immediate pleasure and satisfaction. This mindset may diminish expectations for future academic achievements because academic performance typically demands long-term effort and dedication (Albursan et al., 2022). Students might perceive that they cannot attain quick academic rewards, leading to a loss of confidence in their studies and they cannot complete their academic tasks on time. Thus, individuals with short-form video addiction are prone to academic procrastination. Thus, the following hypothesis is put forward:

> *H1*: short-form video addiction has a positive effect on academic procrastination.

1.2 The mediating role of attentional control

Compared to other specific internet addictions, considering the design and traits of short-form video, individuals with short-form video addiction are vulnerable to cognitive impairment, which could negatively impact their academic outcomes. Hence, attentional control emerged as a distinctive mediator. Attentional control, a cognitive function that regulates the allocation of attention, is significantly linked to executive control (Derryberry and Reed, 2002; Hopfinger and Slotnick, 2020). Derryberry and Reed (2002) proposed that effective attentional control requires not only the active engagement of cognitive resources to focus on relevant information but also the suppression of irrelevant information, which highlights the importance of both promoting goal-directed behavior and restraining interference (Derryberry and Reed, 2002).

The ability to control their attention might be impaired by short-form video addiction. Studies have found that exposure to television shows, characterized by high arousal and quick change to focus, could

impair capacity to maintain concentration on other tasks (Swing et al., 2010). Highly arousing content typically elicits strong excitement in the brain, leading to an increased allocation of cognitive resources for information processing and a more frequent shift in attentional focus (Christakis et al., 2004). Consequently, the cognitive resources are directed toward visual and emotional stimuli, rather than being utilized for task-related cognitive functions. This diversion of resources diminishes the allocation of attention to the task at hand. In comparison to television, short-form videos are inherently as arousing with faster pace of information exchange (Ophir et al., 2009; Moisala et al., 2016; Peng et al., 2018), which could result in higher degrees of dysfunction in attentional control.

Attentional control is essential for on-time academic completion. Students with high attentional control are more adaptive to distractions and external stimuli, leading to reduced attentional bias to unrelated information in performing academic tasks (Ma et al., 2022). Alternatively, students with impaired attentional control might spend more time on distractions such as short-form videos, even if they intend to concentrate in academic tasks. From a neurological standpoint, the fMRI study by Dong et al. (2015) have shown that individuals with internet gaming disorders are in a state of imbalance between executive control and the reward network, and a decrease in executive control leads to an increase in motivation-seeking and craving. With the imbalanced systems, individuals are more likely to prioritize short-term satisfaction for reduced cravings and lose sight on long-term outcomes (Brand et al., 2019). Although the imbalance between executive control and reward network was not yet found in individuals with short-form video addition, we speculate that the potential impairment on attentional control would also suffer from poor executive functions. Therefore, the individuals would prioritize short-term cravings (watching short-form videos) compared to long-term success (academic achievement), resulting in academic procrastination. Our hypothesis is presented as follows:

> *H2*: Attentional control mediates the relationship between short-form video addiction and academic procrastination.

1.3 The moderating effect of boredom proneness

Researchers have found individual differences in the effect of various internet addiction on individual outcomes (Zhang et al., 2019). Neuroticism, among personality traits, have received more attention than others. In the effect of short-form video addiction on attentional control, boredom proneness might play a significant role. Boredom proneness is a personality trait that encompasses emotions such as boredom, unhappiness, restlessness, a lack of enthusiasm, and a sense of meaninglessness (van Tilburg et al., 2013). According to Eastwood et al. (2012), boredom proneness can be defined as an aversive state of wanting to, but being unable to, engage in satisfied activities (Eastwood et al., 2012). Individuals with high and low boredom proneness might receive different impact on their executive functions from short-term video addiction, whereas the specific difference have not yet been investigated. From practical and theoretical perspective, opposing hypotheses were formed regarding the potential moderation.

On the one hand, short-form video addicted student who are high in boredom proneness might suffer from higher level of impairment in attentional control. Boredom proneness has been investigated as an indicator to various internet addiction, including broad internet addiction (Chou et al., 2018), smartphone addiction (Yang et al., 2020), social media addiction (Malik et al., 2023). Individuals high in boredom proneness are also more likely to have problems related to low attentional control, including low sustained attention and increased symptoms of ADHD (Malkovsky et al., 2012). Thus, compared to college students with low boredom proneness, those with high boredom proneness might be predisposed to low attentional control, leading to higher vulnerability to short-form video proneness.

On the other hand, boredom proneness might counteract the impact of short-form video addiction on attentional control. Boredom can drive individuals to escape from monotonous environment built by short-form video apps. Due to the design of short-form video apps, short-form videos are played continuously, and the followed videos are personalized based on user data. Thus, the short-form video apps create an "echo chamber" experience for the users, pushing forward more centralized content with similar information and viewpoints. According to the boredom driven decision-making model, boredom motivates individuals to avoid and find ways to overcome situations that lack sufficient information or stimulation (Seiler et al., 2022). After frequent usage of the apps, even if the content of short-formed videos is arousing and entertaining, people with high boredom proneness might be less engaged with the monotonous environment (Yuan and Wang, 2022). As a result, boredom proneness might serve as a protecting factor for the deleterious effect of monotony and long-term sensory deprivation on executive functions caused by short-form video addiction (Kimberly, 1998; Das et al., 2016; Li and Jia, 2022). Since the past literature does not provide a clear direction of moderating effect of boredom proneness, the current study proposes the following hypothesis:

> *H3*: Boredom proneness moderates the relationship between short-form video addiction and attentional control.

1.4 The present study

In conclusion, the current study proposes a moderated mediation model, presented in Figure 1. We hypothesize that short-form video addiction would place direct effect on academic procrastination in college students. We then hypothesize that the effect would be mediated be attentional control. Finally, the effect of short-form video addiction on attentional control is hypothesized to be moderated by boredom proneness.

2 Methods

2.1 Participants and procedure

Stratified random cluster sampling method was used to determine the survey sample. Researchers will randomly select two classes at each grade level for the distribution of the questionnaires. A total of 1,176 questionnaires were distributed to students in grades 1–3 from

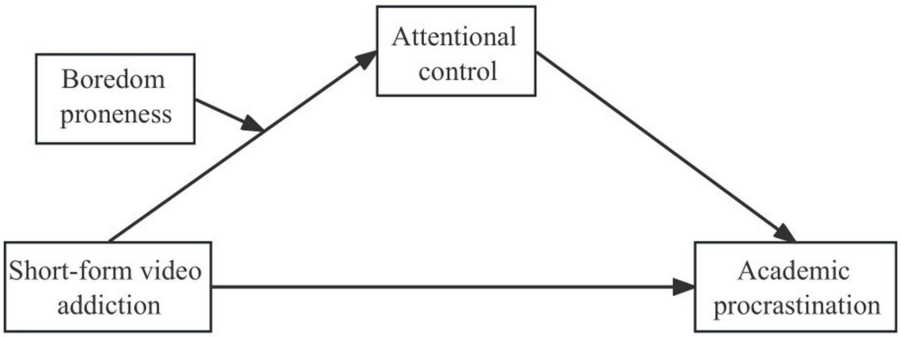

FIGURE 1
Conceptual model of research.

seven universities in central China. Local lecturers distributed hyperlinks or QR codes of the questionnaire to university students on WeChat for them to fill in. After the student entered the main page of the survey, an online informed consent form was displayed. If the student did not disagree with the survey objective in the informed consent form, he/she clicked "Next" to start the survey. The student could stop the survey if he/she objected to it. This Internet-based online questionnaire survey was completely anonymous, voluntary, and non-commercial. After deleting the missing data questionnaires, there were 1,047 valid questionnaires with an effective recovery rate of 89.03%. The participants' ages ranged from 17 to 25 years old ($M_{age} = 20.08$, SD = 1.34). There were 593 boys and 454 girls. Among the students, 310 (29.6%) were freshmen, 246 (23.5%) were sophomores, and 491 (46.9%) were juniors.

2.2 Measurements

2.2.1 Short-form video addiction

Short-form video addiction was assessed using the self-developed Short-Form Video Addiction Scale (SFVAS), which was adapted from the Internet Addiction Diagnostic Questionnaire (IADQ) (Young, 1999). This scale was translated into the Chinese version and was verified to have good validity and reliability. Specifically, two changes were made to the IADQ. (1) the term "internet/online" was changed to "short-form video"; (2) the scale was changed to a 5-point Likert scale ranging from 1 (not at all) to 5 (always). It included items such as "You always spend more time on short-form video apps than you originally planned." Higher scores indicate more severe short-form video addiction. In this study, Cronbach's alpha was 0.872, with good reliability.

2.2.2 Attentional control

Attentional control was measured by the Attentional Control Scale (ACS), which includes 8 items that form two dimensions of attentional focus (e.g., "I have difficulty concentrating when music is playing in the room") and attentional shift (e.g., "I am slow to switch from one task to another) (Carriere et al., 2013). Participants rated each item on a 5-point scale from 1 (none at all) to 5 (always). A higher total score indicates higher attentional control. In this study, Cronbach's alpha of attentional focus and attentional shift were 0.808 and 0.770 respectively, suggesting good reliability.

2.2.3 Boredom proneness

Boredom proneness was assessed using the Boredom Proneness Scale (BPS) for College Students, which includes 30 items that form two dimensions of external and internal stimuli (Shihua et al., 2010). An example item is "I can be patient." Participants rated each item on a 5-point scale from 1 (strongly disagree) to 5 (strongly agree). A higher total score indicates higher boredom proneness. In this study, Cronbach's alpha of external stimuli and internal stimuli were 0.891 and 0.825 respectively, suggesting good reliability.

2.2.4 Academic procrastination

Academic procrastination was measured by the Academic Procrastination Scale (APS) developed by Solomon and Rothblum (1984), which includes 18 items (e.g., Do you procrastinate on this task?). Participants rated each item on a 5-point scale from 1 (none at all) to 5 (always). A higher total score indicates higher academic procrastination. The Cronbach's alpha was 0.863.

2.3 Data analysis

Descriptive statistics and Pearson correlation analysis were also conducted using SPSS 20.0. Then, a hierarchical regression analysis was performed to examine the main effects of the independent variables on the dependent variable. The hypothesized mediating role of attentional control and moderating effect of boredom proneness were examined using the PROCESS macro in SPSS (Model 4 and Model 7). All continuous variables were standardized, and the interaction terms were computed from these standardized scores. The bias-corrected bootstrapping method generates 95% confidence intervals for these effects from 5,000 resamples of the data. 52 The 95% confidence interval excluding zero indicates a significant effect.

3 Results

3.1 Test of common method bias

The result of Harman's single factor test showed the first common factor explained 15.79% (less than 40%) of the variance of all items, indicating that common method bias was not a problem.

3.2 Descriptive statistics

Means and standard deviations, and Pearson correlations among the variables, are presented in Table 1. Short-form video addiction was significantly negatively correlated with attentional control ($r = -0.23$, $p < 0.001$), and significantly positively correlated with boredom proneness ($r = 0.34$, $p < 0.001$) and academic procrastination ($r = 0.17$, $p < 0.001$); attentional control was significantly negatively correlated with boredom proneness ($r = -0.35$, $p < 0.001$) and academic procrastination ($r = -0.37$, $p < 0.001$); boredom proneness was significantly positively correlated with academic procrastination ($r = 0.32$, $p < 0.001$).

3.3 Test of the mediation model

The study variables were first standardized. The results of mediation model are presented in Table 2 and Figure 2. Short-form video addiction significantly positively predicted academic procrastination ($\beta = 0.17$, $p < 0.001$). Short-form video addiction significantly negatively predicted attentional control ($\beta = -0.23$, $p < 0.001$). When short-form video addiction and attentional control were tested together as predictors of academic procrastination, short-form video addiction still significantly positively predicted academic procrastination ($\beta = 0.09$, $p < 0.001$), while attentional control negatively predicted it ($\beta = -0.34$, $p < 0.01$).

3.4 Tests of the moderated mediation

The study variables were first standardized. Table 3 shows the results of the tests of moderated mediation. Boredom proneness was tested as a moderator of the association between short-form video addiction and attentional control. Short-form video addiction, boredom proneness, and their interaction significantly predicted attentional control ($\beta = -0.14$, $p < 0.001$; $\beta = -0.32$, $p < 0.001$; $\beta = 0.07$, $p < 0.05$). To interpret the moderating role of boredom proneness, simple slopes analysis was conducted using the Johnson-Neyman method (Hayes and Preacher, 2014), as presented in Figure3. The effect of short-form video addiction on attentional control was significant under a range of boredom proneness scores. For college students with lower boredom proneness, the effect of short-form video addiction on attentional control was stronger.

4 Discussion

The present study examined the association between short-form video addiction and academic procrastination, and the mediating and moderating effect on the association. Results showed that short-form video addiction was positively associated with academic procrastination. Attentional control was found to mediate the association, meaning that short-form video addiction lowered college students' attentional control, thereby contributing to higher levels of academic procrastination. Additionally, boredom proneness as a personality trait moderated the relationship between short-form video addiction and attentional control.

4.1 The relationship between short-form video addiction and academic procrastination

It was found that short-form video addiction is positively associated with academic procrastination, confirming our hypothesis H1. First, short-form videos are typical "small pleasure" as they are entertainment that is considered to take up only a small amount of time. Based on Silver and Sabini (1981) procrastination theory, individuals unconsciously spend significant time on "small pleasures," thereby occupying the time meant for daily work tasks and leading to task procrastination (Silver and Sabini, 1981). For students suffering from short-form videos addictions, short-form videos are carriers of such "small pleasures." People with short-form videos addiction may spend more time browsing short-form videos for entertainment and continuously checking for news and messages from their friends (Ryan et al., 2014). They give in to pleasant short-term temptations (such as browsing short-form videos) which can provide instant gratification (Nong et al., 2023). Meanwhile, they often postpone the tasks (such as writing a term paper) which are perceived as stressful, frustrating, or boring (Pychyl et al., 2000). Therefore, students who overuse short-form videos often indulge in short-form videos that provide short-term pleasure and delay the aversive academic tasks (Adrian et al., 2016), leading to academic procrastination.

4.2 The mediating role of attentional control

In accordance with our hypothesis H2, results of the current study also discovered that attentional control partially mediated how short-form video addiction affects academic procrastination. Adding the mediation effect to the model significantly elevated the model fit. Higher levels of short-form video additions are accompanied by higher level of exposed information with sustained concentration, which maximizes the user's attention capacity. Short-form videos are typically presented in a continuous and rapidly switching format, with an immediate sense of satisfaction (Peng et al., 2018). This instant

TABLE 1 The descriptive statistics and Pearson correlations.

	M	SD	1	2	3	4
1 Short-form video addiction	1.816	0.701	–			
2 Attentional control	3.114	0.669	−0.23***	–		
3 Boredom proneness	3.266	0.766	0.34***	−0.35***	–	
4 Academic procrastination	1.827	0.409	0.17***	−0.37***	0.32***	–

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 2 The mediating effect of attentional control.

Outcome	Predictors	β	SE	p	R^2	F
AP	Gender	0.08	0.06	<0.01	0.053	14.691***
	Age	0.07	0.04	0.16		
	SFVA	0.17	0.03	<0.001		
AC	Gender	−0.01	0.06	0.75	0.057	15.666***
	Age	0.01	0.04	0.77		
	SFVA	−0.23	0.03	<0.001		
AP	Gender	0.08	0.06	<0.01	0.164	40.956***
	Age	0.07	0.03	0.11		
	AC	−0.34	0.03	<0.001		
	SFVA	0.09	0.03	<0.001		

SFVA, Short-form video addiction; AC, Attentional control; AP, Academic procrastination.

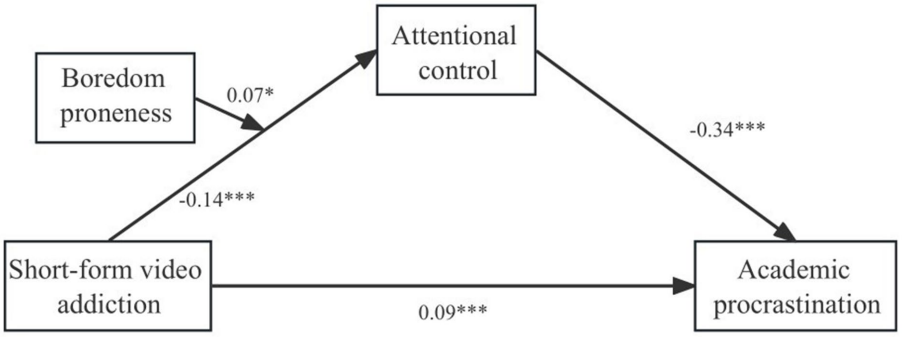

FIGURE 2
The path coefficients in the moderated mediation model. *$p < 0.05$, ***$p < 0.001$.

pleasure can stimulate the brain's reward center, leading to a reinforcement cycle. Students crave more immediate gratification, which can interfere with their long-term attention control (Prabu and Jung-Hyun, 2015). More importantly, although the results are consistent with previous studies that investigated attentional control with overuse of other technologies (e.g., television), there are reasons to believe that short-form videos might have caused more damage to children's attentional control, compared to television or broad internet addition (Woods and Woods, 2016). Traditional TV programs are well-produced and long videos that lasted over 10 min with information of consistent themes, while the production of short-form videos is inconsistent with diverse styles and themes. Thus, in comparison, short-form videos are much more attention-grabbing and attention-shifting (Woods and Woods, 2016), which could lead to more severe cognitive impairment for addictive users.

With impaired attentional control caused by short-form video addiction, college students were more likely to engage in academic procrastination. When individuals encounter unrelated stimuli (such as social media, short-form videos, message notifications), they struggle to control impulsive actions and start working towards their goals (Cardoso-Leite and Bavelier, 2014). Moreover, individuals with difficulties in attentional control often experience negative emotions such as anxiety and depression when they find it challenging to resist temptations and complete tasks (Adrian et al., 2016). This emotional burden not only has adverse effects on mental health but also makes it harder for individuals to focus on tasks, further preventing them from performing tasks that require high cognitive resources and attention (Rebetez et al., 2018).

4.3 The moderating effect of boredom proneness

The study revealed that boredom proneness plays a moderating role in the relationship between short-form video addiction and attentional control, thereby influencing the level of academic procrastination. The result is consistent with our hypothesis H3. Interestingly, although boredom proneness itself was negatively associated with attentional control, the interaction between boredom proneness and short-form video addiction was positively associated with attentional control. The positive association indicated that compared to college students with low boredom proneness, those with high boredom proneness are less impacted by short-form video addiction regarding their attentional control.

According to the sensation-seeking theory, individuals who are more prone to boredom tend to seek novel and exciting experiences (Hunter et al., 2016). When college students who are more prone to boredom develop short-form video addiction, they may actively seek

TABLE 3 The moderating effect of boredom proneness.

Outcome	Predictors	β	*SE*	*p*	R^2	*F*
Attentional control	Gender	0.20	0.06	0.74	0.153	31.302***
	Age	0.02	0.03	0.96		
	SFVA	−0.14	0.32	<0.001		
	BP	−0.32	0.03	<0.001		
	SFVA×BP	0.07	0.03	<0.05		

SFVA, Short-form video addiction; AC, Attentional control; BP, Boredom proneness; AP, Academic procrastination.

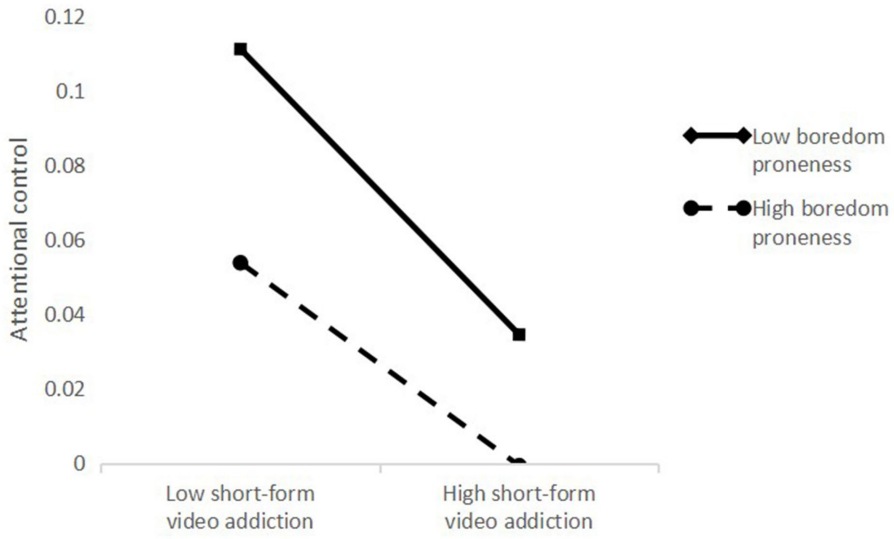

FIGURE 3
Moderating effect of boredom proneness on short-form video addiction and attentional control.

out more diverse and thrilling content (by searching for other videos) to avoid the monotonous environment. Thus, their experience of watching short-form videos might be more controlled by themselves and not dictated by the "echo chamber." This may mitigate the negative impact of short-form video addiction on their attentional control. Conversely, students with low boredom proneness are more likely to trapped in the echo chamber, continuously shifting their attention between short-form videos, which could further impair their attentional control.

Furthermore, college students with high boredom proneness might have a more profound experience with mental health benefits that could protect them from impaired attentional control. For college students with high boredom proneness, watching short-form videos brought positive emotional experiences, expanding their cognitive resources and cognitive ability and serving as a protective factor from short-video addiction (Pychyl et al., 2000). People who are prone to boredom frequently have significant feelings of loneliness and low self-esteem (Farmer and Sundberg, 1986; Vodanovich, 2003). According to the Interaction of Person-Affect-Cognition-Execution (I-PACE) model, internet addiction has compensatory effect when faced with the threat to relationship and the need for self-existence (Williams, 2009; Brand et al., 2019). Similarly, watching short-form videos compensated for the emotional needs for bored college students, leading to positive emotional experiences and increased self-esteem. According to the broaden-and-build theory of positive emotions, positive emotions can enhance cognitive resources and improve attentional performance (Fredrickson, 2001). Thus, for students who are easily bored, their executive functions are not as impacted by the excessive use of short-form videos.

5 Implications and limitations

The study findings have important implications for research and practical applications. First, since short-form video addiction is relatively new and still developing, previous literature has not yet examined how short-form video addiction played a part in academic procrastination. Our study aims to address this research gap by providing a theoretically driven model that focuses on cognitive processes and individual differences. Practically, results of the study may be helpful to disseminate information among college students about the adverse effects of short-form video addiction to reduce its negative impacts. Besides, considering the mediating role of attentional control between short-form video addiction and academic procrastination, educators can guide students using mindfulness to enhance their attentional control, thus reducing academic procrastination (MacDonald and Olsen, 2020). Moreover, students with low boredom proneness are addicted to short-form videos are more at risk for cognitive impairment. Due to the recency of short-form video addiction, specific treatment options are not available.

Using broad internet addiction as an analog, cognitive behavioral therapy (CBT), acceptance and commitment therapy (ACT), and medication might be effective options (Winkler et al., 2013). Meanwhile, it is necessary to adopt a dialectical perspective when considering boredom proneness. On the one hand, based on the negative association between boredom proneness and other variables, universities staff should be mindful of students who are high in boredom proneness. On the other hand, because boredom proneness may mitigate the negative effects of excessive short-form video use on attentional control, schools and parents do not need to overtly worry about students feeling bored.

There are several limitations that should be acknowledged in this study. First, due to the use of cross-sectional data, we cannot establish causal relationships. The cross-sectional data also prevents us to explore the bi-directional effect between short-form video addiction and academic procrastination. Past studies found that academic procrastination is a predictor to internet addiction (Tra and Gken, 2020), which could be extended to short-form video addiction. Future research should consider employing experimental or longitudinal designs to address causality and bi-directional effects. Additionally, the study assumed linear relationship between short-form video addiction and attentional control. The moderating effect of boredom proneness could also be the result of the non-linear relationship between the two variables with diminishing returns in extreme value.

Furthermore, the study sample might not be representative of the college student population, as our sample was based on convenience sampling (Iiker et al., 2015). Also, our study only included college students. Past research on short-form video addiction have focused on teenagers or high schoolers, whose attentional control is still developing. Thus, it is possible that the impact of short-form video addiction is more pronounced among teenagers. Future studies should aim to recruit participants from different age groups to better understand the potential age-related differences.

In light of the recent surge of short-form video usage and short-form video addiction, future studies also should investigate in more mediating variables on the effect between short-form video addiction and academic procrastination. For example, time perspective and time perception might be an important mediating variable for understanding the impact of short-form video addiction on individual's psychological processes. Since short-form videos are short in duration, watching short-form videos may create a false perception of time (Krivonogova et al., 2022). Therefore, college students might spend a large amount of time watching short-form videos without accurate awareness of scheduling, leading to academic procrastination. Also, the academic outcomes of the current study might not be comprehensive. Future studies should also include other outcome variables of academic adjustment other than academic procrastination (Clinciu and Cazan, 2014; Wang et al., 2021).

6 Conclusion

The results of this study yielded the following conclusions. (1) Short-form video addiction had a significant positive predictive effect on academic procrastination. (2) Short-form video addiction not only directly predicted academic procrastination among college students but also indirectly affected it via attentional control, which partially mediated the relationship. (3) Boredom proneness moderated the relationship between video addiction and attentional control. When the level of boredom proneness was high, the negative predictive effect of short-form video addiction on attentional control was diminished. Moreover, in terms of the main effect, boredom proneness had a negative effect on attentional control.

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 Ethics Committee of China University of Geosciences (Wuhan)-Research Center for Psychological Science and Health. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

JX: Writing – original draft, Writing – review & editing. XX: Writing – review & editing, Data curation, Methodology, Validation, Investigation, Funding acquisition. YZ: Writing – original draft.YT: Writing – review & editing. DW: Writing – review & editing. MS: Writing – review & editing. HH: Writing – original draft, 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.

Publisher's note

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Cannabis use in the UK: a quantitative comparison of individual differences in medical and recreational cannabis users

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There is a paucity of research, especially in the UK, that investigates individual differences in both medical and recreational cannabis users. A cross-sectional survey study design was used to assess recreational cannabis users and medical cannabis users currently living in the UK. Recreational cannabis users were invited to take part via social media. Medical cannabis users were recruited from Sapphire Medical Clinics, London, UK, which provides treatment with prescribed cannabis-based medicinal products. Demographic data and cannabis use frequency, as well as post-traumatic stress disorder symptoms (PCL-5), depression symptoms (Centre for Epidemiological Studies Depression Scale), trait and state anxiety (State-Trait Anxiety Inventory), and cannabis use motives [Comprehensive Marijuana Motives Questionnaire (CMMQ)] were collected. The Chi-square and independent-sample *t*-tests were used for the comparison of categorical variables and normally distributed continuous variables. Data were analyzed using analyses of variance (ANOVAs) and *t*-tests. Statistical significance was considered where the value of p was <0.05. The survey was completed by 161 participants. Medical cannabis users were older, consumed cannabis more often, had a higher "Sleep" motive on the CMMQ, and had a higher prevalence in self-reporting current diagnoses of neurological problems, mood disorders, and anxiety disorders ($p < 0.05$). Recreational cannabis users had higher scores on several motives for use (e.g., "Enjoyment," "Coping," "Experimentation," "Boredom," and "Celebration") and higher state anxiety scores ($p < 0.05$). The most common motives for cannabis use in both groups were "Enjoyment," "Low Risk," and "Sleep." There were no differences between groups in gender, "Low-Risk" motive, post-traumatic stress disorder symptoms, depression scores, trait anxiety scores, self-reported prevalence of substance use-related disorders, and past consumption of alcohol, tobacco, or caffeine ($p > 0.05$). The current study not only demonstrates a difference in age and motivations for cannabis consumption between recreational and medical cannabis users but also shows areas of potential overlap, including mental health outcomes, past substance use, and gender. These UK-specific findings indicate that recreational cannabis users experience higher state anxiety, highlighting the need for further evaluation of potential anxiogenic/anxiolytic properties of cannabis. These findings demonstrate the importance of researching individual differences in cannabis users and hold significant implications for future research, clinical practice, and legislation.

KEYWORDS

cannabis, cannabinoid, medical cannabis, recreational drug use, anxiety, depression

1 Introduction

There is a growing consumption of cannabis for both recreational and medical reasons globally (Azofeifa et al., 2016; Hasin and Walsh, 2021; Manthey et al., 2021; Kalayasiri and Boonthae, 2023). In the UK, cannabis is the most commonly used illicit drug, with 7.4% of adults between 16- to 59-years-old reporting having used the drug within the past year (Office for National Statistics, 2022). The introduction of legislative reform in the UK in 2018 has also facilitated the prescription of cannabis-based medicinal products (CBMPs) under medical supervision (Torjesen, 2018). Despite legislative change, there is limited understanding of the differences between medical cannabis users (MCUs) and recreational cannabis users (RCUs) (Pacula et al., 2016). This is especially true in the UK, where there has been a paucity of research compared to the USA and Canada (Schlag et al., 2020). This lack of research has been implicated as a barrier to the implementation of CBMPs in the UK in part due to perceived stigma by patients prescribed CBMPs (Troup et al., 2022), potentially leading to hesitancy to prescribe CBMPs (Morris, 2020; Nutt et al., 2020; Schlag et al., 2020).

There is also a relative deficit in high-quality evidence on the individual differences between MCUs and RCUs. Existing comparisons derive mainly from large-scale population studies in the USA. These studies have illustrated that, compared to RCUs, MCUs are typically older (Choi et al., 2017; Camsari et al., 2019), more likely to report daily consumption (Lin et al., 2016; Choi et al., 2017), have worse overall physical health (Roy-Byrne et al., 2015; Lin et al., 2016), and are more likely to report psychiatric comorbidities, including post-traumatic stress disorder (PTSD), depression, and anxiety (Choi et al., 2017). Research has shown that MCUs are less likely to use illicit drugs (Lin et al., 2016) compared to RCUs, who appear more likely to be polydrug users. However, these findings are likely reflective of the fact that psychiatric conditions are one of the more common classes of disorders for which CBMPs are prescribed rather than medical cannabis use, leading to a higher incidence of psychiatric conditions (Zongo et al., 2022; Olsson et al., 2023). Yet, considering the potential for cannabinoids to induce positive or negative effects on mental health outcomes according to relevant doses consumed, it is important to continue to examine the differences between RCUs and MCUs, considering the underlying differences in their pattern of consumption and underlying traits driving cannabis consumption (Sharpe et al., 2020). This lack of understanding of the similarities and differences between these two groups makes it difficult to legislate in respect of both the medical application and potential risk of recreational or illicit cannabis use.

Prior attempts to evaluate the differences between MCUs and RCUs have focused on recruiting from a general population rather than targeted assessment of individuals with a confirmed prescription for CBMPs (Roy-Byrne et al., 2015; Choi et al., 2017; Camsari et al., 2019). There may be a social desirability bias in reporting cannabis consumption to be medical in nature. This may, therefore, lead to inappropriately including RCUs within a sample of MCUs, limiting the conclusions that can be drawn from those data sets. Where prior comparisons have been conducted between MCUs and RCUs, they have not explored the reasons why differences exist. Different motives for cannabis use have been associated with cannabis use problems (Bresin and Mekawi, 2019), cannabis use patterns (Bonn-Miller et al., 2007; Casajuana-Kögel et al., 2021), and psychiatric disorders (Buckner et al., 2012; Metrik et al., 2016). Examining the motives for cannabis use could provide insights into differences between MCUs and RCUs. For example, previous research has reported that MCUs display an increased frequency of cannabis use and higher psychiatric symptoms (Choi et al., 2017; Turna et al., 2020), which is likely reflective of the frequency required for the relief of the associated symptoms for which CBMPs are used (Bonn-Miller et al., 2014). RCUs tend to use cannabis for enjoyment (Zvolensky et al., 2007) or to experiment and socialize (Bonn-Miller et al., 2014), which could be associated with the heightened polydrug use in this cohort (Lin et al., 2016). Therefore, previous research (Lin et al., 2016; Choi et al., 2017; Turna et al., 2020) has omitted an important factor when examining the differences between RCUs and MCUs. Whilst one significant difference between the two groups is that MCUs are assumed to be primarily using cannabis to alleviate symptoms of an underlying condition, it is also possible that RCUs are also accessing cannabis to self-medicate to varying levels. An example of this is evident in attention-deficit/hyperactivity disorder where some individuals report that their cannabis use is associated with improvements in hyperactivity and impulsivity (Mitchell et al., 2016). To provide a more in-depth understanding of the differences between the groups, improved research, which includes an investigation of motives for cannabis use, is required.

The primary aim of the current study was to compare individual differences in RCUs and MCUs in the UK to investigate potential motivations for use that may reflect overlap or divergence between cannabis users from two distinct groups. Specifically, the study aimed to analyze the differences between RCUs and MCUs with respect to their mental health and their motives for cannabis use, as well as individual differences, including age and cannabis use frequency, as well as caffeine, alcohol, and tobacco use.

2 Method

2.1 Participants

Cannabis users currently living in the UK were invited to participate in the study by recruiting via either social media for

Abbreviations: CBMPs, Cannabis-Based Medicinal Products; RCUs, Recreational Cannabis Users; MCUs, Medical Cannabis Users; PTSD, Post-traumatic stress disorder; CMMQ, Comprehensive Marijuana Motives Questionnaire; PCL-5, The PTSD checklist; CES-D, Centre for Epidemiological Studies Depression Scale; STAI, State–Trait Anxiety Inventory.

RCUs or Sapphire Medical Clinics for MCUs. Sapphire Medical Clinics was the first medical cannabis clinic in the UK to be registered with the regulatory authorities. It is currently the largest clinic with a geographically diverse population spanning all four nations within the UK and the crown dependencies. The invitation to participate included an online link to the survey, which was delivered via Question-Pro (Survey Analytics LLC, Oregon, United States).

To ensure that RCUs and MCUs are separated into two distinct groups, two individual links to the online survey were made. MCUs invited to take part in the survey were recruited from Sapphire Medical Clinics who had consented to being contacted regarding research and had a minimum of two appointments at the clinic and a minimum of one prescription of a CBMP in the past 3 months ($n = 3{,}616$). A total of 296 participants responded to the survey. 151 RCUs responded to the advertisement placed online (Facebook, Instagram, Twitter, and Reddit). Overall, 70 (46.36%) participants from this sample were excluded because they failed to complete the survey, and 1 (0.66%) participant was excluded as they reported never consuming cannabis. A total of 145 (4.01%) participants responded to the invitations from the Sapphire Medical Clinics. Overall, 64 (44.44%) participants were excluded because they failed to complete the survey, leaving a total sample of 81 (55.86%) MCUs.

Participants provided informed consent, and all research was conducted in line with the principles outlined in the Declaration of Helsinki (World Medical Association, 2013). Ethical approval for the study was granted by the ethics committee of the School of Education and Social Sciences of The University of the West of Scotland (approval number: 2022-18118-15377).

2.2 Design

The current study used a cross-sectional questionnaire-based design. Data were collected online using Question-Pro (Survey Analytics LLC, Oregon, United States) between 14 June and 14 July 2022.

2.3 Measures and apparatus

The online survey was devised by a multi-disciplinary team of researchers, including academic physicians, a clinical cognitive neuroscientist, and a Community Link Worker with expertise in drug and alcohol support. The questionnaire included questions on demographics (age, gender, nationality, other substance use, and psychological health) and measures assessing cannabis use motives, depression, anxiety, and PTSD symptoms.

2.3.1 Comprehensive Marijuana Motives Questionnaire

To measure cannabis use motives, the Comprehensive Marijuana Motives Questionnaire (CMMQ) was used (Lee et al., 2007, 2009). CMMQ is a 36-item measure which prompts participants to indicate the frequency with which they use cannabis for 12 distinct reasons (*Enjoyment, Conformity, Coping, Experimentation, Boredom, Alcohol, Celebration, Altered Perception, Social Anxiety, Low Risk, Sleep, and Availability*), using a scale of 1 (almost never or never) to 5 (almost always or always). Each of the 12 distinct reasons has a composite score of 1–15. Higher scores indicate a greater value placed on that motive for using cannabis. Previous research conducted in the USA supports the utility of the CMMQ among RCUs (Blevins et al., 2016) and MCUs (Bohnert et al., 2018).

2.3.2 The PTSD checklist

To assess participants' PTSD symptoms, the PTSD Checklist (PCL-5) was used (Blevins et al., 2015). PCL-5 is a 20-item measure, with four clusters of symptoms that correspond to the DSM-5 as follows: Cluster B (intrusion symptoms), Cluster C (avoidance of stimuli), Cluster D (negative alterations in mood or cognition), and Cluster E (alterations in arousal and reactivity). Responses are scored on a scale of 0 (not at all) to 4 (extremely), with total scores ranging from 0 to 80. Scores over 33 are considered as representing a probable diagnosis of PTSD. Participants were asked to answer PCL-5 items based on their most traumatic event. PCL-5 has good test–retest reliability and convergent and discriminant validity (Blevins et al., 2015).

2.3.3 Centre for Epidemiological Studies Depression Scale

To assess participants' depressive symptoms, the Centre for Epidemiological Studies Depression Scale (CES-D) was used (Radloff, 1977). The CES-D contains 20 items and includes six components (depressed mood, feelings of guilt and worthlessness, feelings of helplessness, psychomotor retardation, loss of appetite, and sleep disturbance). Participants indicated the frequency of the symptoms in the last week, using a scale of (0) "rarely or none of the time" (<1 day) to (4) "most or all of the time" (5–7 days). The total range of scores is from 0 to 60, with higher values representing greater severity of symptoms. Early validation studies indicate that the CES-D has high internal consistency, acceptable test–retest reliability, and good construct validity in both clinical and community samples (Radloff, 1977).

2.3.4 State–Trait Anxiety Inventory

To assess participants' anxiety, the State–Trait Anxiety Inventory (STAI) was used (Spielberger et al., 1983). The STAI is comprised of separate State and Trait scales. Each scale has 20 four-point items. The State scale prompted participants to rate the intensity of anxiety symptoms experienced at that moment ('not at all' to 'very much so'). The Trait scale generally assessed participants' anxiety in terms of intensity ('almost never' to 'almost always'). Scores over 35 on both portions of the STAI are considered high. Early validation studies indicate that STAI has good construct validity (Smeets et al., 1997), discriminant and convergent validity (Spielberger et al., 1983), and test–retest reliability (Rule and Traver, 1983).

2.4 Procedure

Prior to the self-reported online survey, participants were provided with an information sheet with the aim and purpose of the study. The survey began with demographic questions about age, gender, ethnicity, consumption of caffeine, alcohol, nicotine, and cannabis, as well as questions regarding current psychological diagnoses. Following, participants answered the CMMQ (Lee et al., 2007, 2009), the CES-D (Radloff, 1977), the STAI (Spielberger et al., 1983), and the PCL-5 (Blevins et al., 2015).

2.5 Statistical analysis

Data were curated in Excel (Microsoft 365, Microsoft, WA, USA), and appropriate statistical tests of significance were used to evaluate differences between groups. The Chi-square and independent-sample *t*-tests were used for comparison of categorical variables and normally distributed continuous variables. Differences in motives and mental health outcomes between the two cohorts were analyzed using analyses of variance (ANOVAs) and planned *t*-tests. *p*-values for all statistical analyses were considered significant below 0.05. All data were prepared and analyzed using Jeffreys's Amazing Statistics Program [JASP Team (2023); JASP (Version 0.16.3) Microsoft Windows 10, Microsoft, WA, USA].

3 Results

3.1 Demographics

Table 1 displays the complete demographic and clinical characteristics of RCUs and MCUs.

3.1.1 Gender and ethnicity

There were no significant differences in gender between groups. In both, there was a higher frequency percentage of men, with 56.00% of men ($n = 52$) belonging the RCU group and 61.70% of men ($n = 50$) belonging to the MCU group. There were no significant differences in ethnicity, with both groups displaying a higher frequency percentage of self-reporting as white.

3.1.2 Age range

There were significant differences between the 25–34, 35–44, and 45–55 year age groups. RCUs had a higher frequency of reporting being in the 25–34 age group ($n = 46$; 57.50%) than MCUs ($n = 22$; 27.16%; $p < 0.001$), and MCUs had a higher frequency of reporting being in the 35–44 ($n = 26$; 32.10%) and 45–55 age groups ($n = 19$; 23.45%) than RCUs ($n = 11$; 13.75%; $p = 0.006$) ($n = 5$; 6.25%; $p = 0.002$). The differences in age range groups between RCUs and MCUs are further displayed in Figure 1.

To further investigate the differences between the age ranges in the two groups, the age range groups were scored on a 1–5 scale (1 being the 18–24 age group, 5 being the 56–70 age group). The independent sample *t*-test showed a significant overall difference between the RCU and MCU age range groups, $t(159) = 4.610$, $p < 0.001$. This indicates that MCUs had a higher overall score on age range groups ($M = 2.86$, $SD = 1.09$) than RCUs ($M = 2.13$, $SD = 0.9$), exemplifying that MCUs are, on average, older than RCUs.

3.1.3 Substance Use

Considering substance use prior to completing the survey, there were only significant differences for cannabis use ($p = 0.006$) (see Table 1), with MCUs presenting a higher frequency of cannabis use 24 h prior to taking the survey ($n = 71$; 88.75%) than RCUs ($n = 53$; 66.25%; $p < 0.001$) and 8 h prior to completing the survey ($n = 49$; 61.25%; $p = 0.006$) than RCUs ($n = 32$; 40%; $p = 0.006$). There were no significant differences in caffeine, alcohol, and tobacco use between the two groups ($p > 0.050$).

3.1.4 Current psychological diagnoses

Regarding self-reported current psychological diagnoses, MCUs show a greater prevalence of current neurological problems ($p = 0.014$), mood disorders ($p < 0.001$), and anxiety disorders ($p < 0.001$). No differences between the two groups in substance use-related disorders and other psychological disorders were found ($p > 0.050$) (see Figure 2; Table 1).

3.2 Mental health

The differences between the mental health measure scores of the RCU and MCU age groups were analysed using a mixed-design (2 × 4) ANOVA, with within-subject factors of mental health measure scores (PCL-5, CES-D, STAI_S, and STAI_T) and between-subject factors of the cannabis user group (RCU and MCU) (see Table 2). The descriptive statistics for each measure and each group are reported in Table 3. Of note, two participants were removed from the MCU group for this analysis as they failed to complete the measures.

Mauchly's test of sphericity indicated that the assumption of sphericity had been violated [$\chi^2(5) = 0.46$, $p < 0.001$]; therefore, degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity ($\varepsilon = 0.64$).

Using the Greenhouse–Geisser correction, there was a main effect of mental health (*Depression, PTSD, Trait Anxiety,* and *State Anxiety*), $F(1.93, 303.09) = 457.4$, $p < 0.001$, $\eta^2 = 0.32$. Using the Greenhouse–Geisser correction, there was a main effect of Mental Effect*Cannabis User interaction, $F(1.93, 303.09) = 5.07$, $p = 0.007$, $\eta^2 = 0.004$. This interaction is illustrated in Figure 3. There was no significant main effect of the cannabis user group.

Planned independent-sample *t*-tests were conducted to examine the significant main effect of Mental Effect*Cannabis User interaction. As observed in Figure 3, RCUs scored lower on all the mental health measures except from *State Anxiety* scores ($p < 0.001$). As shown in Table 3, there were no significant differences between any of the measures on the cannabis user group; however, the difference between RCU *State Anxiety* scores ($M = 40.54$, $SD = 5.4$) and MCU *State Anxiety* scores ($M = 37.61$, $SD = 14.75$, $p = 0.09$) approached significance.

Furthermore, the chi-squared tests were conducted to analyze whether each mental health measure differed between the two groups. As shown in Table 3, there was only a significant difference between RCUs and MCUs on the State Anxiety measure $\chi^2(41, 159) = 91.418$, $p < 0.001$, demonstrating a difference between higher RCU *State Anxiety* scores and lower MCU *State Anxiety* scores.

3.3 Motives

The differences in motives for cannabis use between RCUs and MCUs were assessed by the CMMQ, which has 12 subscales (*Enjoyment, Conformity, Coping, Experimentation, Boredom, Alcohol, Celebration, Altered Perception, Social Anxiety, Low Risk, Sleep*, and *Availability*). Descriptive statistics for each subscale and group scores are displayed in Table 4 and Figure 4.

The differences in motives between MCUs and RCUs were analyzed using a mixed-design (2 × 12) ANOVA (see Table 5; Figure 5) with within-subject factors of motives subscales (*Enjoyment, Conformity, Coping, Experimentation, Boredom, Alcohol, Celebration, Altered Perception, Social Anxiety, Low Risk, Sleep, and Availability*) and between-subject factors of

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TABLE 1 Demographic and clinical characteristics in RCUs and MCUs.

Baseline characteristic	RCUs	RCUs	MCUs	MCUs	Significant test statistic and value of *p*
	n	%	*n*	%	
Gender					
Women	27	33.75	26	32.10	
Men	52	56.00	50	61.70	
Other	1	1.25	4	4.90	
Prefer not to say	0	0.00	1	1.20	
Ethnicity					
White	68	85.00	75	92.60	
Hispanic/Latino/Spanish Origin	1	1.25	0	0,00	
Black/African American	2	2.50	1	1.23	
Asian	2	2.50	1	1.23	
Middle Eastern or North African	1	1.25	1	1.23	
Other race, ethnicity, or origin	6	7.50	3	4.00	
Age range (Years)					
18–24	16	20.00	9	11.11	
25–34	46	57.50	22	27.16	$\chi^2 = 15.19$, $p < 0.001$
35–44	11	13.75	26	32.10	$\chi^2 = 7.66$, $p = 0.006$
45–55	5	6.25	19	23.45	$\chi^2 = 9.39$, $p = 0.002$
56–70	2	2.50	5	6.17	
Substance use (Past 24 h)					
Caffeine	62	77.50	58	72.50	
Alcohol	24	30.00	20	25.00	
Tobacco	40	50.00	32	40.00	
Cannabis	53	66.25	71	88.75	$\chi^2 = 10.42$, $p < 0.001$
Substance use (Past 8 h)					
Caffeine	54	67.50	49	61.25	
Alcohol	10	12.50	5	6.25	
Tobacco	36	45.00	31	38.75	
Cannabis	32	40.00	49	61.25	$\chi^2 = 7.60$, $p = 0.006$
Current psychological diagnoses					
Neurological problem	11	13.75	24	29.63	$t = 2.47$, $p = 0.014$
Mood disorder	8	10.00	27	33.30	$t = 3.72$, $p < 0.001$
Anxiety disorder	17	21.25	38	46.91	$t = 3.54$, $p < 0.001$
Substance-related disorder	1	1.25	2	2.47	
Any other psychological disorder	10	12.50	15	18.51	

Significant group differences at $p = 0.05$ are Shown. RCU $N = 80$, MCU $N = 81$, (total sample = 161). RCU, Recreational Cannabis Users; MCU, Medical Cannabis Users.

cannabis user group (RCUs and MCUs). Mauchly's test of sphericity indicated that the assumption of sphericity had been violated [$\chi^2(65) = 0.084$, $p < 0.001$]; therefore, degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity ($\varepsilon = 0.70$).

Using the Greenhouse–Geisser correction, there was a significant main effect of motives [$F(7.74, 1230.57) = 119.314$, $p < 0.001$, $\eta^2 = 0.32$], with *Enjoyment* ($M = 11.08$, $SD = 3.55$), *Low Risk* ($M = 10.34$, $SD = 3.92$), and *Sleep* ($M = 9.66$, $SD = 4.14$) motives having the highest overall scores and *Conformity* ($M = 3.24$, $SD = 1.0$) and *Alcohol* ($M = 3.88$, $SD = 2.03$) motives having the lowest overall scores regardless of group (Table 4; Figure 5).

There was a significant main effect of the cannabis user group $F(1,159) = 15.5$ $p < 0.001$, $\eta^2 = 0.22$, with RCUs having a higher overall mean score on motive subscales ($M = 91.10$, $SD = 2.39$) than MCU ($M = 76.80$, $SD = 2.46$).

Using the Greenhouse–Geisser, there was a significant Motives*Cannabis User Group interaction $F(7.74, 1230.57) = 8.219$, $p < 0.001$, $\eta^2 = 0.20$. Planned independent-sample *t*-tests were conducted to examine this interaction (Table 5). There were differences between the two groups on all the motive subscales apart from *Low Risk* and *Social Anxiety* ($p > 0.05$). RCUs scored higher on motive subscales of *Enjoyment, Coping, Experimentation, Boredom,*

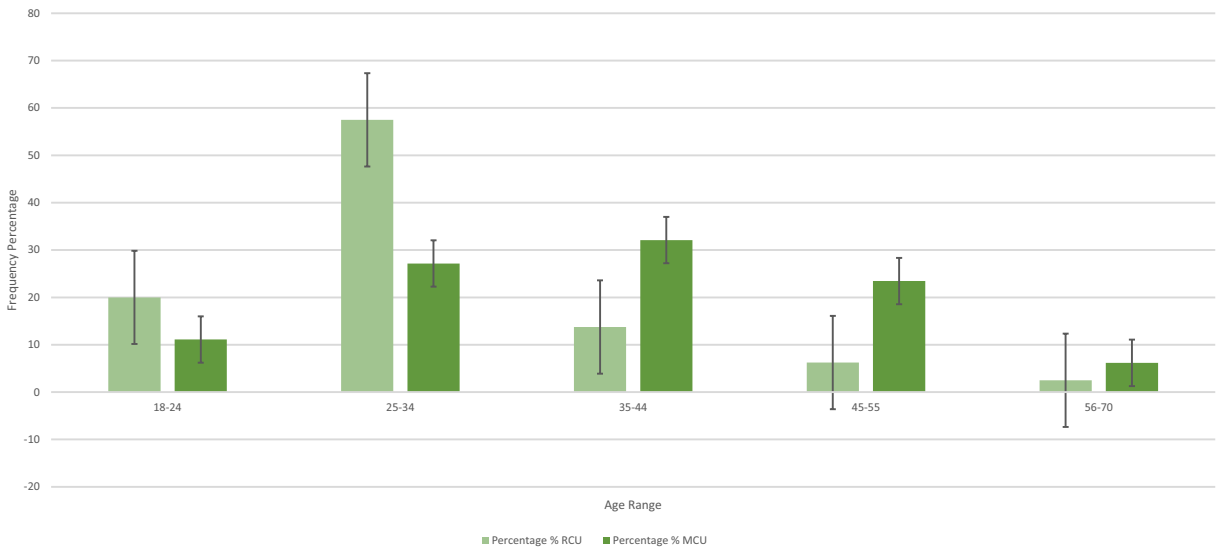

FIGURE 1
Frequency percentage of age range in RCUs and MCUs.

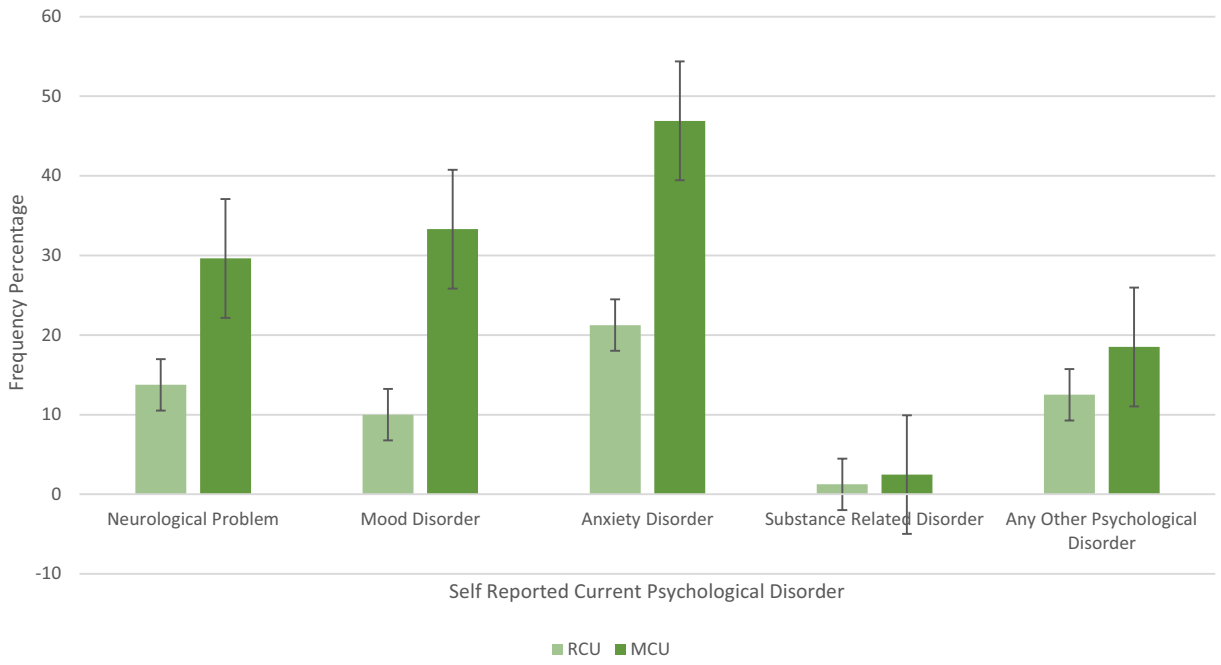

FIGURE 2
Differences in percentage frequency of self-reported current psychological diagnoses between RCU and MCU.

Alcohol, Celebration, Altered Perception, and *Availability* ($p < 0.05$). MCUs scored higher on the *Sleep* motive subscale ($p = 0.017$). All descriptive and *t*-test statistics and *p*-values are reported in Table 4.

4 Discussion

The primary aim of the current study was to investigate differences between RCUs and MCUs in the UK. The two main areas of interest were the differences in mental health (PTSD, depression, and anxiety) and motives for cannabis use. The current study also investigated other potential characteristics, including age, cannabis use frequency, and other substance use. The results showed differences in age, cannabis use frequency, state anxiety, and cannabis use motives between the two groups. MCUs were more likely to be older, present with a higher frequency of cannabis use, have higher scores on *Sleep* motive, and lower scores of state anxiety than RCUs. RCUs had higher scores on several motives, such as *Enjoyment, Conformity, Coping, Experimentation, Alcohol, Celebration, Altered Perception,* and *Availability* compared to MCUs. The current study found no significant differences between the

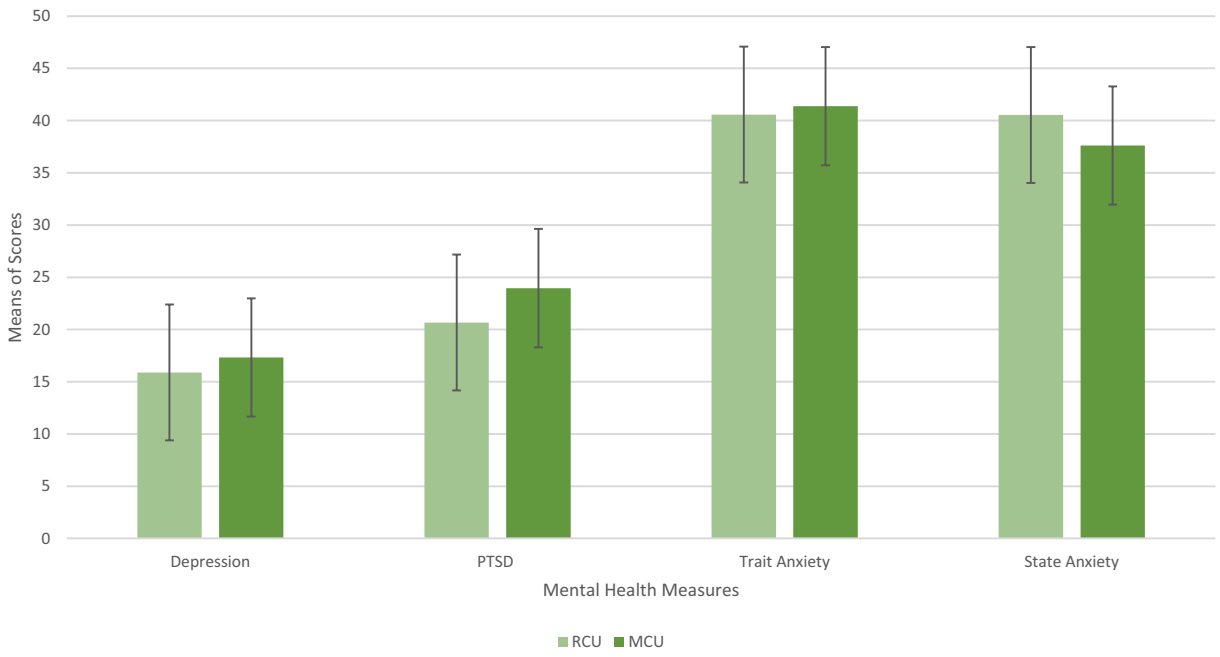

FIGURE 3
Differences in mean score on mental health measures between RCU and MCU.

TABLE 2 Results of 2 × 4 ANOVA on the differences between RCU and MCU on mental health measures scores.

	ANOVA			
Factors	*F*	df	*p*	η^2
Mental health	457.4	1.93	0.001	0.32
Cannabis user	0.10	1	0.75	3.38
Mental Health*Cannabis User Group	5.07	1.93	0.007	0.004

RCU, Recreational Cannabis User; MCU, Medical Cannabis Users.

two groups on PTSD, depression, trait anxiety, other substance use, and two motives (*Social Anxiety* and *Low Risk*).

4.1 Individual differences

Consistent with previous research (Choi et al., 2017; Camsari et al., 2019; Turna et al., 2020), the present study found that there were differences in age between the MCU and RCU groups, with MCUs being, on average, older than RCUs. These age-related differences could be a result of health-related disparities, with older adults being more likely to have symptoms that lead to them seeking CBMPs (McKee et al., 2021). Economic stability may be another factor in understanding these differences, as despite guidelines allowing for the use of CBMPs through the UK's single-payer system, the National Health Service, for several conditions, most prescriptions are privately funded (Lusardi and Mitchell, 2011; FitzRoy and Nolan, 2020). This, in turn, could lead to younger people seeking treatment for their symptoms, relying on unregulated cannabis, which then leads to the potential for increased risk of harm from exposure to unregulated cannabis (Couch, 2020). Further research is needed to understand the mediating role economics has on risks associated with unregulated cannabis use.

Previous research has shown that RCUs are vulnerable to polydrug use (Lin et al., 2016). The present study did not display any differences in alcohol, tobacco, or caffeine use. However, as participants were not asked about illicit drug use, these findings do not suggest that RCUs have more prevalent use of alcohol, caffeine, or tobacco compared to MCUs. Consistent with previous research (Lin et al., 2016; Choi et al., 2017), MCUs were found to have a higher frequency of cannabis use compared with RCUs, which was expected given the regularity with which prescribed CBMPs must be taken.

4.2 Mental health differences

MCUs had a higher incidence of self-reported neurological problems, mood disorders, and anxiety disorders compared to RCUs. These differences were to be expected as the MCU group was recruited from a population who was already treating their symptoms with CBMPs. *State anxiety* scores were lower for the MCU group compared with the RCU group. These differences were statistically significant. Scores for depression (CES-D), PTSD (PCL-5), and trait anxiety (STAI) were slightly higher, trending toward significance for MCUs. Whilst MCUs are usually found to have elevated scores on mental health measures (Choi et al., 2017; Turna et al., 2020), it was unexpected to note the statistically different scores for state anxiety. This difference could be explained by their use of CBMPs, which has been shown to reduce anxiety in patient populations (Ergisi et al., 2022; Sachedina et al., 2022; Rifkin-Zybutz et al., 2023), thus providing further evidence for the anxiolytic properties of CBMPs, which have been increasing in prevalence since the onset of the COVID-19 pandemic (Shevlin et al., 2020a,b; Jenkins et al., 2021; Saeed et al., 2022).

TABLE 3 Descriptive statistics for mental health measures scores per RCU and MCU group, results from *t*-test and χ^2 analyses.

Mental health measure	RCUs		MCUs		*t*-Test			χ^2	
	M	*SD*	*M*	*SD*	*T*	*p*	Cohen's	χ^2	*p*
Depression[a]	15.89	10.76	17.32	13.03	0.95	0.34	0.15	42.24	0.504
PTSD[b]	20.66	18.35	23.96	20.54	1.20	0.23	1.18	65.07	0.274
Anxiety Trait[c]	40.58	11.15	41.38	14.77	0.60	0.57	0.09	47.00	0.469
Anxiety State[d]	40.54	5.40	37.61	14.75	1.60	0.09	−0.26	91.42	0.001

[a]Center for Epidemiological Studies-Depression Scale (CES-D).
[b]The PTSD Checklist (PCL-5).
[c]Trait portion of State–Trait Anxiety Inventory (STAI).
[d]State portion of State–Trait Anxiety Inventory (STAI).
RCU, Recreational Cannabis Users; MCU, Medical Cannabis Users.

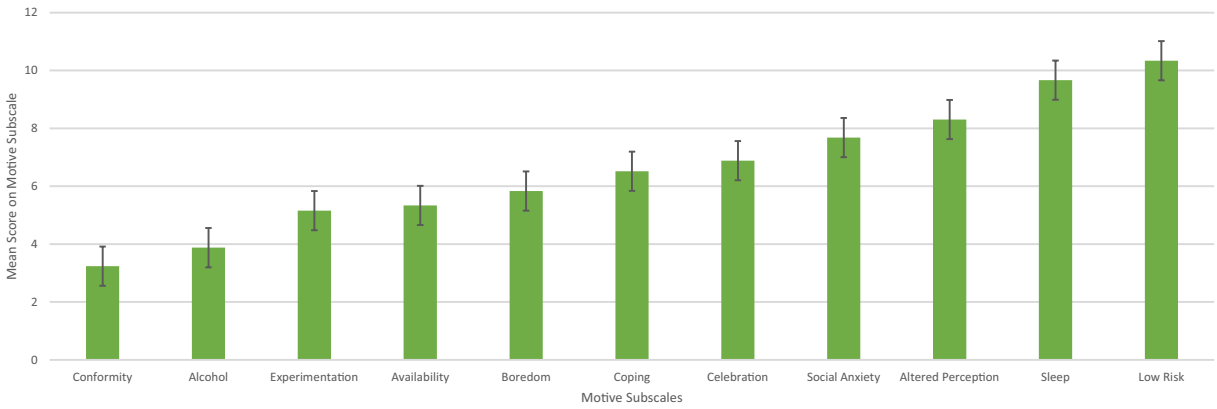

FIGURE 4
Total sample mean scores on motives subscales.

4.3 Motives differences

A comparison of motives for cannabis use supported previous findings, indicating that subscales for *Enjoyment, Low Risk,* and *Sleep* showed the highest scores (Dekker et al., 2009; Gill et al., 2015; Blevins et al., 2016; Altman et al., 2019; Winiger et al., 2021). This was the case for both the RCU and MCU groups. *Low-Risk* motive was also high for both groups, which is supported by the abundance of research illustrating that cannabis is the most globally normalized illicit drug (Korf, 2006; Osborne and Fogel, 2007; Sznitman et al., 2013), with reports of its increasing popularization in recent years (Skliamis et al., 2021). In addition, legislative change has resulted in the legalization of recreational cannabis use in an increasing number of jurisdictions. MCUs were more likely to use cannabis to aid sleep. Haug et al. (2017) reported that middle-aged MCUs are more likely to use cannabis as a sleep aid and to cope with symptoms of insomnia. This result is consistent with our MCU cohort being older and the literature indicating that middle-aged adults have higher rates of insomnia than younger adults (Sepehrmanesh et al., 2010). Moreover, MCUs are affected by chronic health conditions which are likely to be affected by co-morbid sleep disorders, with data from the UK Medical Cannabis Registry suggesting that these individuals experience improvements in self-reported sleep quality after initiation of CBMPs (Olsson et al., 2023).

Contrary to previous literature, which suggests that MCUs often use cannabis to cope (Bonn-Miller et al., 2014), the present study indicates that RCUs are more likely to use cannabis for the *Coping* motive. To our knowledge, this is the first study directly comparing MCUs and RCUs' motives for cannabis use. One explanation for these findings could be that both MCUs and RCUs score similarly on mental health measures, leading the RCU *Coping* motive to be high. For example, in individuals with attention-deficit/hyperactivity disorder, reported use of cannabis is higher than that among the general population (Francisco et al., 2022). However, it is anticipated that a large proportion of individuals with attention-deficit/hyperactivity disorder who remain underdiagnosed, particularly women (Quinn and Madhoo, 2014). Therefore, the consumption of cannabis in some RCUs may represent undiagnosed or sub-clinical psychiatric conditions, leading to an increase in the *Coping* motive. Future comparisons need to investigate differences in motives between the two cohorts and consider their potential association with mental health disorders.

4.4 Limitations

The findings of the current study should be considered in the context of their limitations and strengths. The main limitations include a relatively small sample size, self-reported assessments, and failure to control for the medical–recreational subgroup.

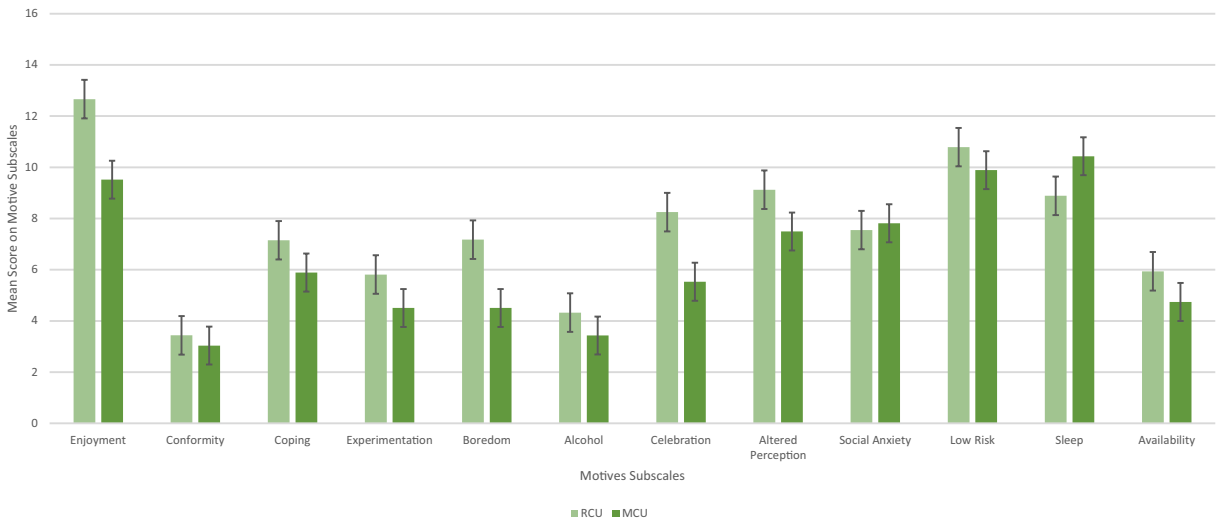

FIGURE 5
Differences in mean scores on motive subscales between RCU and MCU.

TABLE 4 Descriptive statistics and *t*-test results for differences in motive subscales between RCUs and MCUs.

Motive subscales	Total sample		RCUs		MCUs		*T*	*p*	Cohens
	M	*SD*	*M*	*SD*	*M*	*SD*			
Enjoyment	11.08	3.54	12.66	2.51	9.52	3.72	−6.284	<0.001	−0.990
Conformity	3.24	1.00	3.44	1.37	3.04	0.25	−2.594	0.010	−0.409
Coping	6.52	3.53	7.15	3.68	5.89	3.28	−2.294	0.023	−0.362
Experimentation	5.15	2.96	5.81	3.19	4.51	2.58	−2.859	0.005	−0.451
Boredom	5.83	3.38	7.18	3.68	4.51	2.41	−5.448	<0.001	−0.859
Alcohol	3.88	2.03	4.32	2.32	3.43	1.60	−2.852	0.005	−0.449
Celebration	6.88	4.01	8.25	3.96	5.53	3.61	−4.556	<0.001	−0.718
Altered perception	8.30	4.40	9.13	4.35	7.49	4.33	−2.384	0.018	−0.376
Social anxiety	7.68	4.42	7.55	4.48	7.82	4.38	0.379	0.705	0.060
Low risk	10.34	3.92	10.79	3.76	9.89	4.05	−1.458	0.147	−0.230
Sleep	9.67	4.14	8.89	4.42	10.43	3.72	2.401	0.017	0.379
Availability	5.33	2.73	5.94	3.02	4.74	2.29	−2.840	0.005	−0.448

RCU, Recreational Cannabis Users; MCU, Medical Cannabis Users.

TABLE 5 Results of 2 × 12 ANOVA on the differences between RCU and MCU on motive subscales.

	ANOVA			
Factors	*F*	df	*p*	η^2
Motives	119.314	7.74	0.001	0.32
Cannabis user group	15.5	1	0.001	0.22
Motives*Cannabis User Group	8.219	7.74	0.001	0.20

RCU, Recreational Cannabis Users; MCU, Medical Cannabis Users.

Furthermore, the recruitment of participants from two different sources, a medical cannabis clinic for a patient population and social media from a recreational cannabis group, may also be a source of selection bias. This strategy, however, was utilized due to the differences in legality between medical and recreational cannabis use in the UK, with each strategy utilized to provide access to the most diverse sample possible. Future investigations should provide appropriate improvements to the current study design. Despite the limitations, the current findings have implications for future research, clinical practice, and legislation. Firstly, to our knowledge, this is the first study to investigate the potential differences in cannabis use motives between RCUs and MCUs. The current study provided considerable insight into the differences and overlaps in motives between the two groups, offering a substantial baseline for future comparisons. The current study is also the first to investigate differences between the two groups in the UK. The findings advocate the importance of conducting this type of comparison in countries other than Canada and the USA. The results showed different characteristics of cannabis users in this population, identified vulnerable groups

for illicit cannabis use, and exemplified the potential consequences of the poor integration of CBMPs in the UK. These findings further support the need to develop a clear policy position on both medical and recreational cannabis use in the UK. It highlights two distinct populations that potentially require the development of separate legislation, whilst acknowledging there is also overlap between the motivations for cannabis use between the two groups. It is, therefore, important to develop further research into these two distinct yet overlapping populations with an aim of clarifying similarities and distinctions in more detail. Finally, these findings illustrate the need to investigate both the benefits of CBMPs, such as a reduction in symptoms of anxiety. Research in these areas could provide individuals with the knowledge they require making informed decisions when choosing to use or prescribe medical cannabis, which in turn could improve the integration of CBMPs in the UK, particularly in supporting developing and implementing policy.

5 Conclusion

Overall, the current study provides a foundation for future research investigating recreational and medical cannabis use in the UK. The findings propose clear differences between the two cohorts but also demonstrate areas of potential overlap. Notably, RCUs reported higher state anxiety at the time of the survey, despite similar levels of trait anxiety as MCUs. In addition, RCUs reported motives for cannabis use that were more closely associated with social reasoning, including *Enjoyment* or *Celebration*. Interestingly, they scored higher than MCUs on the *Coping* component of the CMMQ, which requires further examination in the future studies. MCUs were conversely older and reported a higher frequency of cannabis use. As the popularity of cannabis increases globally, and especially the use of CBMPs, this type of research will foster a more in-depth and substantial understanding of the risks and benefits associated with using cannabis recreationally and medically.

Data availability statement

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

Ethics statement

The studies involving humans were approved by the University of the West of Scotland School of Education and Social Sciences Ethics Committee. 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

BC: Conceptualization, Writing – original draft, Writing – review & editing, Writing – review & editing, Data curation, Formal Analysis, Investigation, Methodology. SE: Data curation, Writing – review & editing, Resources. MS: Resources, Writing – review & editing. LT: Conceptualization, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

SE is the Head of Research at Sapphire Medical Clinics. MS is the Chief Medical Officer of Curaleaf International.

The remaining 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.

Publisher's note

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Corrigendum: Cannabis use in the UK: a quantitative comparison of individual differences in medical and recreational cannabis users

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cannabis, cannabinoid, medical cannabis, recreational drug use, anxiety, depression

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In the published article, there were errors in the figure numbering and captions.

Figure 2 should be re-numbered to be Figure 5, and the caption should be changed to "Differences in mean scores on motive subscales between RCU and MCU".

Figure 3 should be re-numbered to be Figure 2, with the caption "Differences in percentage frequency of self-reported current psychological diagnoses between RCU and MCU."

Figure 4 should be re-numbered to be Figure 3, with the caption "Differences in mean score on mental health measures between RCU and MCU."

Figure 5 should be re-numbered to be Figure 4, with the caption "Total sample mean scores on motives subscales."

Additionally, in the published article, there were errors in the in-text figure citations.

Where Figure 3 has been cited in the text of Section 3.1.4 Current psychological diagnoses, this should instead be "Figure 2". The corrected sentence is below.

"No differences between the two groups in substance use-related disorders and other psychological disorders were found ($p > 0.050$) (see Figure 2; Table 1)."

Where Figure 4 has been cited in the text of Section 3.2 Mental health, this should instead be "Figure 3". The corrected sentence is below.

"This interaction is illustrated in Figure 3."

Where Figure 4 has been cited in Section 3.3 Motives, this should instead be "Figure 5". The corrected sentence is below.

"Using the Greenhouse–Geisser correction, there was a significant main effect of motives [$F_{(7.74,1230.57)} = 119.314$, $p < 0.001$, $\eta^2 = 0.32$], with *Enjoyment* ($M = 11.08$,

SD = 3.55), *Low Risk* (*M* = 10.34, *SD* = 3.92), and *Sleep* (*M* = 9.66, *SD* = 4.14) motives having the highest overall scores and *Conformity* (*M* = 3.24, *SD* = 1.0) and *Alcohol* (*M* = 3.88, *SD* = 2.03) motives having the lowest overall scores regardless of group (Table 4; Figure 5)."

Where Figure 5 has been cited in the text of Section 3.2 Mental health, this should instead be "Figure 3". The corrected sentence is below.

"As observed in Figure 3, RCUs scored lower on all the mental health measures except from *State Anxiety* scores ($p < 0.001$)."

Additionally, in Section 3.1.3 Substance use, instead of "(see Figure 2; Table 1)", only Table 1 should be cited here. A correction has been made to **Section 3 Results**, "*3.1.3 Substance use*". The corrected paragraph is shown below.

"Considering substance use prior to completing the survey, there were only significant differences for cannabis use ($p = 0.006$) (see Table 1), with MCUs presenting a higher frequency of cannabis use 24 h prior to taking the survey ($n = 71$; 88.75%) than RCUs ($n = 53$; 66.25%; $p < 0.001$) and 8 h prior to completing the survey ($n = 49$; 61.25%; $p = 0.006$) than RCUs ($n = 32$; 40%; $p = 0.006$). There were no significant differences in caffeine, alcohol, and tobacco use between the two groups ($p > 0.050$)."

Lastly, in Section *3.3 Motives*, Figure 4 and Figure 5 should be cited along with Table 4 and Table 5, respectively. Corrections have been made to **Section 3 Results**, "*3.3 Motives*", Paragraphs 1 and 2. The corrected paragraphs are shown below.

"The differences in motives for cannabis use between RCUs and MCUs were assessed by the CMMQ, which has 12 subscales (*Enjoyment, Conformity, Coping, Experimentation, Boredom, Alcohol, Celebration, Altered Perception, Social Anxiety, Low Risk, Sleep, and Availability*). Descriptive statistics for each subscale and group scores are displayed in Table 4 and Figure 4."

"The differences in motives between MCUs and RCUs were analyzed using a mixed-design (2 × 12) ANOVA (see Table 5; Figure 5) with within-subject factors of motives subscales (*Enjoyment, Conformity, Coping, Experimentation, Boredom, Alcohol, Celebration, Altered Perception, Social Anxiety, Low Risk, Sleep, and Availability*) and between-subject factors of cannabis user group (RCUs and MCUs). Mauchly's test of sphericity indicated that the assumption of sphericity had been violated [$\chi^2_{(65)} = 0.084$, $p < 0.001$]; therefore, degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity ($\varepsilon = 0.70$)."

The authors apologize for these errors and state that they do not change the scientific conclusions of the article in any way. The original article has been updated.

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Relationship between positive parenting and cyberbullying perpetration among adolescents: role of self-esteem and smartphone addiction

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Introduction: Adolescents may perpetrate cyberbullying in cyberspace, which they perceive as a medium of social communication, and cyberbullying perpetration is closely related to adolescent behavior, mental health, and development. This study aimed to examine the relationship of certain factors related to cyberbullying in adolescents using the framework of Jessor's problem behavior theory.

Methods: This cross-sectional study investigated the mediating effect of adolescent self-esteem and smartphone addiction in the relationship between positive parenting and adolescent cyberbullying perpetration. The secondary analysis used data from the 2018 Korean Children and Youth Panel Survey. The data on positive parenting, adolescent self-esteem, smartphone addiction, and perpetration of cyberbullying of 2,394 Korean adolescents (boys: 1,297, 54.2%) were analyzed. Hayes' PROCESS macro program was used to confirm the mediating role.

Results: The results revealed that 26.5% ($n = 634$) of adolescents had perpetrated cyberbullying. Positive parenting did not directly relate to cyberbullying perpetration. Adolescent self-esteem and smartphone addiction played a mediating role between positive parenting and adolescent cyberbullying.

Discussion: Individual adolescent characteristics and parent/family system characteristics should be considered in policies aimed at preventing adolescent cyberbullying perpetration, preceded by the management of appropriate smartphone use. Improving young people's self-esteem and teaching them how to use smartphones correctly can help prevent cyberbullying.

KEYWORDS

adolescents, cyberbullying, parenting, self-esteem, smartphone addiction

1 Introduction

Cyberspace is an online platform that creates and strengthens social relationships among young people. In cyberspace, adolescents experience various functional benefits, such as acquiring useful information or identifying social issues, feeling psychological satisfaction, and relieving stress (Kim, 2022). However, since adolescents perceive cyberspace as a medium for social communication, they may perpetrate cyberbullying, such as swearing, criticism, threats, and other forms of bullying (Chen et al., 2023). The perpetration rates of cyberbullying by South Korean youth increased from 22.8% in 2020

to 29.2% in 2021 (Korea Communications Commission. 2021, 2022), and its prevalence is believed to be increasing, representing a substitute for physical violence. Experiencing cyberbullying (i.e. being the victim) increases the risk of anxiety, depression, low self-esteem, emotional pain, substance use, and suicidal behavior in adolescents, requiring efforts to reduce this phenomenon (Katz et al., 2019). Cyberbullying perpetration is closely related to adolescent behavior, mental health, and development, and can be considered a serious psychiatric health problem (Zhu et al., 2021). To reduce these problems, efforts at home should be made first.

Jessor's problem behavior theory (PBT) (Jessor and Jessor, 1977) explains the relationship between the perceived environment system, personality system, and behavior system in a socio-psychological framework, hypothesizing that the presence of one type of problem behavior in adolescents may increase the likelihood of developing another problem behavior (Vazsonyi et al., 2008; Zhu et al., 2021). The perceived environment consists of social influencing factors regarding the preferences and support of family and friends, and the personality system includes social cognitive variables related to values, beliefs, attitudes, and preferences for oneself and society. The behavioral system includes problem behaviors such as delinquent behavior, substance use, and early sexual activity that violate social and legal norms and tend to elicit some form of social control (Zhu et al., 2021).

According to the PBT theory, the adolescent's family environment is associated with the adolescent's problem behavior. Characteristics of the family, such as parenting attitudes and beliefs, were found to affect adolescent cyberbullying perpetration rates (Zurcher et al., 2018) Positive parenting is associated with parental warmth, support, participation, and open parent–child communication characteristics (Yu and Shek, 2021), and is defined by praise, encouragement, autonomy, and consistency (Seay et al., 2014). Positive parenting can bring beneficial changes in adolescents' emotional stability, psychosocial development, and academic achievement (Seay et al., 2014; Kim and Kim, 2021).

Positive parenting requires the communication of constructive emotions as well as verbal and non-verbal expressions that confirm to adolescents that they are valued (Kim and Kim, 2021). Such parenting impacts adolescents' emotional stability, psychosocial development, and academic achievements (Rosenberg, 1965). Positive interaction with parents can prevent exposure to the risk of cyberbullying perpetration and further increase mental health benefits for adolescents (Katz et al., 2019). Therefore, positive parenting may help prevent or reduce cyberbullying perpetration risk. Additionally, since positive interaction with parents can prevent exposure to the risk of cyberbullying perpetration and maintain the healthy mental health of adolescents (Katz et al., 2019), identifying how positive parenting can reduce or prevent the risk of cyberbullying perpetration is necessary.

Self-esteem refers to one's self-evaluation of one's social role, formed through love, acceptance, and positive interactions by reflecting on social and emotional experiences with significant others and their evaluations (Lei et al., 2020; Du et al., 2022). Positive parenting can change adolescents' perception of their own self-esteem, lead to positive changes in friendship, academic, and school life satisfaction (Park, 2021; Reginasari et al., 2021; Du et al., 2022), and play an important role in controlling cyberbullying perpetration behavior (Mun and Choi, 2015; Kim and Kim, 2021). Furthermore, since positive parenting is an important factor in the formation of adolescents' self-esteem (Mun and Choi, 2015), it is necessary to provide evidence for establishing a psychiatric health program that can improve adolescents' self-esteem and reduce cyberbullying.

Moreover, adolescent smartphone addiction threatens adolescents' psychological well-being, aggravates depression, promotes low self-esteem and fear of rejection, and impedes interpersonal relationship formation and development (Mun and Choi, 2015). Adolescents who are highly dependent on smartphones and active in cyberspace for a significant amount of time tend to witness or experience victimization by cyberbullying; exposure to such cyber environments leads to adolescents encountering threats such as cyberbullies (Chen et al., 2023). Positive parenting is an important factor that can change adolescent psychological and behavioral characteristics (Du et al., 2022), is linked to minimizing the risk of becoming addicted to smartphones, and can be an important variable in mediating the risk of becoming a perpetrator of cyberbullying (Katz et al., 2019; Garaigordobil and Navarro, 2022).

According to previous studies, the factors to prevent adolescents from partaking in cyberbullying were found to be affected by parental control style (Katz et al., 2019; Kim and Kim, 2021), empathy and emotional intelligence, parent–child relationship, school climate (Zhu et al., 2021), and parental support (Kim, 2022). The parenting attitudes of adolescents' parents are more important than anything else because emotional control, problem-solving, and judgment can be less controlled in the adolescent (Kim and Kim, 2021). Therefore, positive parenting can serve as an important psychiatric health strategy to reduce cyberbullying perpetration behavior by improving adolescents' self-esteem and reducing smartphone addiction.

Consequently, this study aimed to examine the relationship of certain factors related to cyberbullying in adolescents using the framework of Jessor's problem behavior theory. A theoretical framework was created to evaluate their relationships. This study aimed to identify the associations among environmental and personal factors that contribute to the risk of cyberbullying perpetration in adolescents by examining the continuous mediating effect of self-esteem and smartphone addiction on the association between positive parenting style and cyberbullying rates. This study also aimed to present the theoretical foundation required to develop intervention strategies and programs that can help prevent cyberbullying perpetration.

The study hypotheses were as follows; Hypothesis 1: Positive parenting influence adolescent cyberbullying risk. Hypothesis 2: Self-esteem plays a mediating role in the relationship between positive parenting and adolescent cyberbullying perpetration. Hypothesis 3: Adolescent smartphone addiction plays a mediating role in the relationship between positive parenting and adolescent cyberbullying risk. Hypothesis 4: Adolescent self-esteem and smartphone addiction play a continuous mediating role in the relationship between positive parenting and adolescent cyberbullying perpetration risk.

2 Methods

2.1 Study design

This study was a secondary analysis using the Korean Children and Adolescent Panel Survey (KCYPS) and was a cross-sectional, descriptive study to verify the continuous mediating effect of adolescent self-esteem and smartphone addiction on the relationship between positive parenting and adolescent cyberbullying perpetration.

2.2 Participants

This study used data from the second year of the Korean Children and Youth Panel Survey 2018 (KCYPS 2018), a representative panel survey in South Korea. The data were obtained from the National Youth Policy Institute (2020). KCYPS 2018 was a nationally representative sample (National Youth Policy Institute, 2020). Multi-stage stratified cluster sampling was used to obtain a cohort of 2,500 fourth-grade elementary school students and first-grade middle school students, and 5,000 guardians from the original panel.

In the current study, the second survey of the KCYPS 2018 was used. Data were collected from August to November 2019. A trained interviewer visited households and conducted a Tablet-Assisted Personal Interview (TAPI) survey. The interviewer separated the original and guardian panels and conducted the survey using two independent questionnaires (one for students and one for guardians) simultaneously. Of 2,438 adolescents in 2019, 2,394 (boys: 1,297, 54.2%) were included in this study, excluding cases where a smartphone was not used or of there was a missing value (Table 1).

2.3 Materials

2.3.1 Sociodemographic characteristics

The demographic characteristics of the participants included sex, age, household family structure, perceived economic level, and perceived health level. The family structure was classified into living with both parents, living with one parent, and others. Economic status was classified into "low/average/high" using parents' responses to the item, "What is the economic status of your household?" Adolescents' perceived health level was measured by their responses to the item, "How do you feel about your health compared to your peers?" as "not healthy at all," "not very healthy," "healthy," and "very healthy."

2.3.2 Positive parenting

Positive parenting perceived by adolescents was measured by 12 items in "warmth," "autonomy support," and "structure "of the Parents as Social Context Questionnaire for Korean Adolescents (PSCQ-KA) scale developed by Skinner et al. (2005) and adapted into a Korean version by Kim and Lee (2017). Each item was scored on a 4-point scale (1 = "strongly disagree," 4 = "strongly agree"). Cronbach's α was 0.882, 0.836, and 0.766 for "warmth," "autonomy support," and "structure," respectively, in the study by Kim and Lee (2017). Cronbach's α was 0.907 in this study.

2.3.3 Self-esteem

Self-esteem was measured using the Korean self-esteem scale (Jon, 1974). This scale consists of a total of 10 items. Each item was scored on a 5-point scale (1 = "strongly disagree," 5 = "strongly agree"). A higher score indicated a higher level of self-esteem. Cronbach's α was 0.930 in previous research (Jon, 1974) and 0.848 in this study.

2.3.4 Smartphone addiction

Adolescents' smartphone addiction was measured using the "Smartphone Addiction Proneness Scale" developed by Kim et al. (2012). This scale consisted of 15 items, including "My school grades drop due to excessive use of a smartphone," "I have been criticized for frequently using a smartphone," and "I feel restless and nervous without a smartphone." Each item was scored on a 4-point scale (1 = "strongly disagree," 4 = "strongly agree"), with a higher score indicating a higher level of smartphone addiction. Cronbach's α was 0.814 in previous research (Kim et al., 2012) and 0.868 in this study.

2.3.5 Cyberbullying perpetration

The perpetration of cyberbullying was measured using the cyberbullying perpetration scale developed by Lee et al. (2015). The scale comprises 15 items asking whether the respondent had committed 15 acts of bullying on a smartphone or on the Internet in the past year, including "I have personally sent swear words or harsh words to someone," "I have stalked someone by sending words, texts,

TABLE 1 Sociodemographic characteristics (n = 2,394).

	Categories	Total	Cyberbullying perpetration n = 634 (26.5%)	No cyberbullying perpetration n = 1,760 (73.5%)	t or χ^2
		N (%) or M ± SD			
Sex	Boys	1,297 (54.2)	378 (59.6)	919 (52.2)	10.297**
	Girls	1,097 (45.8)	256 (40.4)	841 (47.8)	
Age		14.52 ± 0.33	14.52 (0.33)	14.53 (0.34)	−0.883
Family structure	Living with both parents	2,165 (90.4)	573.4 (89.3)	1,599 (90.9)	1.378
	Living with one parent	211 (8.8)	63 (9.9)	148 (8.4)	
	Not living with parents	18 (0.8)	5 (0.8)	13 (0.7)	
Perceived economic status	Low	310 (12.9)	85 (13.4)	225 (12.8)	3.006
	Average	1,862 (77.8)	501 (79.0)	1,361 (77.3)	
	High	222 (9.3)	48 (7.6)	174 (9.9)	
Perceived health status	Unhealthy	214 (8.9)	56 (8.8)	158 (9.0)	0.848
	Healthy	1,474 (61.6)	382 (60.3)	1,092 (62.0)	
	Very healthy	706 (29.5)	1.06 (0.17)	510 (29.0)	

**$p < 0.01$.

TABLE 2 Descriptive statistics and correlations between main variables.

Variables	*M*	SD	1	2	3
1. Positive parenting	3.14	0.46	–		
2. Self-esteem	2.93	0.45	0.510***	–	
3. Smartphone addiction	2.13	0.46	−0.286***	−0.409***	–
4. Cyberbullying perpetration	0.26	0.44	−0.065**	−0.081***	0.149***

M, mean; SD, standard deviations; **$p < 0.01$, ***$p < 0.001$.

and images against his or her will," and "I have repeatedly invited someone to an Internet chat room or prevented him or her from leaving against his or her will." Each item was scored on a 6-point Likert scale, from 1 point for "never," 2 points for "1–2 times a year," 3 points for "once a month," 4 points for "2–3 times a month," 5 points for "once a week," and 6 points for "several times a week," with a higher score indicating a higher level of cyberbullying. By summing the values of each item, severe positive skewness was confirmed, and the values were converted into binary data (cyberbullying perpetration no = 0, yes = 1) for analysis. Cronbach's α was 0.920 in this study.

2.4 Analysis methods

Analysis was performed using IBM SPSS 26.0 and PROCESS macro version 4.0. A frequency analysis examined the sociodemographic characteristics of the participants. The *t*-test and χ^2 test were used to confirm the difference between the cyberbullying perpetration and non-cyberbullying perpetration groups. Pearson's correlation analysis was conducted to identify the correlation between major variables. Hayes's PROCESS macro program was used for analysis (model 6) to confirm the mediating role of self-esteem and smartphone addiction in the relationship between positive parenting and the perpetration of cyberbullying. Variables that showed a significant difference in cyberbullying perpetration were input as control variables. The significance of indirect pathways was confirmed using a bootstrapping technique. When checking the significance of the indirect path, samples were extracted and analyzed 5,000 times, with a 95% confidence interval.

2.5 Ethical considerations

This study was conducted in accordance with the guidelines of the Declaration of Helsinki and was approved by an institutional review board (approval number: WS-2022-32).

3 Results

3.1 Differences in cyberbullying perpetration according to sociodemographic characteristics

Overall, 26.5% ($n = 634$) of the participants had committed cyberbullying in the past year. Cyberbullying perpetration rates showed a significant difference according to sex ($\chi^2 = 10.297$, $p < 0.001$). Boys (54.2%) were more likely to commit cyberbullying than girls (45.8%). There was no significant difference in cyberbullying perpetration according to age ($t = -0.883$, $p = 0.377$), family structure ($\chi^2 = 1.378$, $p = 0.502$), perceived economic status ($\chi^2 = 3.006$, $p = 0.222$), and perceived health status ($\chi^2 = 0.848$, $p = 0.655$) (Table 1).

TABLE 3 Results of path analysis.

Path			*B*	se	*t* or *Z*	*p*	LLCI	ULCI
PP	→	SE	0.494	0.058	29.383	<0.001	0.461	0.527
PP	→	SA	−0.106	0.022	−4.890	<0.001	−0.149	−0.064
SE	→	SA	−0.366	0.023	−16.172	<0.001	−0.410	−0.321
PP	→	CP	−0.045	0.117	−0.386	0.700	−0.275	0.185
SE	→	CP	−0.155	0.130	−1.200	0.230	−0.409	0.098
SA	→	CP	0.698	0.113	6.199	<0.001	0.477	0.919

PP, Positive parenting; SE, Self-esteem; SA, Smartphone addiction; CP, Cyberbullying perpetration; CI, Confidence interval; LLCI, Lower limit CI; ULCI, Upper limit CI.

3.2 Correlation of main variables

Table 2 shows the correlation between independent and dependent variables. Adolescent cyberbullying perpetration showed a significant negative correlation with positive parenting ($r = -0.065$, $p = 0.002$) and self-esteem ($r = -0.081$, $p < 0.001$) and a significant positive correlation with adolescents' smartphone addiction ($r = 0.149$, $p < 0.001$). Adolescents' smartphone addiction showed a significant negative correlation with positive parenting ($r = -0.296$, $p < 0.001$) and self-esteem ($r = -0.409$, $p < 0.001$), and adolescents' self-esteem showed a significant positive correlation with positive parenting ($r = 0.510$, $p < 0.001$).

3.3 Mediating effect analysis

The PROCESS macro program was used to confirm the serial mediating effect of adolescent's self-esteem and smartphone addiction in the relationship between positive parenting and adolescent cyberbullying perpetration. Among the sociodemographic characteristics, sex, which showed a significant relationship with cyberbullying perpetration, was input as a control variable.

Table 3 and Figure 1 show the results of verifying the significance of the model paths. Positive parenting was significantly associated with adolescent self-esteem ($B = 0.494$, $t = 29.383$, $p < 0.001$), smartphone addiction ($B = -0.106$, $t = -4.890$, $p < 0.001$), but not with cyberbullying perpetration ($B = -0.045$, $Z = -0.386$, $p = 0.700$). Adolescent self-esteem was significantly associated with smartphone addiction ($B = -0.366$, $t = -16.172$, $p < 0.001$) but not with cyberbullying perpetration ($B = -0.155$, $Z = -1.200$, $p = 0.230$). Adolescent smartphone addiction was significantly associated with cyberbullying perpetration ($B = 0.698$, $Z = 6.199$, $p < 0.001$).

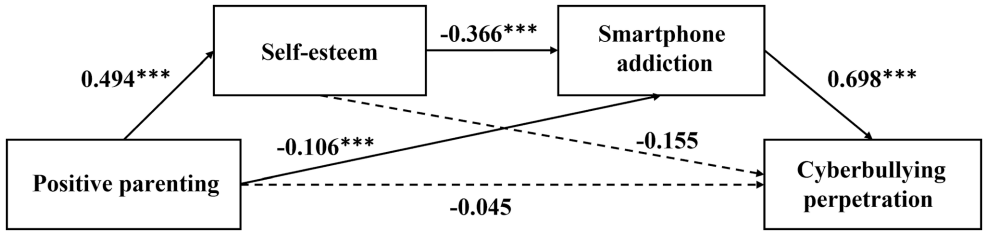

FIGURE 1
Serial multiple mediation with non-standard path coefficients. ***$p < 0.001$.

TABLE 4 Direct and indirect relations in the serial multiple mediation model.

	B	BootSE	BootLLCI	BootULCI
Direct effect	−0.045	0.117	−0.275	0.185
Total indirect effect	−0.277	0.067	−0.410	−0.146
1. PP → SE → CP	−0.077	0.067	−0.210	0.057
2. PP → SA → CP	−0.074	0.021	−0.119	−0.037
3. PP → SE → SA → CP	−0.126	0.022	−0.175	−0.086

PP, Positive parenting; SE, Self-esteem; SA, Smartphone addiction; CP, Cyberbullying perpetration; BootSE, Bootstrapping standard error.

As a result of the bootstrapping, self-esteem and smartphone addiction fully mediated the relationship between positive parenting and cyberbullying perpetration, with a total indirect effect of −0.277 (CI [−0.410 to −0.146]). Specifically, the mediating effect was composed of indirect effects generated by three pathways: (1) positive parenting → self-esteem → cyberbullying perpetration (B=-0.077, CI [−0.210 to 0.057]); (2) positive parenting → smartphone addiction → cyberbullying perpetration (B=−0.074, CI [−0.119 to −0.037]); and (3) positive parenting → self-esteem → smartphone addiction → cyberbullying perpetration (B=−0.126, CI [-0.175 to −0.086]) (Table 4).

As shown previously, cyberbullying perpetration rates are higher for boys than girls. Therefore, we analyzed the correlation of main variables between boys and girls separately. Girls' cyberbullying perpetration showed a significant negative correlation with positive parenting (r=−0.090, p=0.003) and self-esteem (r=−0.145, p<0.001) and a significant positive correlation with smartphone addiction (r=0.227, p<0.001). On the other hand, only smartphone addiction was significantly correlated with boys' cyberbullying perpetration (r=0.093, p<0.001). Additionally, when the mediating effect was checked by separating girls and boys, the results were the same as the overall results.

4 Discussion

This study aimed to evaluate the continuous mediating effect of self-esteem and smartphone addiction on the relationship between positive parenting and adolescent cyberbullying perpetration, based on Jessor's PBT (Zhu et al., 2021). In this study, we showed the mediating effects of self-esteem and smartphone addiction on the relationship between positive parenting and adolescent cyberbullying perpetration.

As a result of a survey of cyberbullying perpetration based on general characteristics, there were more cyberbullying perpetration cases among men than women. This study (Polanin et al., 2022; Yang et al., 2022) found that male students reported more relational aggression and cyberbullying perpetration than female students. This type of cyber-aggression was found to be more noticeable when students are aware of their parents perceived hostility, neglect, and rejecting parenting attitudes.

From the results of the path analysis, Hypothesis 1: Positive parenting influence adolescent cyberbullying risk. Factors that can affect adolescent behavior are very diverse, ranging from genetic factors to socio-environmental factors. It is necessary to understand the social and physical environment surrounding an individual and their community to make meaningful conclusions about their behavior (Rosenberg, 1965). Therefore, it may not be possible to simply verify the relationship between parenting and adolescent cyberbullying perpetration without considering other influencing factors.

The path in which positive parenting mediated self-esteem and indirectly affected adolescent cyberbullying perpetration was not statistically significant, and Hypothesis 2 was rejected. These results are consistent with those of previous studies (Lereya et al., 2013; Seay et al., 2014), showing a positive correlation between positive parenting and adolescent self-esteem. These conflicting findings may indicate that self-esteem has an indirect effect on cyberbullying perpetration rates through its relationship with smartphone addiction, the preceding problem behavior, rather than being directly related to cyberbullying perpetration.

Hypothesis 3 was supported, as positive parenting had a significant indirect effect on cyberbullying perpetration by mediating smartphone addiction rates. While positive parenting plays an important role in the development of children's psychological and behavioral control and parent–child communication in adolescence, it also improves the autonomy and control of adolescent behavior (Hofferth and Anderson, 2003). Moreover, positive parenting encourage moderation in the use of smartphones by adolescents (Augner and Hacker, 2012). Adolescents who are highly dependent on smartphones and active in the cyberspace for an extended period tend to witness or experience cyberbullying, which can increase the risk of perpetuating cyberbullying (Chen et al., 2023). Furthermore, disconnection from any social reality experienced in the cyberspace may aggravate the experience of cyberbullying perpetration.

Hypothesis 4 was supported, as positive parenting indirectly influenced cyberbullying perpetration rates through the sequential mediation of adolescent self-esteem and smartphone addiction. In adolescence, self-esteem tends to increase with positive experiences, driving values of self-esteem and a sense of self (Sallis et al., 2008). According to IPAR Theory (Rohner, 2016), parents' accepting attitudes enable adolescents to value themselves and to evaluate themselves positively. Conversely, adolescents who perceive the rejection of parents

have damaged self-awareness, leading to negative self-evaluation (Ramírez-Uclés et al., 2018). With low self-esteem, adolescents may feel alienated from their parents or friends and use smartphones to recover their self-esteem, leading to smartphone addiction (Andreassen et al., 2017). Further, adolescents with low self-esteem may commit delinquency to overcome a negative self-image; they may also struggle with impulse control (Kaplan, 1980). According to Jessor's PBT (Zhu et al., 2021), taking part in one type of problem behavior increases the likelihood of taking part in another type of problem behavior since one problem behavior provides a socially organized opportunity to learn and practice other problem behaviors. Consequently, smartphone addiction may increase the risk of perpetuating cyberbullying. By testing Hypothesis 4, we have shown that positive parenting indirectly affected adolescent cyberbullying perpetration rates, mediated through self-esteem and smartphone addiction. Therefore, to help prevent adolescent cyberbullying, supporting positive parenting is required, as are interventions that consider these mediators.

The evidence presented in this study, which was based on Jessor's PBT (Zurcher et al., 2018), suggests that the relationship between positive parenting and adolescent cyberbullying perpetration is complex and mediated by other factors. The analysis yielded statistically significant results, indicating the potential contribution of these factors on policy. Moreover, this evidence suggests a need for adolescent behavior experts to understand the continuity of problem behaviors that are embedded in PBT. In addition, factors such as adolescent self-esteem and smartphone addiction should be accounted for in intervention development.

This study had several limitations. First, this was a cross-sectional study, precluding meaningful discussions of causality. Longitudinal studies are required to evaluate the temporal and causal relationships among these variables. Second, this study included some sociodemographic characteristics of parents and adolescents; however, other factors may affect cyberbullying perpetration rates. Future studies should examine individual psychological factors as well as school- and community-related characteristics. This study collected data through a self-report questionnaire, and there is a possibility that the research participants did not report honestly, and there is a possibility that the data was underreported due to the tendency to answer in ways that are considered socially desirable, especially in relation to cyberbullying. Therefore, in future research, it would be beneficial to use or expand qualitative research methods such as observational research, in-depth interviews, and phenomenological research to compensate for the possibility of distortion of such information. Through qualitative research on the characteristics of the family system, there is a need to identify a positive parenting environment that can prevent cyberbullying among adolescents. Finally, the participants of this study came from East Asia. Positive parenting attitudes and cyberbullying perpetration by adolescents may be influenced by cultural factors such as moderation and filial piety (Wei and Liu, 2022), which were not applied in this study. Therefore, future studies should consider the mediating or moderating effects of cultural factors that may affect parents or adolescents.

5 Conclusion

This study aimed to evaluate the impact of positive parenting on adolescent cyberbullying perpetration rates, mediated by self-esteem and smartphone addiction. In this study, adolescent smartphone addiction and self-esteem were complete mediating factors in the relationship between positive parenting and adolescent cyberbullying perpetration rates; the relationship between the latter two variables was indirect. This evidence suggests that family system characteristics should be considered when designing interventions against cyberbullying perpetration, including smartphone addiction management.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: 3. Korea Communications Commission. 2021. (2022). Cyberbullying survey report. Available online at: https://www.kcc.go.kr/user.do?mode=view&page=A02060400&dc=60400&dc=&boardId=1030&boardSeq=53091.

Ethics statement

The studies involving humans were approved by Woosuk University institutional review board (approval number: WS-2022-32). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Written informed consent was obtained from the minor(s)' legal guardian/next of kin for the publication of any potentially identifiable images or data included in this article.

Author contributions

JK contributed to conception and design of the study, organized the database, and performed the statistical analysis. JK, HS, and GJ wrote the first draft of the manuscript and sections of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

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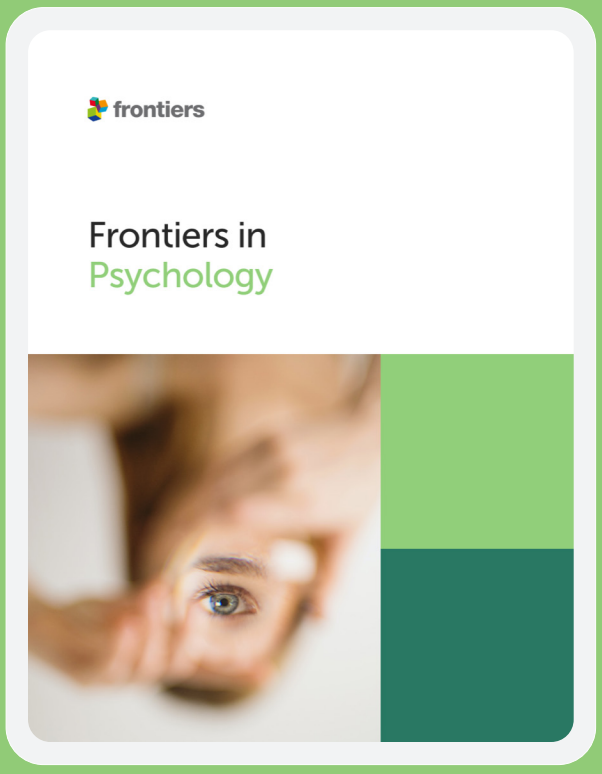

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