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Behavioral addictions: Emerging science

Edited by
Andreas Chatzittofis and Hyoun S. Kim

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Behavioral addictions: Emerging science

Topic editors

Andreas Chatzittofis — University of Cyprus, Cyprus

Hyoun S. Kim — Ryerson University, Canada

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Table of contents

04 Editorial: Behavioral addictions: Emerging science
Andreas Chatzittofis and Hyoun S. Kim

07 Online Sex Addiction: A Qualitative Analysis of Symptoms in Treatment-Seeking Men
Lukas Blinka, Anna Ševčíková, Michael Dreier, Katerina Škařupová and Klaus Wölfling

19 Understanding the Association Between Intolerance of Uncertainty and Problematic Smartphone Use: A Network Analysis
Chang Liu, Lei Ren, Kuiliang Li, Wei Yang, Ye Li, Kristian Rotaru, Xinyi Wei, Murat Yücel and Lucy Albertella

29 Protective and risk factors of problematic smartphone use in preteens using panel study on Korean children
Jungim Yun, Gyumin Han and Hyunmi Son

37 Harm avoidance, daily stress, and problematic smartphone use in children and adolescents
So Young Yoo, Su Mi Park, Chi-Hyun Choi, Sun Ju Chung, Soo-Young Bhang, Jae-Won Kim, Yong-Sil Kweon and Jung-Seok Choi

45 Applying network analysis to understand the relationships between impulsivity and social media addiction and between impulsivity and problematic smartphone use
Zhihua Guo, Shuyi Liang, Lei Ren, Tianqi Yang, Rui Qiu, Yang He and Xia Zhu

56 Gender differences in psychiatric comorbidity and personality characteristics among adults seeking treatment for problematic internet use
Rodrigo Menezes Machado, Hyoun S. Kim, Vinicius Oliveira de Andrade, Lindsey A. Snaychuk, Carla Cavalheiro Moura, Cornelia Belliero Martini, Cristiano Ricardo Faedo Nabuco de Abreu, David C. Hodgins and Hermano Tavares

65 Therapeutic management of buying/shopping disorder: A systematic literature review and evidence-based recommendations
Octavian Vasiliu

84 Changes in sports gambling behavior during the COVID-19 pandemic in Canada
Elijah Otis, Andy J. Kim, Sherry H. Stewart, Simon B. Sherry and Igor Yakovenko

98 Factors influencing the addiction characteristics of non-suicidal self-injurious behaviors in adolescents: A case-control study
Junhong Zhu, Rui Qian, Hao Zhong, Yi Li, Xuebing Liu and Jun Ma

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Yasser Khazaal,
Université de Lausanne, Switzerland

*CORRESPONDENCE
Andreas Chatzittofis
✉ Chatzittofis.andreas@ucy.ac.cy

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Editorial: Behavioral addictions: Emerging science

Andreas Chatzittofis[1,2]* and Hyoun S. Kim[3,4]

[1]Medical School, University of Cyprus, Nicosia, Cyprus, [2]Department of Clinical Sciences and Psychiatry, Umeå University, Umeå, Sweden, [3]Department of Psychology, Toronto Metropolitan University (Formerly Ryerson University), Toronto, ON, Canada, [4]University of Ottawa Institute of Mental Health Research at the Royal, Ottawa, ON, Canada

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Editorial on the Research Topic
Behavioral addictions: Emerging science

Introduction

In recent years, besides psychoactive substances, certain maladaptive behaviors have also been considered to be in the spectrum of addiction and classified as non-substance or behavioral addictions (1, 2). These behavioral addictions include those recognized in the International Statistical Classification of Diseases and Related health problems (11th ed.) (ICD-11) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) such as gambling disorder and gaming disorder as well as putative behavioral addictions such as patterns of addictive internet use, problematic smartphone use, and shopping/buying disorder, while compulsive sexual behavior disorder is under "Impulse control disorder" (3, 4).

Although for some of these disorders there is preliminary data on the underlying mechanism, the pathophysiology is far from clear (5–7). As the debate on the exact phenomenology and classification of these mental health disorders is ongoing, there is an urgent need for further research in the field. In addition, the comorbidity of behavioral addictions with other psychiatric disorders is of importance as it raises new challenges for both the assessment and treatment of patients. The COVID-19 pandemic and the quarantine measures applied also had an effect on behavioral addictions with reported increases in the use of the internet, pornography, and gaming (8).

This Research Topic aims to gather new empirical data and highlight recent advances in behavioral addictions with a focus on comorbidity with other psychiatric disorders as well as the impact of the COVID-19 pandemic on behavioral addictions. We are excited to present the following articles, composing this Research Topic adding new elements to the understanding of these complex disorders, providing insight in their recognition and management.

Understanding of behavioral addictions

Blinka et al. conducted a qualitative study of 23 men in treatment for problematic internet sex use focusing on the phenomenology of psychiatric symptoms. Common patterns were pornography use and cybersex, with continuous masturbation on a daily basis starting in early adulthood and continuing through the years. The symptoms were consisted with the addiction model with loss of control and pre-occupation being the most profound symptoms. Together with the onset of erectile dysfunction, negative consequences developed slowly and included life dissatisfaction, regret, and feelings of unfulfilled potential.

Identification of risk factors and comorbidity

In a study of 325 healthy adults, Guo et al. applying network analysis, reported that the dimensions of impulsivity were closely associated with the components social media addiction and problematic smartphone use. The authors revealed that "motor impulsivity" was the most critical bridge node in both networks and propose it as a promising target for applying preventive and treatment interventions for social media addiction and problematic smartphone use.

Yun et al. performed a secondary analysis of the Panel Study on Korean Children reported an increase in problematic smartphone use between 2017 and 2018 with child's externalizing problems and permissive parenting behavior being the risk factors for preteens' problematic smartphone use. Protective factors included peer communication, parental supervision, and authoritative parenting behavior.

In another effort to identify personality traits as risk factors for problematic smartphone use in 184 children, Yoo et al., reported positive correlations between harm avoidance as personality trait and smartphone addiction proneness and addiction symptoms. In addition, the authors reported mediation effects of daily stress on the relationship between harm avoidance and Problematic Smartphone Use at baseline and follow up, suggesting that managing stress might be important in Problematic Smartphone Use with high harm avoidance.

Liu et al. investigated how the different components of the intolerance of uncertainty (IU) are associated with problematic smartphone use (PSU) *via* a symptom-level network approach. In a sample of 1,849 Chinese university students, the authors reported that the strongest pathway linking IU and PSU was between emotional reactions to uncertainty and coping-motivated smartphone use. Thus, the authors highlight the role of problematic smartphone use as a coping response to negative emotions derived from uncertainty and the potential of interventions targeting intolerance of uncertainty.

Regarding comorbidity, in a study by Machado et al., the authors investigated gender differences in adults seeking treatment for problematic internet use. Women had more psychiatric comorbidities compared to men and more severe behavioral addictions, such as compulsive buying and disordered eating. These women had also higher scores in impulsivity, novelty seeking, and self-transcendence compared to men. These results highlight the importance of assessing for co-occurring conditions in this clinical population.

Zhu et al. conducted a case-control study among 84 adolescents with adolescent non-suicidal self-injury to characterize the behavior addiction characteristics of the group. Factors such as being female, being only child, presence of internet addiction, and negative parenting styles were predictors of NSSI behavioral addiction characteristics in adolescents. Thus, the authors suggest that the development of coping strategies targeting this vulnerable group.

The COVID 19 pandemic

Regarding the effects of the COVID 19 pandemic, Otis et al. investigated the gambling behavior of 85 sports gamblers during the course of the pandemic. The hypothesis on an initial decline in the early stages of the pandemic (due to availability restrictions), followed by an increase in gambling behaviors the months after the restart of live sporting events was partly supported, although gambling behaviors did not completely return to baseline levels. These results may have implications regarding legislation concerning access to gambling.

Evidence based interventions

An extensive systematic review on the efficacy and tolerability of therapeutic interventions (psychological and pharmacological), for buying/shopping disorder is published by Vasiliu concluding that cognitive behavioral therapy (CBT) is supported by the current evidence, followed by the combination of CBT + antidepressants as well as monotherapy with serotoninergic antidepressants. This review helps clinicians to choose the most evidence-based treatment for these patients and emphasizes the need for high-quality trials.

In conclusion, recognizing the limitations of current knowledge, we should emphasize the need for further research in the field of behavioral addictions. Focus should be on the underlying mechanisms of these disorders elucidating both the phenomenology and pathophysiology helping the better classification and our understanding. Finally, research is urgently needed on applied interventions and management of behavioral addictions in order to minimize their burden on the population.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Online Sex Addiction: A Qualitative Analysis of Symptoms in Treatment-Seeking Men

Lukas Blinka[1]*, *Anna Ševčíková*[1], *Michael Dreier*[2], *Katerina Škařupová*[1] and *Klaus Wölfling*[2]

[1] Institute for Research on Children, Youth, and Family, Faculty of Social Studies, Masaryk University, Brno, Czechia, [2] Outpatient Clinic for Behavioral Addictions, Department of Psychosomatic Medicine and Psychotherapy, University Medical Center of the Johannes Gutenberg-University Mainz, Mainz, Germany

Background: Problematic sexual internet use has been attracting increasing research attention in recent years. However, there is a paucity of qualitative studies about how this problem manifests on a daily basis in the clinical population and whether the phenomenon should fall within the hypersexual, compulsive-impulsive, or addictive spectrums of disorders.

Methods: Twenty-three semi-structured interviews, including AICA-C clinical interviews, were conducted with men who were in treatment for problematic internet sex use (aged 22–53; Mage = 35.82). The interview structure focused on the patterns of sexual behavior in question, their development, the manifestation of symptoms, and other associated psychosocial problems. A thematic analysis was applied as the main analytical strategy.

Results: Typical problematic patterns included pornography use and cybersex, together with continuous masturbation for several hours several times a week. This pattern emerged relatively early in young adulthood and became persistent for years. The majority of participants fulfilled the criteria for behavioral addiction (as defined, e.g., by the components model of addiction), with loss of control and preoccupation being the most pronounced and withdrawal symptoms being the least. Together with the onset of erectile dysfunction, negative consequences were reported as being slowly built up over years and typically in the form of deep life dissatisfaction, regret, and feelings of unfulfilled potential.

Discussion and Conclusion: The Addiction model is relevant for describing the difficulties in treatment-seeking men who suffer from problematic sexual internet use. However, the manifestations of the additional criteria are nuanced. In the case of negative consequences, their onset might be very slow and not easily reflected. While there was evidence of several forms of tolerance, potential withdrawal symptoms in online sex addiction need further attention to be verified.

Keywords: pornography addiction, hypersexuality, Compulsive Sexual Behavior (CSB), addiction symptoms, qualitative study, treatment-seeking sample

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Edited by:
Hyoun S. Kim,
Ryerson University, Canada

Reviewed by:
Nick Kerman,
Centre for Addiction and Mental Health, Canada
Marco Scanavino,
University of São Paulo, Brazil

***Correspondence:**
Lukas Blinka
lukasblinka@gmail.com

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INTRODUCTION

Internet use for sexual purposes has rendered various opportunities and effects. Internet users may benefit from searching for sexual information, searching for sexual partners, or exploring and fulfilling sexual needs (1, 2). Nonetheless, several risks emerged (3). One of the most discussed risks has been labeled excessive, out-of-control, problematic, compulsive, or addictive use of the internet for sexual purposes (4, 5). These terms are often understood to be synonymous. In this text, we use Problematic Sexual Internet Use [PSIU, (6)] as an umbrella term. Despite a rapidly growing number of recently published studies, the available literature has several limitations. Our knowledge is mostly derived from the findings of survey-type research conducted in the general population. We have rather limited information from other types of studies, including qualitative studies, that would examine such problematic internet use in a clinical or sub-clinical sample and, specifically, for people who have sought help for their behavior (5). Increasing evidence for this subpopulation is highly needed due to controversies that guide the conceptualization of the phenomenon, specifically whether and to what extent the addiction model is applicable in this problematic behavior, or whether it is better to use the classification of the compulsive-impulsive spectrum of disorders (7), which is a distinction that has important implications for the treatment approach. Moreover, the analysis of the symptoms reported by those in treatment for PSIU is essential for the better understanding of the condition, the improvement of diagnostic guidelines, and better-targeted treatment approaches.

In the existing literature, there are several theoretical conceptualizations related to PSIU. These include hypersexual, addiction, and compulsive models. All are umbrella terms for various non-paraphilic problematic behaviors, which range from online and offline pornography use, cybersex, and telephone sex, and which result in excessive masturbation or other forms of sexual behavior with consenting adults. The concept of hypersexual disorder (8) received extensive attention and was proposed for inclusion in DSM-5, albeit unsuccessfully (9, 10). Later on, the International Classification of Diseases underwent revision, resulting in acknowledgment within the Compulsive Sexual Behavior Disorder [CSBD; 11] as an official disorder that belongs under the umbrella of impulse control disorders (11). The behavioral addiction model is a long-term popular conceptualization (12, 13) that has been applied to excessive sexual behavior and has not been officially acknowledged. However, the diagnosis of "Other specified disorders due to addictive behaviors" in ICD-11 (14) may be convenient, particularly in the case of problematic pornography use (15). These three models have several substantial overlaps and differences (7). First, they all describe problematic sexual behavior that is repetitive and long-term, it is a condition that cannot be explained by another major condition or another disorder, and it concerns a non-paraphilic behavior. Second, they agree on the manifestation of three main symptoms: (1) *salience* (i.e., the activity becomes dominant in one's life and interferes with fulfilling important goals and obligations, overpowering one's thinking and feeling in the form of cognitive preoccupation and craving); (2) *loss of control* or *relapse* (i.e., repeatedly unsuccessful efforts to control or reduce sexual fantasies, urges, and behaviors while disregarding the risk of physical and emotional harm to oneself or to others, and restoring the previous behavioral pattern even after a long period of abstinence); and (3) *negative consequences*, *conflicts*, or *problems* (i.e., the activity brings personal distress or impairment in social, occupational, or other important areas of life). In terms of differences, only the addiction and hypersexual models point to the (4) *mood regulation* component, which is pleasure-seeking behavior that attempts to elevate one's mood. The compulsive model considers the problematic behavior rather connected to decreasing anxiety and does not see it as reward-pleasure seeking, *per se*. Further, only the addiction model includes two additional criteria: (5) *tolerance* (i.e., the over-time tendency to experience less or none of the pleasurable effects that stem from the activity), and (6) *withdrawal symptoms* (i.e., unpleasant feelings when the behavior cannot be performed).

Some of the symptoms and manifestations of PSIU are relatively well described in the literature. These include negative consequences (16–19), loss of control (20), mood management (21, 22), and salience/preoccupation (23). However, relatively weaker evidence exists for tolerance and withdrawal symptoms, and their manifestations. For instance, Schneider (24) described how cybersex may escalate and quickly become a dominant activity. Wines (17) showed that some members of Sex Addicts Anonymous tend to increase their problematic behavior after relapse. Some evidence shows that depression, anger, anxiety, insomnia, fatigue, increased heart rate, disorientation, confusion, numbness, and the inability to focus or concentrate–all states described by patients–could be signs of withdrawal symptoms (17, 25). However, these experiences were reported in relation to offline, rather than online (PSIU), sexual behavior. Moreover, Sassover and Weinstein (26) critically point to the lack of empirical evidence as to whether these feelings could be explained by withdrawal or, rather, if they represent preceding dysphoric states.

Furthermore, some scholars (27) doubt the very existence of withdrawal symptoms and tolerance in behavioral addictions, in general. Criticism has been specifically raised against the application of the addiction model to the out-of-control use of the internet for sexual purposes, which has been deemed inappropriate due to a lack of evidence for the presence of all six addiction-model components (26, 28, 29). Moreover, a large number of studies [see (30, 31) for systematic review] found that religiosity or moral incongruence may affect the perceptions of one's own behavior and ultimately lead to the overestimation of the problem and an inappropriate (self) diagnosis. On the other hand, Gola et al. (32) stated that moral incongruence (i.e., the potential religiosity behind it) is culturally influenced and its status as exclusion criteria for PSIU is questionable. A lack of qualitative studies on the manifestations of PSIU in different cultural contexts may result in a misunderstanding of the problems due to which some people seek help.

Despite the rapidly growing body of research in recent years (5), there are still uncertainties about the conceptualization of PSIU (26, 33). As suggested (34), when there is an

uncertain status for any potential behavioral addiction, a person-centered (i.e., qualitative) approach is needed to explore its phenomenology and etiology. Thus, the present study aims to describe the lived experience of men in treatment for their PSIU. The main goal is to analyze and describe the perceived manifestation of symptoms, their development over time, and the associated psychological and health issues. This, subsequently, enables us to confront the results with the existing classifications in the literature–whether they can be addressed as part of the addiction model or with the hypersexual or compulsive models.

MATERIALS AND METHODS

Sample and Participants

Adult men (aged ≥ 18) who had an experience with treatment PSIU were included in the study. Because there are no specialized sex addiction or behavioral addiction treatment centers in the Czech Republic, we searched online for active professionals (i.e., clinical psychologists, psychotherapists, practitioners) with the focus on sexology and addictology. In total, 104 practitioners were contacted and asked whether they had such patients and whether they would invite them to participate in the research. Due to the lower effectiveness of this style of recruitment, we also contacted Czech and Slovak self-help groups (because the two countries are interconnected due to the shared history and mutually comprehensive languages). Specifically, the Sex Addicts Anonymous (SAA) and Sexaholics Anonymous (SA) networks were proffered a request to participate in the research. Upon further analysis, we included only those SAA and SA members who were also undergoing professional treatment.

The sample characteristics are shown in **Table 1**. The overall study sample included 23 men 22–53 years old (Mage = 35.82 years, SD = 7.54, Median = 34; 6 of which were of Slovak nationality, 26%). The sample can be characterized as rather well-educated, with only one man having only elementary education and 15 participants (65%) having achieved a college or university level of education. Sixteen participants were married or engaged at the time of the interview, six were divorced, and one was widowed. Seven participants were religious (Roman Catholic), and four of them confirmed that the use of pornography conflicted with their religion (P5, P7, P9, P14; $n = 4$; 17%). All of the participants, except one, self-identified as heterosexuals. We also asked about having a history of other forms of addiction, drug use, or mental health conditions from which the participants suffered or for which they received treatment. Only a minority of the participants ($n = 5$; 22%) reported no comorbidity with other disorders or had no further clinical or subclinical issues. The most common past

TABLE 1 | Key characteristics of the participants.

Subject	Age	Nationality	Education	Family status	Religiosity	Comorbidity
1	22	CZ	HS	Engaged	N	Low self-confidence/shyness
2	34	CZ	HS	Married	N	Recreational polydrug use
3	50	CZ	U	Single	N	Bulimia nervosa, obesity; low self-confidence/shyness
4	27	CZ	C	Married	N	Alexithymia
5	36	CZ	HS	Single	Y	Excessive gaming; ecstasy and methamphetamine use; low self-confidence/shyness
6	34	CZ	U	Married	N	None
7	34	CZ	U	Married	Y	None
8	40	CZ	E	Married; children	N	Excessive alcohol use
9	29	CZ	C	Single	Y	None
10	32	CZ	HS	Single	N	Excessive alcohol use, gambling, alexithymia, low self-confidence/shyness
11	42	CZ	U	Married; children	N	Excessive gaming, low self-confidence/shyness
12	53	CZ	HS	Widowed; children	N	Excessive gaming; binge drinking; depression
13	44	CZ	U	Divorced; children	N	Excessive alcohol use
14	26	CZ	U	engaged	Y	Low self-confidence/shyness
15	40	CZ	C	Married, children	Y	Bipolar and schizoid disorder; methamphetamine use; gambling; low self-confidence/shyness
16	29	SK	U	Married	Y	Excessive gaming
17	32	CZ	U	Married; children	N	Excessive gaming; methamphetamine use
18	41	SK	U	Divorced	N	Excessive alcohol use
19	30	CZ	U	Married	N	None
20	37	SK	U	Married; children	Y	Alexithymia; low self-confidence/shyness
21	42	CZ	U	Married; children	N	Excessive gaming; low self-confidence/shyness
22	32	CZ	HS	Engaged	N	None
23	38	CZ	HS	Engaged	N	Narcissistic personality disorder; excessive alcohol use; excessive gaming; methamphetamine use

CZ, Czech nationality; SK, Slovak nationality; E, elementary school; HS, high school; C, college; U, university; N, non-religious; Y, religious.

or present addiction-like comorbidity included seven cases of excessive computer gaming, six cases of excessive alcohol use, four cases of amphetamine or methamphetamine use, three cases of gambling behavior, and one case of bulimia nervosa. Only a few participants reported other mental disorders, including major depression, bipolar disorder, schizoid personality disorder, and narcissistic personality disorder. It must also be noted that there was another level of comorbidity that could not be labeled as clinical, though, in the words of the respondents, it was very important for their condition–specifically, it was their perceived unattractiveness, shyness, and/or inability to confidently communicate with women (P1, P3, P5, P10, P11, P14, P15, P20, P21; $n = 9$; 39%). Upon the observation of the interviewer (a trained psychologist), a portion of the participants suggested alexithymia, another issue which manifested as the lowered ability to be aware or reflect upon one's own emotional states and to communicate them. This was very significant for Participants 4, 10, and 20 ($n = 3$; 13%), but probably played some role for other participants, too.

Procedure

After receiving informed consent, 13 interviews were carried out face-to-face and eight interviews were conducted online as video calls. Two participants were interviewed with an online chat. The anonymity of the participants was strictly safeguarded and all of the identification details were deleted from the interview transcriptions. The audio interviews lasted from 37 min to 2 h and 13 min. The two typed interviews via Skype chat lasted about 5 h.

A semi-structured interview protocol was created to map the three main parts. The first part included questions about the background characteristics of the participants, such as education, family situation, sexual development, other addictive behaviors, and other physical or mental issues (e.g., "*Have you ever taken drugs?*" "*If yes, when/which drugs/how often*?"). The second part included queries about the patterns of their problematic sexual behavior (e.g., questions on how it manifests, how the typical episode looked, its frequency and length, preferred content, triggering factors), the start of the problems and their development over time (e.g., "*How did you know you already had a problem?*"), the escalation of the problem, and their experience with the treatment (e.g., what facilitated the need for the treatment, how the behavior changed under influence of the treatment). The interview structure was developed to be flexible so that each problematic sexual behavior could be explored intensively. The third part (although often mixed with the second part) included the manifestation of the symptoms of the sexual behavior in question. We asked participants to describe their problematic sexual behavior and how it manifested (e.g., "*In what way has watching pornography become uncontrollable for you?*"). For this purpose, we utilized the AICA-C: a Standardized Clinical Interview to Assess Internet addiction (35). Its results are shown in **Table 2**. Since AICA-C is based on the criteria of behavioral addiction (i.e., craving, tolerance, withdrawal symptoms, the loss of control, preoccupation, negative consequences) but excludes mood management, the interview structure was enriched with passages that mapped mood management symptoms.

Data Analysis

In this study, we used a thematic analysis because it provides a flexible and useful research tool for identifying, analyzing, and reporting patterns (i.e., themes) within the data (36). Since the topic of the out-of-control use of the internet for sexual purposes has been intensively studied in recent years (5) through several theoretical models, we focused on the further validation and precision of these conceptualizations rather than on the creation of a new theory. Therefore, the use of a theoretical or deductive– "top-down" –approach to the data analysis is relevant and justifiable (37). The themes and patterns were derived based on the consideration of the selected theoretical framework, which includes the conceptualization of behavioral addiction because it also covers the criteria for hypersexuality and CSBD.

Prior to coding the interviews, the categories that covered the criteria of behavioral addiction in general [e.g., (38, 39)] and sex addiction in particular [e.g., (40)] were established in an Excel spreadsheet. The coding was done by the first author and supervised by the second author. We specifically focused on marking experiences that would correspond to craving, a growing tolerance to consumed sexual materials, and to withdrawal symptoms (e.g., *I started deceiving; look for loops; abstinence starts when I run out of porn memories*"). However, the "bottom-up" approach, which allows for the creation of codes and themes derived from the content [e.g., (36)], was also adopted for the data analysis. This resulted in the identification of new topics and the generation of new codes. These novel codes were read once again to develop potential themes (e.g., sexual objectification of women - "*when I use public transport and meet different women on the tram and start fantasizing about them in a sexual way*"). The themes were further sorted and refined in order to make them distinct and coherent (i.e., this step led to the specification of ways that the criterion of behavioral addiction may manifest, like the increasing amount of time or the increasing intensity of the sexual material), while the codes were allowed to be included in several themes at the same time. Finally, the bottom-up themes were re-analyzed in relation to the criteria of addictive behavior (e.g., sexual objectification emerged as part of withdrawal symptoms). The whole author team was involved in this step.

RESULTS

Form of the Problem

In all of the participants, the out-of-control sexual behavior was related to the internet and there was no indication of offline out-of-control sexual behavior (however, five participants reported occasional visits to sex workers or serial infidelity - P3, P8, P10, P17, P18). The primary source of their problem was masturbation and online sex content consumption—primarily online pornography, although the majority of participants indicated the occasional excessive visiting of dating websites and cybersex via chats and video chats. Specifically, cybersex played a role in intensifying the experience when pornography alone was not viewed as exciting and rewarding enough, typically toward the end of a *session* (i.e., when ejaculation was demanded). There were various contexts for porn consumption (e.g., porn on a

TABLE 2 | Participants' characteristics in relation to problematic sexual internet use.

Subject	Age of problem recognition	Form of problematic behavior	AICA-C addiction symptoms					
			Craving	Tolerance	Withdrawal	Salience	Consequences	Loss of control
1	18	Porn, cybersex, dating websites	4	4	2	5	4	5
2	23	dating websites; Masturbation with porn	2	0	2	2	2	1
3	30	Masturbation with; dating websites; sex workers	3	4	1	4	3	5
4	24	Masturbation with porn	4	2	3	4	2	5
5	30	Masturbation with porn	2	2	1	2	2	4
6	32	Masturbation with porn	2	0	0	1	4	1
7	29	Masturbation with porn	4	5	4	4	3	5
8	32	Masturbation with porn; sex workers; cybersex	3	4	uncertain	4	4	4
9	19	Masturbation with porn	3	3	3	4	3	4
10	25	Masturbation with porn; cybersex; sex workers	4	4	4	5	3	4
11	25	Masturbation with porn	1	0	0	1	1	3
12	37	Masturbation with porn	4	5	3	4	5	5
13	25	Masturbation with porn; sex workers	4	5	3	4	5	5
14	19	Masturbation with porn	2	2	2	2	1	3
15	28	Masturbation with porn	5	3	2	3	2	2
16	16	Masturbation with porn	4	1	2	5	3	5
17	25	Masturbation with porn; serial infidelity	5	4	uncertain	4	5	4
18	Uncertain	Masturbation with porn; coercive sexual practices; sex workers	4	4	3	4	4	4
19	24	Masturbation with porn	3	2	4	3	2	4
20	30	Masturbation with porn	4	3	2	4	3	4
21	30	Masturbation with porn	3	1	1	5	2	5
22	Uncertain	Masturbation with and without porn, cybersex	4	3	4	2	2	4
23	Uncertain	Masturbation with porn	4	1	2	5	2	5

Questions about the AICA-C symptoms were asked about the peak period. Each criterion was evaluated on a scale ranging from 0 = never/no sign to 5 = very frequent/very significant.

smartphone together with masturbation and quick ejaculation in a bathroom, repeated several times a day). However, the most prominent type of problematic behavior, in both the pleasurable as well as the destructive form, was a *session* where the person was alone, watching porn, and masturbating, yet trying to delay ejaculation for several hours. One of the perceived indications of addiction was an inability to resist the temptation to stay in the pleasurable state for as long as possible (i.e., not performing a simple quick masturbation). Concerning the form of the problematic behavior, we consider our sample to be homogenous.

Development of the Problem

Porn consumption was originally a response to sexual urges. Over time, it became a dominant and more convenient activity than any other sexual practices. According to half of the participants, a precursor to their problematic behavior was excessive masturbation during adolescence (P3, P4, P9, P10, P12, P13, P14, P16, P17, P19, P21, P22). However, the problem emerged/started and was fully recognized much later, generally in the third decade of their lives (Mage of problem recognition = 26.05, SD = 5.39, Median = 25). Most of the participants reflected on the start and escalation of the problem during the first years after high school, when they had more time to be by themselves. Particularly those who transitioned to university claimed that the combination of (1) too much spare time, (2) an unorganized time schedule, (3) the need to be constantly on the computer, (4) periods of increased stress, and (5) having shallow social connections, all enhanced their consumption of online pornography and related sexual content. Over time, the participants did not know which other activity they could use to either fill their spare time or to cope with various feelings, like boredom, stress, and loneliness.

"Especially before exams, I felt anxious, in tension, stressed, you know? And then usually I was not able to concentrate, my mind was flooded with erotica. Then I was watching porn [and masturbating] really a lot, so I was exhausted both physically and mentally. And it is a vicious circle because that only starts more stress, shame, compunctions… I am not sure if I ever had any hobbies. So, it was the stress and boredom in college times, those were the roots" (P3).

Another pattern, while not exclusive to the previous one, was connected to the lack of an intimate partner and being overall unsuccessful on the marriage market (P10, P11, P21, P22).

"I was always very shy, it takes me a lot of energy to overcome my inner barriers to contact and talk to women. Till 30 I was simply not courageous enough to start any attempt and had no sex, till 30 I was just watching porn" (P11).

Four participants developed the problem along with problematic substance use–two with alcohol consumption (P13, P8) and two with methamphetamine use (P15, P23). Their sexual behavior was intensified by their attempts to stop the substance use and remained significant even after several years of substance sobriety.

"The progression was so that I had an issue with both, porn and alcohol, and then my wife didn't want to be with me. I wanted sex and she didn't. But I was unable to have proper sex anyway [issue with premature ejaculation and erectile difficulties]. I had a small studio where I masturbated every day after work for several hours. And I was scared that my wife will find out. And I ended up hospitalized, I was drinking really a lot. …After [divorce and successful treatment of alcohol addiction] I had only the porn" (P15).

With respect to the development of out-of-control sexual behavior, the course of the problem was gradual and represented a long-term issue that started, for various reasons, in young adulthood and plateaued as a lifestyle for years.

Treatment Experience

There was no clear pattern for help-seeking behavior. Participants contacted professionals based on their availability, without differentiating their educational background (e.g., psychotherapy, clinical psychology, psychiatry, sexology). Therefore, the participants differed in their type of therapy. Some were prescribed serotonin-based antidepressants (P2, P12, P14), most underwent psychotherapy, which, in three cases, were years-long processes (P17, P19, P23). Two men did not recognize the problem themselves (P4, P6); their partners were dissatisfied with their intimate lives because those men preferred pornography to partnered sex and faced erectile difficulties. In many cases, the problematic sexual behavior was not the focus of treatment because the participants mostly asked for treatment for depression (P2, P12, P14), erectile dysfunctions (P9, P12), and the treatment of problematic substance use (P5, P8, P13, P15, P18), and not for out-of-control sexual behavior, *per se*. None of the treatments were, in the words of participants, labeled as successful. When the participants explicitly mentioned their problematic pornography use, their healthcare providers were seen to neither really understand the nature of the issue nor provide an atmosphere or discourse that would encourage the participant to extrapolate about the problem:

"I felt humiliated to express myself, but the psychologist seemed to feel even more shame than I did. I think she did not expect what would come. And the therapy totally failed in the effect" (P7).

As an opposite example, Participant 9 was staggered that the sexologist did not see anything wrong with excessive masturbation as "it is not harming anyone else so it is OK to continue."

The majority of the participants had issues with low self-esteem, loneliness, and perceived unattractiveness. The psychotherapy usually focused on addressing those issues and did not take into consideration the sexual behavior. According to a number of participants (P5, P8, P13, P15, P18) their psychotherapy was successful when dealing with other issues (e.g., alcohol, methamphetamine use, gambling); however, because the pornography use was not addressed, that problem later intensified as a substitute. For example, Participant 10, who tried to overcome porn addiction by throwing out his computer started visiting pubs, drank alcohol, experimented with amphetamines, and gambled to fill the post-pornography void. This new behavior, however, was labeled by his treatment provider as the "real harm" and suggested buying a new computer to stay at home and be entertained, which created a relapse to porn addiction and also led to excessive gaming.

These cases show that some professionals were not prepared to work with this issue because they underestimated the addiction factors, like a relapse. However, participants themselves confirmed that they did not feel comfortable opening up about issues related to their sexual lives and sexual excesses. This was, for various reasons, including the sensitivity of the topic (i.e., feelings of shame), the desire to keep porn in their lives despite the many problems it was causing, and because other issues, like alcohol use, despite being minor, were seen as more harmful at that moment.

Manifestation

The symptoms were studied in two ways: by applying a clinical AICA-C interview and by letting the participants talk about what they found significant and how the symptoms actually manifested. In AICA-C (using a scale of 1-5 with 5 representing the most intense occurrence of the symptom while 1 representing the symptom not being present at all), the most significant symptom was the loss of control (average score 3.95), followed by preoccupation (3.52), craving (3.39), negative consequences (2.91), tolerance (2.69), and withdrawal symptoms (2.08). These scores also roughly corresponded to the comments made during the respondents' narrations; however, mood modification (not included in the structure of AICA-C) was very significant and common as well.

Salience

This criterion (i.e., referring to the interference of the activity by fulfilling important goals and obligations, overpowering one's thinking and feeling in the form of cognitive preoccupation and craving) manifested in several ways. First, participants intensively spoke about their experience with a **cognitive preoccupation** with sexual thoughts and fantasies and a craving. In their narrations, craving and cognitive preoccupation were not separable. Some thoroughly described triggering situations that provoked craving and fantasizing–mostly upon seeing women on the street, at work, in shopping malls, or just in advertisements and on billboards (P1, P3, P6, P7, P8, P9, P10, P12, P14, P15, P16, P17, P18, P19, P20, P23):

"…during spring and summer, walking on the street was like browsing a catalog for pornography" (P23).

Other men, however, faced intrusive sexual thoughts despite the lack of sexually explicit cues and without any specific pattern (P1, P5, P7, P8, P13, P14, P20, P22, P23). Nonetheless, some had their mind suddenly "flooded" with sexual fantasies in non-triggering situations that were labeled as "times of emptiness": situations where they were alone, bored, and doing repetitive

work (P2, P3, P6, P7, P9, P10, P11, P14, P16, P20, P21) or when stressed, sad, in a bad mood, or generally down (P3, P6, P9, P10, P11, P16, P17, P18, P20). Salience was also intertwined with **ritualization**. Watching online pornography was anticipated as a habit before sleep, after work, and during free time (P9, P17, P19). Such situations developed into triggering cravings, as seen in an example of one participant who regularly experienced sexual fantasies and cravings during the last hour of the workday:

"I was just waiting for when it would be the time when I'd be able to turn on the internet. I was just looking forward to it and I was not capable of doing anything, no meaningful thing" (P9).

For most of the participants, the activity dominated their **lifestyle** and represented the only way they were able to spend free time (P1, P2, P7, P8, P10, P12, P13, P14, P15, P16, P17, P18, P19, P21, P23).

All other activities were sacrificed (P12, P13, P17, P21). Only one participant mentioned that he was freely able to switch to other leisure activities (P22) while several mentioned that they were not (always) bothered because it was a hobby (so that they looked forward to it) (P1, P10, P11), and two others were reconciled with the behavior (P4, P9).

"I was thinking why I like it so much when it is such a time-eater. But I realized it is a hobby like anything else. You also spend that time if you like fishing. It is a way of life" (P1).

Mood Management

Probably the most important reason or motivation for why the participants started and continued in their patterns of porn use was **pleasure-seeking**. Basically, all of the participants realized that engaging in online sexual activities provided them with a large amount of (albeit usually short-term) positive feelings, such as a "good feeling," "pleasure," "joy," a "perfect escape from reality," and the "pleasant feeling of being in a whirlpool":

"It's like when, for example, I lay in a hot tub and I feel comfortable there and I stay there longer than I originally wanted to" (P1).

Another function of internet use for sexual purposes was to **counter the state of boredom**. This was an often-mentioned reason for porn use that preceded the start of problematic behavior. However, over time, the participants did not know how to spend their leisure time. Some participants explicitly described that there might be a bi-directional association between excessive pornography use and unstructured time, in that both may be the outcome and the origin of one another. In other words, poor time management in addition to procrastination could play a role in the development of out-of-control behavior.

"I had time again, a lot of free time, and there would be only one way to fill it. Because even if I spent 2 h with porn, I then had another 10 h where I often just had nothing to do... So what used to be, basically, a leisure-time or procrastinating activity at the beginning, became a stress-conditioned neurotic obsession" (P4).

Over time, the positive motivation for the behavior started to be overshadowed by its use as a coping strategy to **avoid negative emotions**.

"Then I was just horribly frustrated with my life, every evening I felt like that. So I was just looking forward to the escape, to experience at least something nice" (P15).

Many participants acknowledged that they used online pornography as an escape from stress (P3, P4, P12, P13, P14, P16, P20); as a way to deal with conflicts with partners and colleagues at work (P2, P6, P9, P11, P12, P15, P17, P18, P20, P21); as a way to soothe bad moods and general life dissatisfaction (P3, P6, P5, P8-19, P21); as a way to cope with loneliness (P2, P4, P7, P20). However, a few found this to be an inefficient and counterproductive strategy because they felt even worse afterwards (P1, P3, P5, P13, P22):

"… and after three-four hours [of watching porn] the feelings of despair kick in that I totally wasted myself and everything... I simply like it too much, I want the pleasure, I want the porn, but then it is also a life failure" (P22).

Loss of Control

Loss of control represented the most important characteristic of the problematic behavior. Except for Participants 2 and 6, who generally believed that they had their excessive pornography use under control, all of the other participants expressed they will always "lose the battle." There were two main patterns for the loss of control. First, there was a **loss of sense of time and self** during sessions, a tendency to stay much longer with the pornography than originally intended, and total immersion (P1, P3, P5, P7, P10, P11, P12, P13, P19, P20, P22, P23):

"I just opened the computer, just to read emails, and then I stayed the whole night watching and masturbating and, at the end, I had no idea how that actually happened" (P10).

Some participants even called this tendency "insanity," a "state of madness," and "total obsession" and they felt the uncontrollable need to do it as much as possible (P4, P7, P8). Often, they struggled with whether to open the computer at all, but they knew that when they had such an idea, there was no way to resist it. The tendency to struggle with the intention only increased the appetite and desire (P19, P20, P21). And even with the intention "just to have a look" they ended up watching porn as much as possible, unless external factors, such as family, school, work obligations, or strict time schedule would not allow it. External factors (i.e., family, school, and work obligations, strict time schedule) were generally very important; otherwise, the participants felt unable to manage themselves:

"I really did not like weekends. From Monday to Friday, I was in school, I had some obligations, and there was less room for pornography or masturbation or some sort of fantasies. And then I just feared the weekends" (P14).

The second type of loss of control was a **relapse** into the behavior after a period of relative control. It showed the inability to abandon the habit for good. All participants experienced at least some relapses and the majority of them experienced many intensive relapses (P1, P3, P4, P6, P8, P9, P10-17, P20-23). Especially after a period of abstinence, some participants had extended sexual sessions and quickly returned to the consumption of hard pornography in order to "catch up on" everything they had missed:

"And when there is that day [of relapse] that you are alone at home, when you start the day like this, you can bet good money that the day will go to hell and that you won't do what

you wanted because you will have to repeat it maybe three, four times [sessions that are each several hours long]" (P32).

In the majority of cases, the (temporary) abandonment of the behavior was natural (i.e., the pornography started fading in its effects), until it faded enough that the participants started to feel the need to renew the sexual images in their mind (i.e., see the part on withdrawal symptoms). Interestingly, some participants had experience with the impulsive termination of the behavior (e.g., Participant 9 once destroyed his computer and later cut through the internet cables).

Conflicts and Negative Consequences

Participants were clear about the problems that their out-of-control behavior caused. At the intrapsychic level, more than half of the participants spoke about self-disdain and self-degradation to the point that they stopped respecting themselves. Typically, they had feelings of self-disgust, shame, and even suicidal thoughts (P1, P2, P4, P5, P10, P11, P12, P14, P16, P18, P19, P20, P21, P23):

"I cried so many times because of it, and then I did not know at all what I should do" (11). Moral conflicts due to religious beliefs were reported in some participants as well; however, they were not felt to be as major as other conflicts (P5, P7, P9, P14) and they were mentioned only when directly asked about them.

For some, this behavior led to a stagnation in their career (P1, P2, P7, P12, P13, P17) and general life stagnation, neglected family life, missed life opportunities, and feelings that their life was being wasted (P2, P3, P8, P17, P18, P19, P20). Excessive behavior (especially in the form of sessions) led to significant weariness, exhaustion, and lack of sleep (P3, P8, P9, P11, P14, P15, P18, P22, P23).

"It was several times a day [sessions that took 2 h each] four-five times a day was the peak, and I was simply exhausted, the penis was used so much that it pained a lot, but I continued because I wanted it [to stay with the porn], you simply must continue, you must, but the body says no" (P14).

From the sexual point of view, the majority of the participants confirmed combinations of various problems, including penis pain due to prolonged masturbation sessions, erectile dysfunctions, and premature ejaculations due to the desensitization of their sexual stimuli, and the general loss of interest in normal sex (P1, P2, P4, P9, P10, P12, P13, P14, P16, P17, P20, P23). Some of those who were in a long-term partnership reported conflicts with their spouses, especially due to their higher preference for virtual sex (P2, P6, P7, P8, P9, P11, P14, P18, P23) or because they developed a preference for coercive sexual practices (P13, P15, P18).

"I had an erectile issue at that time. The andrologist examined me and there was nothing physiological. I had a partner, and she thought she is not attractive or that is her fault. And the relationship stopped working. But it was just the porn, I was used to porn and the real sex simply was not what could arouse me" (P9).

Those in relationships reported that the porn use isolated them from their partners and that they were no longer able to experience intimacy and closeness in their relationships. The main and very strong pattern of negative effects was that an overwhelming majority of the participants struggled with reducing women to sexual objects:

"Today I notice other things about women than I did before. Because [the addiction] always wanted to see just that dirty stuff, to tell you the truth. But today, as though I am getting better, I already notice other things about a woman, things like the eyes, the smile…" (P3).

Being able to acknowledge women as more than sexual objects was considered to be a sign of recovery by the participants.

It is important to note that negative consequences were experienced as long-term issues that were possible to keep secret for a very long time (i.e., in the words of participants as "hidden," "invisible addiction"). The destructive potential of the behavior was felt more in retrospect (as a "wasted life") rather than as an acute state that would significantly facilitate a search for help.

Tolerance

There were three participants who reported no form of tolerance (P2, P6, P11). However, the majority of participants had experienced some form of increasing tolerance in their behavior. These took various forms. It manifested as the **growing amount of time** spent on online sexual activities (P5, P7, P8, P9, P10, P12, P13, P14, P15, P17, P18, P19, P21, P23). The respondents prolonged the sessions (typically from 1 h to more than 8 h) and/or they included more sessions into their daily routine, like very early in the morning, which was usually preferred:

"And it just escalated, so that I was looking more often for certain movies. In the end, I set my alarm clock so that it would wake me at three in the morning, so that it woke me up because I knew that I just had to" (P7). Increasing time usually escalated to the point that the participants become satiated, so they left the behavior for some time only to return to it after some time of control (usually a matter of weeks).

Building up a tolerance to online pornography also manifested as the **growing intensity of the sexual material**. This could be partially explained as desensitization:

"It is a thing that always needs more and more, because those pictures stop being really, like, hot. They stop working, and a person needs a stronger stimulus" (P20). There were several types of progression-erotic pictures had to be substituted with more sexually explicit materials, mainly video chats (i.e., cybersex) and the communication in erotic chats also became more and more obscene. Also, the content, classic heterosexual vaginal intercourse, was no longer attractive. With growing frequency, the participants searched for hardcore porn sites with more intensive stimuli (P1, P10, P12, P13, P14, P15, P16, P18, P20, P22). This even manifested as a greater openness to exposure to paraphilic-focused sexual and fetishist materials, typically content included zoophilic, hebephilic, rape, coercive, and generally sadomasochistic materials (P3, P10, P12, P13, P14, P15, P18, P20). However, when inquiring about the content, participants were generally unwilling to share this information and considered it to be a sensitive issue. Often, this unceasing need for extreme stimuli resulted in strong negative feelings:

"So then I was really disgusted by what I was watching, because it was still harder and it just did not often bring that effect" (P13). It must be noted that this progression (to fetish or

extreme and paraphilic materials) stayed within the session and did not transform into long-term changes in sexual preference. Subjects described that, during porn-masturbation sessions, their psyche was in a state of madness, in which they were incessantly searching for new material on the internet, clicking on more and more videos. Also, to reach ejaculation after an hours-long session of masturbation, they needed stronger than usual stimuli.

"Yeah, it was that it simply was not enough and, definitely, that I was not excited, so I was looking for more of what excites me. And still, the extra was too little, so I still searched for what would excite me" (P12).

In some cases, **pushing the boundaries** in physical contact also characterized increasing tolerance. Some participants (P1, P9, P15, P17) pushed the boundaries for the sexual activities they would practice, and they were prepared to take greater risks (e.g., compromise their anonymity in cybersex). They even became afraid of where this adventurism would end up:

"You allow more, you are more daring, you let yourself do more than you had done before. I watched pornography in front of my wife. I masturbated in front of her, but, of course, without her seeing it; this is not something I would have done in the beginning" (P7). "I was doing cybersex sometimes, but then I also started visiting videochats that were not erotic, searching for girls and masturbated on camera" (P1).

Withdrawal Symptoms

The study identified various **acute unpleasant symptoms** when the participants had to terminate the activity and especially when they could not, or did not want to, perform the activity for some time. However, it must be said that most participants found these symptoms rather mild and controllable. One of the reasons for the rare experience of withdrawal symptoms was that masturbation was found to be easily performable when needed and thus negative states were easily avoidable (P1, P7, P12, P17, P20, P21). They could masturbate with the use of their memories of the consumed porn or their imagination about sexual objects (mostly women met on a street). In general, symptoms included increased emotionality, like nervousness and the inability to focus (P2, P3, P5, P7, P8, P12, P13, P14, P15, P16, P18, P19), and increased irritability/frustration (P4, P7, P8, P10, P12, P13, P14, P15, P16, P18, P22, P23), which emerged when they could not watch porn, could not find an adequate sexual object, and had no privacy for masturbation.

"I tried to not do it [neither watching pornography nor masturbating]. Well, of course, this resulted in problems in my relationship. I was feeling unbelievable, like a surge of anger. And I was smashing things and I blamed my wife for everything possible…" (P15).

Rare symptoms included intensive apathy (P10), seeping difficulties (P9), permanent sexual arousal (P11), and various bodily feelings (e.g., chills, sweating, headache, sickness), likely as a result of somatization (P19). However, some respondents expressed doubts that acute withdrawal states do really exist (P15, P16, P17); according to them, negative states were experienced because they did not, or could not, use porn and masturbation as coping mechanisms.

Apart from acute withdrawal states, respondents also described experiencing mental/cognitive states that resulted from long-term abstinence from pornography and that could be understood as **pre-relapse states**. First, there was a phenomenon of **fading memory images**, where they were no longer able to recall the exact images that used to arouse them, and when they yearned to look at any sexual object offline in order to refresh their memory (P3, P4, P9, P10, P12): "But the fight [for abstinence] lasted half a year. Gradually, I suddenly forgot how it actually looked, I mean all that pornography. Hell, what she (looks) like, what was in that movie and everything?... I have almost no recollection right now, what will make me happy, will I ever be happy?" (P3).

Many participants described **intensive longing** — a strong desire to recall sexual images and reach exposure to sexually explicit content (P3, P4, P5, P7, P9, P10, P13-17, P19, P20). The lack of sexual memory generated a specific compensatory behavior. Nearly half of the participants talked about using **exploitative staring** (P3, P7, P12, P13, P15, P16, P17, P18, and P20). This can be understood as a substitution strategy that is based on searching for any kind of sexual object (i.e., women in a public space). This type of objectification of women is similar to what we described in the salience section above. However, in this case, it is deliberate behavior (e.g., visiting swimming pools, bars, other places where they could expect to see women):

"I remember when I was without pornography. It was not only the most attractive woman that I was staring at. I tried to make the most of everything, to get enjoyment from it. I seriously searched so much for anything that I was staying on the balcony to search if I would see any woman down below" (P16). This excerpt suggests that, during a period of abstinence, the participant's mind missed being flooded by pornographic images. Therefore, this participant tried to get as much as possible from each random potentially sexual object in order to feed his fantasy and mind.

DISCUSSION

The aim of this qualitative study was (1) to provide insight into the experience of 23 men who sought help for their problematic sexual internet use and (2) to enhance our understanding of whether the phenomenon should fall within the hypersexual, compulsive-impulsive, or addictive spectrums of disorders. In this respect, the patterns of the problematic behavior, the manifestation of symptoms, and the development of the issue over time were analyzed and supported, especially the relevance of the addiction conceptualization.

The problematic behavior typically included excessive masturbation while watching porn for several hours and repeated several times a week or day, and occasionally amended with other online sexual activities. All of the participants (except for four) fulfilled all of the criteria for addiction, including the signs of tolerance and withdrawal symptoms, which indicates that the addiction model is useful for the understanding of the phenomenon. This finding corroborates other recent studies that have reached similar conclusions [i.e., the addiction models

seemed to fit the description of the symptoms associated with PSIU; (4, 41)]. Nonetheless, it must be noted that our support of the addiction model does not automatically disregard other models, either hypersexuality or CSBD. In fact, the core criteria for all the three models—salience, the loss of control (including relapses), and consequent problems—were experienced very strongly by the participants and, in addition, these reached the highest average scores in the AICA-C clinical interview. In this respect, all three models seem to be relevant. However, the significance of mood management indicated support for the hypersexuality and addiction models more than the CSBD. The gain of positive feelings, ranging from excitement and pleasure to countering the states of boredom, was reported as the primary motivational factor in the engagement in the problematic sexual behavior, despite the adverse consequences. The activity was also used as a means for coping with negative mood states (e.g., stress, anxiety); however, the importance of this purpose developed over time as a result of the excessive engagement in the activity. This development—the gradual shift from primarily a gratifying use of pornography to a compensatory use—has been described in the I-PACE Model for behavioral addictions (42) and further supports the validity of the addiction model in our study.

The notion and the existence of the criteria of withdrawal symptoms and tolerance have been criticized and doubted in behavioral addictions, in general (27, 34), and particularly with respect to excessive sexual behavior (26). In our study, experience with these symptoms was common. The tolerance manifested as increasing time devoted to the problematic activity, increasing willingness to push the boundaries of what would be considered safe, and especially as the increasing roughness of the consumed erotic materials. The erotic content sometimes reached the levels of being close to paraphilic content. However, the participants themselves did not consider themselves to be paraphilics nor that the paraphilic content (i.e., eliciting sexual arousal patterns that focus on non-consenting others) was their sexual preference. Furthermore, the periods of increased engagement in the activity were regularly superseded by the periods of the diminished effectiveness of the erotic materials used to induce arousal. This effect is labeled as a temporary satiation (39). Concerning the withdrawal symptoms, they manifested as mild distress–nervousness, irritability, and, occasionally, physical symptoms due to somatization. However, as compared to other symptoms, withdrawal symptoms were not seen as significant or disturbing. Moreover, it was not clear to what extent the symptoms were built up because porn could not be used as a coping mechanism for negative states of mind. In this respect, the criticism of withdrawal symptoms in behavioral addictions is partially justifiable (26). However, we identified another form of potential withdrawal that we could not detect within the literature. During the temporary satiation phase, when the erotic images faded from memory, the participants started to feel the distress and the urge to renew them. In most of the participants, this usually resulted in increased sexual-objectification behavior (i.e., searching for scantily dressed women, staring at them and at their sexual parts when possible). These acts generally signified a phase that put male sex addicts at risk of relapse.

According to some researchers, the symptoms approach in behavioral addictions is problematic. Instead, they define the addiction as (1) functional impairment and (2) persistence over time (34). Both of these conditions were fulfilled in our study–the problems caused by engagement in the activity were common (together with the loss of control and salience/craving). The participants ascribed their excessive online pornography use to many adverse impacts on their mental and physical health, as well as on their personal, family, and work life. Furthermore, their intimate and sexual lives were also negatively affected (e.g., by erectile difficulties, loss of interest in partnered sex, inability to share intimacy with their life partners). The issue itself was experienced for a long time−10 years on average–culminating in early adulthood and basically plateauing afterward. The fact that the issue is deeply embedded into the participants' lifestyles points to the targeting of these problems in potential intervention.

There are several practical reasons that signify the importance of understanding PSIU as a behavioral addiction. First, there was high comorbidity with other conditions, especially with other addictive behaviors, including alcohol and amphetamine use, gambling, and excessive computer gaming. Since the co-occurrence of addictive behaviors is common (40), the other (non-sexual) conditions could be seen as more harmful by the medical professionals, and the treatment targeted them instead of the sexual behavior (despite the fact that the sexual behavior was the main condition). Second, the consequences of the porn use were not felt by the participants as immediately threatening and harmful (unlike the use of methamphetamine or gambling) and they accumulated negative effects slowly over a long time period. Third, the shame surrounding this phenomenon may be a significant obstacle in treatment. The sensitivity of the issue discouraged the participants from fully disclosing their condition to the health professionals. Instead, they waited for the professional to address the issue, which often did not happen, raising the question of whether training professionals in sexual issues in general, and specifically potential sex and porn addiction, would improve their clinical practices. Although there is evidence that points to the role of moral and religious incongruence in the false indication of sex and porn addiction (30), our study showed that the feelings of shame may also have different origins. The negative feelings stem from the intensity of the behavior and the roughness of the consumed content (e.g., human-animal sex, rape). Since paraphilia is generally considered to be exclusion criteria (8, 11, 14), the presence of paraphilic or near paraphilic content may be confusing in diagnostics and should be further explored. Some studies reported the co-occurrence of paraphilic content consumption and porn addiction (19); however, that is usually explained by the compensation of unfulfilled sexual fantasies (43). In our study, it was connected to the effect of tolerance and desensitization.

Some limitations of the study should be noted. First, the findings are limited by what the participants shared with regards to their sexual lives and the content of the consumed online pornography. The participants were largely unwilling to talk about the content of the materials they were consumed and they were also uncomfortable about discussing the extent of their

behavior. Second, the sample included participants who were members of Sex Addicts Anonymous and Sexaholic Anonymous, whose narration of their stories could have been more influenced by addiction models, which are at the core of the 12-step program (44). Third, our sample included only men. Although literature suggests that this phenomenon is more common in men (45), there are studies that identified the specifics of sex addiction in women (46). Similarly, our sample predominately included heterosexual men, while the non-heterosexual orientation has been identified as an important risk factor for problematic sexual behavior (47). In general, women and non-heterosexuals within PISU are under-researched and future studies should focus to fill this gap. Fourth, the AICA-C clinical interview has not previously been used and calibrated in the Czech language and its coding was done by only one researcher, thus the inter-rated reliability could not be assessed. Lastly, the sample included participants who predominately had a problem with pornography use. Other forms of online sexual behavior like cybersex and visiting dating sites were minor in our study and problematic offline sexual behavior was not found. Thus, our study is applicable only for (1) online pornography use and not to other forms of sexual behavior, and (2) the use is intensive enough that the participants decided to seek professional help.

We acknowledge that the criticism of the usage of addiction terminology in relation to common or just vaguely problematic porn use may be justifiable (e.g., 28); however, this study shows that, in the case of help-seeking men and their problematic pornography use, the addiction model of the available conceptualizations was the most useful to describe the condition in the present sample.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/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

AŠ conducted the interviews and did the data analysis supervision. LB conducted the analysis and wrote the first draft. LB, AŠ, MD, KŠ, and KW interpreted the results and edited the draft. All authors contributed to the article and approved the submitted version.

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Understanding the Association Between Intolerance of Uncertainty and Problematic Smartphone Use: A Network Analysis

Chang Liu[1], Lei Ren[2], Kuiliang Li[3], Wei Yang[4], Ye Li[4], Kristian Rotaru[1,5], Xinyi Wei[6], Murat Yücel[1] and Lucy Albertella[1]*

[1] BrainPark, Turner Institute for Brain and Mental Health and School of Psychological Sciences, Monash University, Clayton, VIC, Australia, [2] Military Medical Psychology School, Fourth Military Medical University, Xi'an, China, [3] School of Psychology, Army Medical University, Chongqing, China, [4] Psychological Counseling Center, Xijing University, Xi'an, China, [5] Department of Accounting, Monash Business School, Monash University, Caulfield, VIC, Australia, [6] Department of Psychology, Renmin University of China, Beijing, China

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Hyoun S. Kim,
Ryerson University, Canada

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André Luiz Monezi Andrade,
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Lukas Blinka,
Masaryk University, Czechia

***Correspondence:**
Lei Ren
rl_fmmu@163.com

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Background: Existing research has demonstrated that intolerance of uncertainty (IU) is associated with problematic smartphone use (PSU). However, little is known about how different IU components such as uncertainty-related beliefs, emotions, and behaviors may impact on different PSU symptoms.

Methods: Extending previous research, the current study examined the specific associations between IU components and PSU symptoms via a symptom-level network approach. A regularized partial correlation network consisting of different IU components and PSU symptoms was estimated among 1,849 Chinese university students. We examined pathways and influential nodes (i.e. central components/symptoms and bridge components/symptoms) within the IU-PSU network.

Results: The strongest pathway linking IU and PSU was between emotional reactions to uncertainty and coping-motivated smartphone use. Importantly, emotional reactions toward not having enough information (a reflection of emotional reactions to uncertainty) may act as both a central and a bridge component in maintaining the whole IU-PSU network.

Conclusions: The results are in line with the I-PACE model and highlight that PSU may be a coping response for negative emotions derived from uncertainty. Finally, the current findings highlight the potential of interventions targeting intolerance of uncertainty for reducing PSU.

Keywords: intolerance of uncertainty, problematic smartphone use, network analysis, central symptoms, bridge symptoms

INTRODUCTION

Problematic smartphone use (PSU), characterized by excessive smartphone use and associated negative daily-life consequences (1), has received increasing attention from the psychology/psychiatry field in recent years. Young adults, especially university students, may be more likely to experience PSU due to digital nativity (2). The median prevalence of PSU among children and young people was 23.3% (3). Importantly, PSU is often associated with physical and psychological concerns, including depression, anxiety, sleep impairments, and spinal disorders (4–6). Given the high prevalence and negative consequences associated with PSU, there is a call to understand the mechanism underlying PSU (2, 7). The Interaction of Person-Affect Cognition-Execution (I-PACE) theoretical model proposes that personal predispositions (e.g., personality traits, affective and cognitive responses) may serve as vulnerability factors and contribute to the development and maintenance of PSU (8, 9). In line with this model, which features such core components as predisposing variables, emerging research has attempted to explore how psychopathology constructs may underpin PSU.

One candidate transdiagnostic risk factor for PSU is intolerance of uncertainty (IU) (10). IU, which is defined as the tendency to react negatively to uncertain situations and events due to negative beliefs about uncertainty and its implications (11), has been examined in relation to anxiety-related and obsessive-compulsive disorders (12, 13). Emerging research found that IU may be associated with problematic behaviors including problematic alcohol use, problematic internet use, problematic gambling, compulsive buying and disordered eating (14–16). To date, only one study examined the relationship between IU and PSU. Using a repeated-measures design, the study found that baseline IU level showed a significant positive correlation with PSU measured after 1 month (10). According to the I-PACE model, the relationship between IU and PSU can be explained as follows: individuals with certain predisposing traits (e.g., IU) may be more likely to experience excessive worry and somatic stress when facing ambiguous situations. These negative emotional reactions may diminish top-down control, increasing engagements in behaviors that may provide instant, short-term relief (e.g., spending a large amount of time on their mobile phones, searching for reassurance). This process may be enhanced through negative reinforcement, with stress-reduction reinforcing smartphone use such that the individual consequently will engage in smartphone use whenever facing the negative emotional state induced by uncertainty.

Despite significant contributions from previous research, there is a lack of a nuanced understanding of how distinct IU components may be associated with specific PSU symptoms. PSU and IU have been examined as unitary constructs in previous research (10). However, PSU may manifest as a heterogeneous condition involving different symptoms (e.g., loss of control, disruption, withdrawal, preoccupation and tolerance), with each symptom distinct from one another in terms of its relative importance (17, 18). Similarly, IU has been identified as a multidimensional construct consisting of uncertainty-related beliefs, emotions, and behaviors (19). These different IU components may play different roles in the development and maintenance of specific PSU symptoms. Neglecting the construct/symptomatic heterogeneity may be problematic as it may hinder a more a nuanced understanding of the relationships existing between different components of IU to individual PSU symptoms (20). This drawback has been demonstrated by several recent studies. For instance, individual PSU symptoms have shown different associations with self-control (21), problematic internet use (22) and neuroticism (23). Meanwhile, different components of IU were found to have distinct effects on generalized anxiety disorder (24). In viewing this drawback, it has been proposed that psychopathology research may benefit from moving beyond disorder-level analysis to a more fine-grained symptom-level analysis (25, 26).

One statistical method which is suitable for the symptom-level analysis is the network approach. Theoretically, the network framework conceptualizes psychopathology as a complex system with nodes (both symptom and non-symptom variables) that interact and reinforce each other via their potential causal linkage (i.e., edges). This is in line with the I-PACE model, which proposes that PSU arises from interactions between predisposing variables, affective and cognitive responses to stimuli, and executive functions (e.g., inhibitory control). As a symptom-oriented graphical approach, the network approach offers the ability to visualize the complex relationships between psychological constructs at a more granular level (e.g. at the level of components and symptoms). Within a network, variables (both symptom and non-symptom) are depicted as nodes, which may connect (via edges) and reinforce each other and constitute mental health conditions (27). By observing the network structure and examining the centrality index, the researcher may get an insight of the symptoms that share a closer connection and thus form a cluster, the symptoms that are more influential than others in terms of their effects, the symptoms that may have cross-cluster connections, as well as the pathways linking different symptoms (28–30). Such insights may not only help researchers elucidate the mechanisms that underlie the component-to-symptom associations, but also shed light on developing more precise and targeted interventions (31).

To our knowledge, no study to date has examined how individual IU components may contribute to specific PSU symptoms. To address this gap and extend previous research on IU-PSU association, the current study modeled the component-to-symptom relationships between IU and PSU via the network approach. Specifically, we examined: (1) the unique associations between IU components and PSU symptoms, (2) the most influential nodes that maintain the network system, and (3) the most influential nodes that bridge the IU cluster and the PSU cluster. Based on existing theory research (15), we hypothesized that emotional reactions toward uncertainty may bridge to coping-motivated smartphone use. As compulsivity (i.e., continued use despite problems) is a cardinal feature of addiction (32), we hypothesized that the symptom characterized by compulsivity may be the central PSU symptom. Further, based

on previous research, we hypothesized that the "preference for planning ahead" may be the central IU component (19).

METHODS

Ethics Statement

The data collection procedure followed the Declaration of Helsinki and was approved by the Ethics Committee of the First Affiliated Hospital of the Fourth Military Medical University (Project No. KY20202063-F-2).

Participants

Participants were undergraduate students from five universities (i.e. Xijing University, Yan'an University, Xi'an International Studies University, Xi'an Shiyou University and Shangluo University) in Shaanxi Province, China. The data was collected via a Chinese online survey platform (Wenjuanxing). Before the survey, a WeChat (one of the largest instant messaging application in China) message with links to the online survey was sent to all students who were currently enrolled in the aforementioned universities. All participants provided informed consent before participation. Demographic information was collected at the start of the survey. All questions in the survey were set as forced responses (i.e., participants need to provide responses to all questions before they can submit). Therefore, there were no incomplete responses. One hundred and seventy-six participants were excluded due to failing the two honesty check items (e.g., participants did not choose the second option when they responded to "Please choose the second option for this question"). The final sample consisted of 1,849 participants (59% female, mean age = 19.00, SD = 1.32, range = 17–23 years).

Measures

Problematic Smartphone Use

Problematic smartphone use during the past year was measured by a modified version of the Chinese translated nine-item Internet Gaming Disorder Scale - Short Form (33) This is the only scale that adopted the Diagnostic and Statistical Manual of Mental Disorders (fifth edition) (34) criteria for Internet Gaming Disorder and comprehensively addressed nine symptoms (i.e., preoccupation, withdrawal, tolerance, loss of control, giving up other activities, continuing despite problems, deception, escapism/avoidance, and negative consequences) that characterize addictive behaviors. The modified version (with "gaming" replaced by "smartphone use") has been used to measure PSU in several existing studies, with good internal consistency (35–37). Sample items include "Do you feel more irritability, anxiety or even sadness when you try to either reduce or stop your smartphone use" and "Have you continued your smartphone use despite knowing it was causing problems between you and other people." Participants responded on a 5-point Likert-type scale ranging from 1 = "never" to 5 = "very often." The scale demonstrated good internal consistency in the current study (McDonald's omega = 0.89).

Chinese Version of the Intolerance of Uncertainty Scale-Short Form (C-IUS-12)

The C-IUS-12 was used to measure different components of IU (38). Participants reported to what degree each item applies to them on a 5-point Likert-type scale ranging from 1 = "not at all characteristic of me" to 5 = "entirely characteristic of me." Sample items include "Unforeseen events upset me greatly" and "When I am uncertain I can't function very well." The scale demonstrated good internal consistency in the current study (McDonald's omega = 0.87).

Data Analysis

Graphical Gaussian model (GGM) was used to estimate the IU-PSU network (39) GGM is undirected network, and its edge represents the pairwise relations between nodes after controlling for all other nodes in the network. The network was estimated on the basis of nonparametric Spearman's Rho correlations (40). Spearman correlations are recommended when data are skewed (41–43). Graphical Least Absolute Shrinkage and Selection Operator (LASSO) algorithm was used for regularization. By purposefully introducing a penalty hyperparameter, trivially small correlations were shrunk to zero during the regularization process. This helps reduce false-positive relationships and obtain a sparse network (40). The hyperparameter value may range from 0 (resulting in a more sensitive network with more remaining edges) to 1 (resulting in a more specific network with less remaining edges). To ensure that edges remaining in the final network are genuine, the hyperparameter was set to 0.5 to balance the tradeoff between sensitivity and specificity (40).

Two clusters were pre-defined before analysis, namely the PSU symptom cluster (items from the PSU scale) and the IU cluster (items from the C-IUS-12 scale). The resulting network consisted of nodes (individual items from the PSU scale and C-IUS-12 scale) and edges (regularized partial correlation between nodes) (40). The Fruchterman-Reingold algorithm was used for visualizing the layout (44). Within the network, nodes that are strongly correlated were placed next to each other, while the least connected nodes were placed further apart. Blue edges represent positive correlations, and red edges represent negative correlations. The edge thickness represents the magnitudes of the regularized partial correlation between nodes. These procedures were conducted via the R package qgraph (45).

To identify the central nodes, we calculated the node expected influence (the sum of edge weight of a given node) using the qgraph package. Compared to traditional centrality indices (i.e., strength, closeness, and betweenness), expected influence accounted for both positive and negative edges and was demonstrated to be a better approach for identifying influential nodes with the presence of negative edges (46). Further, a recent study (47) showed that only node expected influence successfully predicted how strongly changes in nodes were related to change in the remainder of the nodes when compared with other centrality measures (i.e., strength and predictability). Given that the presented network contained both positive and negative edges, it was more appropriate to use node expected influence than other centrality indices. Central nodes are considered as core to understanding the etiology and intervention targets of mental

health concerns due to their strong interconnectedness within the network (46). To identify important nodes that bridge the IU-PSU connection, we calculated the bridge expected influence (i.e. the sum of edge weights from a given node to the other cluster) (48). Nodes with higher bridge expected influence are considered to play a more central role in activating nodes from the opposite cluster. The bridge expected influence was calculated via the R package networktools (49). In order to identify the number of central and bridge nodes, we conducted a rigorous method with a blind 85th percentile cutoff on the value of node expected influence and bridge expected influence to avoid the confirmation bias that might arise when we interpret centrality statistics. Consequently, three nodes will be identified as central and three nodes will be identified as bridge nodes.

To ensure network accuracy, we bootstrapped the confidence intervals of the edge weights with 2,000 bootstrapped samples. To ensure stability of the centrality index (i.e. node expected influence and bridge expected influence), we calculated the correlation stability (CS)-coefficient via a bootstrapped case-dropping procedure (with 2,000 bootstrapped samples). In order to be considered stable, the CS-coefficient should not be lower than 0.25 and ideally above 0.50 (50). We also conducted bootstrapped difference tests to examine whether two edge weights or two node centralities (i.e., node expected influence and bridge expected influence) differ significantly from one another. The level of significance was set to $p < 0.05$ for all bootstrapped comparison tests. The aforementioned steps were conducted via the R package bootnet (50).

RESULTS

Descriptive Statistics

Table 1 displays the descriptive statistics of examined variables. The sample consisted of 1,849 participants (59% female, mean age = 19.00, SD = 1.32, range = 17–23 years).

Network Structure

Figure 1 presents the 21-item IU-PSU network. There are 138 of 210 (66%) possible edges (weight range from -.05 to .43) within the network. Overall, more positive edges ($n = 123$) were observed than negative edges ($n = 15$). The strongest between-cluster edges were between IU 2 ("It frustrates me not having all the information I need") and PSU 8 ("Do you use your smartphone in order to temporarily escape or relieve a negative mood?"; edge weight = 0.11); IU 1 ("Unforeseen events upset me greatly") and PSU 8 ("Do you use your smartphone in order to temporarily escape or relieve a negative mood?"; edge weight = 0.08). The strongest negative between-cluster edges were between IU 7 ("I should be able to organize everything in advance") and PSU 1 ("Do you feel preoccupied with your smartphone use?"; edge weight = −0.05).

Within the PSU symptom cluster, all of the connections between nodes are positive (weight range from 0.01 to 0.31). The strongest edges are between PSU 2 ("Do you feel more irritability, anxiety or even sadness when you try to either reduce or stop your smartphone use?") and PSU 3 ("Do you feel the need to spend increasing amount of time engaged smartphone use in order to achieve satisfaction or pleasure?"; edge weight = 0.31). Within the IU cluster, most of the connections between nodes are positive (weight range from −0.05 to 0.43). The strongest edges are between IU 1 ("Unforeseen events upset me greatly") and IU 2 ("It frustrates me not having all the information I need"; edge weight = 0.43). The bootstrapped 95% confidence interval is relatively narrow, indicating that the edges of the IU-PSU network are considered to be accurate (**Supplementary Figure S1**). **Supplementary Figure S2** showed the bootstrapped difference test for edge weights.

Centrality of Network

The expected influence values are presented in **Figure 2A**. PSU 6 ("Have you continued your smartphone use despite knowing it was causing problems between you and other people?"), IU 2 ("It frustrates me not having all the information I need") and IU 10 ("When I am uncertain I can't function very well") showed high expected influence and were considered to be central nodes in the IU-PSU network. The CS-coefficient for node expected influence (value = 0.75) was larger than 0.5, indicating this centrality index was adequately stable (**Supplementary Figure S3**). **Supplementary Figure S4** showed the bootstrapped difference test for node expected influence.

Bridge Nodes

The bridge expected influence values are presented in **Figure 2B**. Three bridging nodes with the highest bridge expected influence were PSU 8 ("Do you use your smartphone order to temporarily escape or relieve a negative mood?"), IU 2 ("It frustrates me not having all the information I need") and IU 1 ("Unforeseen events upset me greatly"). The CS-coefficient for bridge expected influence (value = 0.75) was larger than 0.5, indicating this centrality index was adequately stable (**Supplementary Figure S5**). **Supplementary Figure S6** showed the bootstrapped difference test for node bridge expected influence.

DISCUSSION

Existing research demonstrates that IU may contribute to PSU when measured using item sum scores (10). Employing network analysis, the current study further explored the complex interrelationship between IU components and PSU symptoms. In line with our hypothesis and the I-PACE model, we found that the strongest inter-cluster connections were between negative emotional reactions to uncertainty (IU 1 and IU 2) and coping-motivated smartphone use (PSU 8). Specifically, individuals with higher levels of negative emotional reactions to uncertainty may experience more intense arousal when facing uncertain situations. This may reduce their inhibitory control and predispose them to engage in short-term behaviors (e.g., smartphone use). By constantly pairing stress-reduction with smartphone use behaviors, such behaviors may be acquired as a maladaptive coping strategy when distressed by uncertainty.

Similar to previous studies, we found intra-cluster connections were generally stronger than inter-cluster connections (20, 51). The strongest edges within the IU cluster

TABLE 1 | Mean, standard deviation (SD), skewness, and kurtosis of each variable selected in the present networks.

Items	*M* (SD)	Skewness	Kurtosis
IU 1 ("Unforeseen events upset me greatly")	3.0 (1.1)	−0.37	−0.90
IU 2 ("It frustrates me not having all the information I need")	3.0 (1.1)	−0.45	−0.95
IU 3 ("One should always look ahead so as to avoid surprises")	3.8 (0.9)	−1.09	1.51
IU 4 ("A small, unforeseen event can spoil everything, even with the best of planning")	3.4 (1.0)	−0.54	−0.40
IU 5 ("I always want to know what the future has in store for me")	3.5 (1.1)	−0.62	−0.25
IU 6 ("I can't stand being taken by surprise")	2.9 (1.1)	−0.07	−0.84
IU 7 ("I should be able to organize everything in advance")	3.3 (0.9)	−0.43	−0.22
IU 8 ("Uncertainty keeps me from living a full life")	2.6 (1.1)	0.10	−0.95
IU 9 ("When it's time to act, uncertainty paralyzes me")	2.8 (1.1)	−0.05	−1.09
IU 10 ("When I am uncertain I can't function very well")	2.8 (1.1)	−0.09	−1.20
IU 11 ("The smallest doubt can stop me from acting")	2.5 (1.1)	0.22	−1.01
IU 12 ("I must get away from all uncertain situations")	2.3 (1.1)	0.50	−0.65
IU total	35.9 (8.1)		
PSU 1 ("Do you feel preoccupied with your smartphone use? (Some examples: Do you think about previous smartphone use or anticipate the next smartphone use? Do you think smartphone use has become the dominant activity in your daily life?"))	2.7 (1.0)	0.05	−0.62
PSU 2 ("Do you feel more irritability, anxiety or even sadness when you try to either reduce or stop your smartphone use?")	1.6 (0.8)	1.32	1.57
PSU 3 ("Do you feel the need to spend increasing amount of time engaged smartphone use in order to achieve satisfaction or pleasure?")	1.8 (0.9)	1.03	0.92
PSU 4 ("Do you systematically fail when trying to control or cease your smartphone use?")	2.2 (1.0)	0.53	−0.32
PSU 5 ("Have you lost interest in previous hobbies and other entertainment activities as a result of your engagement with the smartphone?")	1.6 (0.8)	1.41	1.76
PSU 6 ("Have you continued your smartphone use despite knowing it was causing problems between you and other people?")	1.8 (1.0)	1.05	0.51
PSU 7 ("Have you deceived any of your family members, therapists or others because of the amount of your smartphone use?")	1.7 (0.8)	1.13	0.80
PSU 8 ("Do you use your smartphone in order to temporarily escape or relieve a negative mood (e.g., helplessness, guilt, anxiety)?")	2.2 (1.1)	0.57	−0.54
PSU 9 ("Have you jeopardized or lost an important relationship, job or an educational or career opportunity because of your smartphone use?")	1.5 (0.8)	1.51	2.22
PSU total	17.0 (6.1)		

M, mean; SD, standard deviation.

were between IU 1 ("Unforeseen events upset me greatly") and IU 2 ("It frustrates me not having all the information I need"). These results are consistent with previous research on the network structure of IU (19, 24). For the PSU cluster, we found PSU 2 ("Do you feel more irritability, anxiety or even sadness when you try to either reduce or stop your smartphone use") has a strong connection to PSU 3 ("Do you feel the need to spend increasing amount of time engaged smartphone use in order to achieve satisfaction or pleasure?"). Despite tolerance and withdrawal usually going hand in hand, we may not rule out the possibility that such a correlation may be due to different causal sources. This potential confounding influence should be taken into consideration when interpreting the observed relationship between PSU 2 and PSU 3.

Supporting our second hypothesis, the centrality analysis showed that PSU 6 ("Have you continued your smartphone use despite knowing it was causing problems between you and other people?") was the most central PSU symptom. Previous research has shown that continued use is a core symptom of PSU in Chinese adolescents (44). Our results replicate this finding in a university student sample. Meanwhile, the preference for planning ahead (IU 7) did not emerge as the central IU component as we hypothesized. Previous research showed that the factor structure of the IU measure differed across racial groups (52). Thus, it is unsurprising that the central node may be different from previous research using Italian samples (19). We found IU 2 ("It frustrates me not having all the information I need"), and IU 10 ("When I am uncertain I can't function very well") were central IU nodes in the current study. Compared to negative beliefs about uncertainty (IU 3, 4, 5, 7), emotional (IU 2) and behavioral (IU 10) reactions to uncertainty may be more critical for maintaining the structure of the IU-PSU network.

In the network presented in our study, node bridge centrality may cast light on the specific role played by different components of IU in the development and maintenance of PSU. In the IU cluster, IU 2 ("It frustrates me not having all the information I need") and IU 1 ("Unforeseen events upset me greatly") were identified as bridge nodes for the IU-PSU association. This

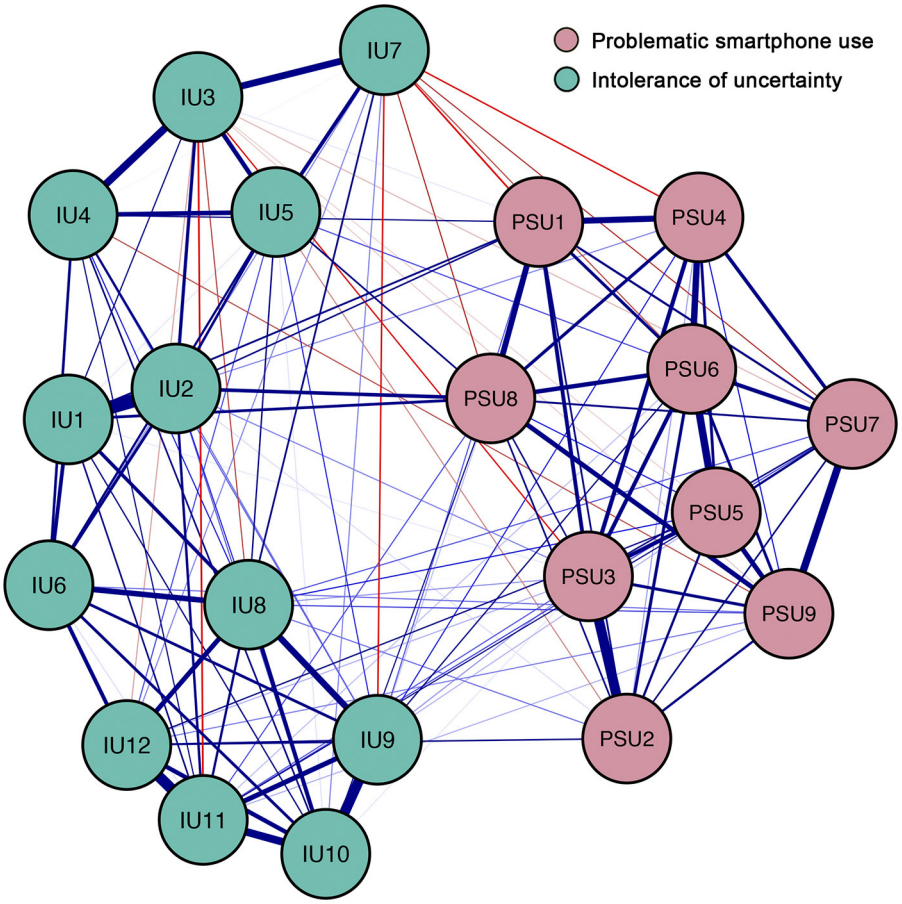

FIGURE 1 | Network structure of different components of intolerance of uncertainty and symptoms of problematic smartphone use. Blue edges represent positive correlations, red edges represent negative correlations. The thickness of the edge reflects the magnitude of the correlation. Cut value = 0.03. The text of variables selected in network can be seen in **Table 1**.

suggests that IU 2 and IU 1 have stronger associations with symptoms of PSU than other components of IU. Thus, from a network perspective, targeting IU 2 and IU 1 may be more effective at reducing symptoms of PSU than targeting other components of IU. As previously stated, both IU 1 and IU 2 were strongly correlated with coping-motivated smartphone use, indicating a potential pathway for interventions. In the PSU cluster, PSU 8 ("Do you use your smartphone in order to temporarily escape or relieve a negative mood?") was identified as the bridge node. This indicates that PSU 8 might be susceptible to the IU cluster.

It is worth mentioning the crucial role of IU 2 (i.e. as both a central node and a bridge node) was also reported in a network study that examined the relationship between IU components and generalized anxiety disorder symptoms (24). This indicates that IU 2 may be a target for research and interventions across different mental health conditions, in line with current transdiagnostic models of psychopathology (e.g., RDOC) (53). In fact, a recent study had showed that the centrality of node in the cross-sectional and between-subject networks may be ill-defined and the supporting evidence is inconsistent (47). Thus, this hypothesis needs to be further investigated in future studies.

The current findings have important implications for intervention development. It has been proposed that addressing central nodes may reduce its associated symptoms within the whole network, while addressing bridge nodes may disrupt the illness pathway and reduce the comorbidity/co-occurrence (54, 55). Based on current findings, IU 2, identified as both a central node and a bridge node, may be a potential target for early interventions of PSU. Specifically, information about individuals' tendency to experience negative emotional reactions toward uncertainty may be used to identify individuals at risk of developing PSU and target early interventions to reduce risk for developing PSU. A randomized controlled trial of Intolerance of Uncertainty Treatment demonstrated promising results in reducing IU level and anxiety-related symptoms (56). Theoretically, reducing one's negative emotional responses toward uncertainty (e.g., worry and anxiety) may lead to less motivation for excessive smartphone use. Coping-skills interventions, which aim to help individuals develop adaptive coping responses under distress, may be another candidate

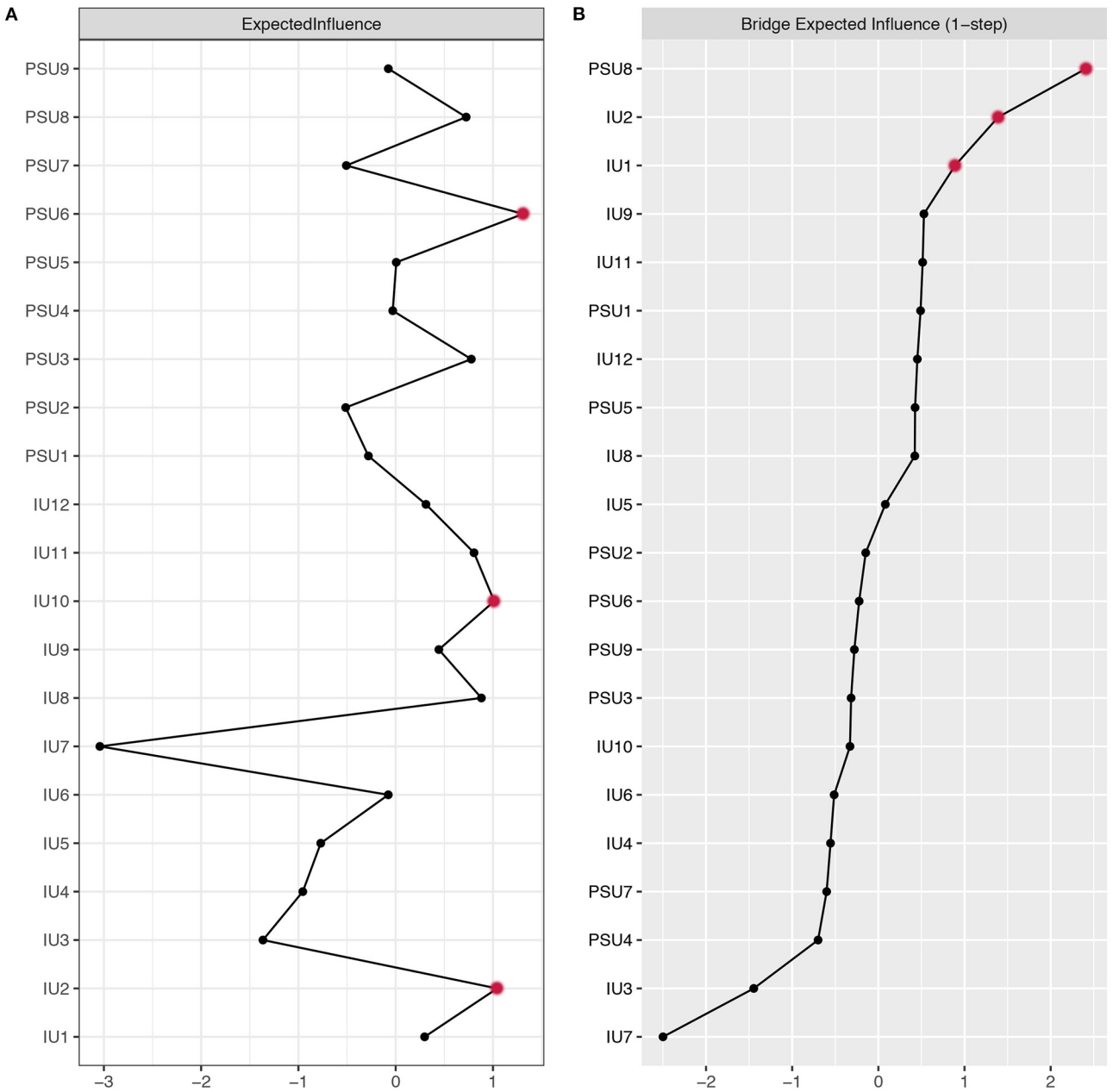

FIGURE 2 | Centrality plot depicting the **(A)** expected influence and **(B)** bridge expected influence of each variable selected in the present network (*z*-score). The text of variables selected in network can be seen in **Table 1**.

intervention. Specifically, individuals may recognize excessive smartphone use as the only means of coping strategy for uncertainty-related distress and be over-reliant on it despite aversive consequences. Thus, helping these individuals recognize and successfully implement other adaptive coping strategies may reduce the reliance on the maladaptive ones (e.g., excessive smartphone use). Indeed, coping-skills interventions have been shown effective in reducing substance misuse (57, 58). Whether such intervention may be effective in reducing PSU symptoms warrant future research.

Several limitations should be considered when interpreting the current results. First, the study utilized a cross-sectional design, which prevented us from drawing conclusions on temporal associations. Future studies should consider addressing this limitation by utilizing longitudinal study designs. Second, the study used a convenient sampling approach among university students. This, in combination with the data-driven nature of the network approach, may reduce the generalizability of the current findings to other samples. Future research is required to replicate our results in more diverse populations (e.g., clinical

samples). Third, both IU and PSU were measured by self-report scale, which may induce recall bias. Fourth, the present network investigated between-subject effects at a group level. That is, the network structure of a single individual may not be replicated in the same way. Finally, despite being used in several empirical studies, the validation of the modified nine-item Internet Gaming Disorder Scale - Short Form is still ongoing. Nevertheless, the scale demonstrated good internal consistency in the current study.

CONCLUSION

The current study advances the understanding of the relationship between IU and PSU by examining how distinct IU components relate to specific PSU symptoms via a network approach. By highlighting the inter-group connection between emotional reactions to uncertainty and coping-motivated smartphone use, our findings may shed light on future research aiming to develop theoretical understanding and interventions for reducing PSU. Further, as PSU symptoms may fluctuate over time, it is plausible that the network structure may also change in the course of time. Future studies should examine the temporal association between IU components and PSU symptoms to see if the network structure identified in the current study may change over time. Finally, the current findings highlight the potential of IU interventions for reducing symptoms of PSU; future studies are needed to determine this potential.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article may be available from the corresponding author on reasonable requests. Requests to access these datasets should be directed to LR, rl_fmmu@163.com.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the First Affiliated Hospital of the Fourth Military Medical University. The questionnaire was completed online in the WeChat application after electronic informed consent was obtained.

AUTHOR CONTRIBUTIONS

CL, LR, and LA developed study idea and design. CL wrote the original draft of this manuscript. All authors contributed to revising subsequent versions of the paper.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.917833/full#supplementary-material

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EDITED BY
Hyoun S. Kim,
Ryerson University, Canada

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Jung-Seok Choi,
Samsung Medical Center, South Korea
André Luiz Monezi Andrade,
Pontifical Catholic University of Campinas, Brazil

*CORRESPONDENCE
Hyunmi Son
hmson@pusan.ac.kr

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Protective and risk factors of problematic smartphone use in preteens using panel study on Korean children

Jungim Yun[1,2], Gyumin Han[1] and Hyunmi Son[1]*

[1]College of Nursing, Pusan National University, Busan, South Korea, [2]Nursing Department, Dong-Eui Medical Center, Busan, South Korea

Background: Increased smartphone use by children and adolescents places them at higher risk of overdependence. The problematic smartphone use of preteens is rapidly increasing. The preteen period is one of considerable developmental change and the influence of problematic smartphone use should be identified by reflecting on this change and considering its social psychological factors.

Methods: This study employed a secondary analysis using data from the 10th (2017) to 11th (2018) wave of the Panel Study on Korean Children. STATA/BE 17 was used to analyze the panel logit model. Among the 1,286 participants aged 9–10 from the Panel Study on Korean Children, 342 with complete responses were selected as the participants of this study.

Results: The risk group for problematic smartphone use showed an increase from 126 in 2017 to 149 in 2018. Factors influencing risk of preteens' problematic smartphone use were the child's externalizing problems ($p = 0.015$) and permissive parenting behavior ($p = 0.003$). Protective factors influencing preteens' problematic smartphone use were peer communication ($p = 0.023$), parental supervision ($p = 0.020$), and authoritative parenting behavior ($p = 0.001$).

Conclusions: Preteens with externalizing problems are at a higher risk for problematic smartphone use and are therefore a group to be observed with caution. It is also required to guide them to form good relationships with friends. Finally, in the problematic smartphone use of preteens, parents are both a protective factor and a risk factor. Therefore, guidance is required so that children can behave properly.

KEYWORDS

Addictive behavior, preteen, problematic smartphone use, peer, parenting

Introduction

Smartphones are becoming a necessity in the daily lives of most individuals due to their convenience for all users. Today's adolescents are digital natives, accustomed to learning, playing, and recreation using smartphones. Despite their numerous benefits, excessive smartphone use due to lack of self-control can lead to problems in daily

life, known as Problematic Smartphone Use (PSU) (1). PSU can result in physical and psychological problems among adolescents including sleep disorders, difficulties in academic achievement and maladjustment to school life (2–5). PSU also causes a deterioration of empathy and emotional intelligence as well as interpersonal dysfunction in adolescents (6), inducing aggression that can result in behaviors such as deviance and delinquency (7, 8).

PSU in the preteen period, which corresponds to the onset of adolescence, shows the steepest increase compared to other adolescent age groups. Preteen is the transitional period of development from childhood to adolescence between the age of 9 and 12 (9) in which the characteristics of children and adolescents coexist. PSU among preteens increased by about 19% in 2020 compared to 2018, higher than the average increase of 13% among high school students (10). During the preteen period, most children own a smartphone for the first time, and as personal time without parental control increases, they actively use their smartphones for various purposes (11). Preteens with a high risk of engaging in PSU due to immature self-control are highly likely to persist with PSU in adolescence and adulthood (12).

Children's behaviors are not only affected by individual thoughts and concepts, but also by the interaction of various environmental factors such as interpersonal, community, and policy factors surrounding the child (13). Therefore, an ecological approach is required to identify the factors affecting children's problem behavior. Studies on adolescents have mainly considered individual factors such as depression, interpersonal sensitivity, school maladjustment (14, 15), and interpersonal factors such as peer relationship (16), and peer support (17). Studies focused on childhood have examined interpersonal factors such as parental smartphone use and parenting attitudes (18). Another study examined the relationship of PSU with the school environment, which is an important community factor for children and adolescents (19). However, previous studies examining the ecological factors affecting PSU were mainly conducted on adolescents or children, therefore, studies focusing on the preteen period were insufficient. In order to understand the preteens, which is an important period in PSU, it is necessary to explore the interaction of various influencing factors focusing on the preteens period.

The preteen period marks a period of rapid change in psychological and social development. The parent-centered interpersonal relationship of childhood expands and social development changes rapidly (20). It becomes important to form a peer group and forge friendships and bonds with peers during this period (21). Most previous studies examining the factors affecting PSU are cross-sectional studies on adolescents and children, and are limited, not reflecting changing preteen characteristics. To intervene in problematic smartphone use suitable for the preteen period, identifying the influencing factors that reflect developmental changes is necessary.

The purpose of this study is to identify the protective and risk factors related to PSU in preteens based on an ecological model. Moreover, the study identifies factors that reflect preteen changes and developmental characteristics using panel data and presents effective countermeasures for PSU prevention. In the ecological model, we exclude the community and policy factors that fall under the same conditions, and focus on the individual and interpersonal relationships that are important, as established in a literature review.

Methods

Design

This longitudinal study is a secondary analysis of data from the Panel Study on Korean Children (PSKC) 10^{th} (2017) to 11^{th} (2018) wave investigating problematic smartphone use.

Setting and participants

In the PSKC, children born in 2008 at medical institutions nationwide will be followed up until 2027 to track their growth and development. The PSKC uses stratified multi-step sampling and data are collected by dividing the country into six regions. The number of births per year in each region is proportionally allocated. PSKC data were acquired from a balanced panel surveyed at regular intervals. In this study; since raw data measuring PSU, which is available to the general public, is in the 10 and 11 PSKC, 9–10-years-old participants, who are among the early preteens, were targeted. The initial sample size of PSKC was 2,150 in 2008, with the survey consisting of responses from guardians, children, parents, and school-teachers. Until the 11th data of 2018 used in this study, 1,097 participants, who were either guardians, children, parents, or school-teachers, responded to the survey. The variables used in this study were answered by children, parents, and teachers, and 342 participants responded to all the necessary variables in this study. Therefore, 342 preteens were selected as final analysis participants in this study. Considering a previous study that showed that when the number of n is 200 or more in panel data, it appears almost identical to the population result (22), it is considered to be a sufficient number for panel logit analysis.

Measurements

Among the measurements used in this study, overall happiness, self-esteem, and peer attachment were analyzed using the results of children's responses to the questionnaire, and strengths and difficulties, and school adaptation were analyzed using the questionnaire answered by the child's

classroom teacher observing the child. In addition, problematic smartphone use, parental supervision, and parenting behavior were used as responses from the child's primary caregiver.

Sociodemographic and smartphone-related characteristics. Sociodemographic characteristics included gender, residence area, household monthly income, and mother's educational level and employment status. Smartphone-related characteristics included items on whether preteens owned a smartphone and the duration of daily smartphone use.

Problematic smartphone use. The level of problematic smartphone usage was measured using the "K-Scale" (Internet Addiction Diagnostic Scale) (23). Among the K scale contents, the term "Internet" has been modified to "smartphone, media." Answered by the participants' mothers, this instrument consists of 15 items: 5 items on factor 1 (daily life disorder), 4 items on factor 3 (withdrawal), 4 items on factor 4 (tolerance), and 2 items for an unclassified factor. The questionnaire items are evaluated on a four-point Likert scale from "not at all" (1 point) to "a great deal" (4 points), with higher scores indicative of a greater risk of addiction. Using the total and summation scores for sub-domains, participants were classified as general, potential-risk, and high-risk users.

General users had a total score of <27 points, and the criteria for each factor were as follows—factor 1: < 12 points, factor 3: < 10 points, and factor 4: < 9 points. Potential-risk users had a total score of 28–29 points with a score of > 13 points for factor 1, > 11 points for factor 3, and > 10 points for factor 4. Lastly, high-risk users had a total score of > 30 points, with a score of > 14 points for factor 1, > 12 points for factor 3, and > 11 points for factor 4. In this study, the potential and high-risk groups were classified as high-risk groups, and the general group was analyzed by classifying them into the general group. Cronbach's αat wave1 is 0.83, and at wave 2 is 0.87.

Individual factors

Overall happiness. Overall happiness was measured by the Child Paper Self Completion Questionnaire used in the Millennium Cohort Study (MCS) (24) and represented the happiness index of daily life such as academics, appearance, family, friends, school, and life. The questionnaire consists of six items evaluated on a four-point Likert scale from "not happy at all" (1 point) to "very happy" (4 points). High scores indicate high overall happiness. Cronbach's αat wave1 is 0.73, and at wave 2 is 0.80.

Self-esteem. Self-efficacy was measured using the tool of the Millennium Cohort Study (MCS) (25), which reduced the Rosenberg's self-esteem scale from 10 to 5 according to age. Questionnaire items are evaluated on a five-point Likert scale from "not happy at all" (1 point) to "very happy" (5 points). High scores indicate high self-esteem. Cronbach's αat wave 1 is 0.75, and at wave 2 is 0.81.

Strengths and difficulties. Strengths and difficulties were measured using the Korean version of the Goodman's Strengths and Difficulties questionnaire provided on the author's website (26). PSKC researchers conducted a Korean language feasibility test to increase respondents' understanding. Measurements were based on observations made by the classroom teacher on the child's behavior over the past 6 months. Children's strengths and difficulties are divided into prosocial behavior and total difficulties. Difficulties are classified into internalizing and externalizing problems. Internalizing problems are emotional symptoms and peer relationship problems; externalizing problems are behavioral problems and hyperactivity/inattention. The tool consists of 25 items evaluated on a four-point Likert scale from "not at all" (1 point) to "a great deal" (4 points). Cronbach's αat wave1 is 0.89, and at wave 2 is 0.87.

School adjustment. School adjustment was measured using Ji and Jung's school adjustment inventory (27). Data were collected from participants' teachers through an online questionnaire. The tool comprises 35 items in four sub-domains: 11 items on adjustment to school life, 11 items on adjustment to academic performance, 8 items on peer adjustment, and 5 items on teacher adjustment. Each item is evaluated on a five-point Likert scale from "strongly disagree" (1 point) to "strongly agree" (5 points). High scores indicate better school adjustment. Cronbach's αat wave1 is 0.97, and at wave 2 is 0.97.

Peer factors

Peer attachment. Peer attachment was measured by extracting only the peer attachment scale from Armsden and Greenberg's Parent and Peer Attachment Scale (28). The tool comprises 9 items in 3 sub-domains: communication, trust, and alienation. Communication implies respecting ideas when talking with friends, listening to what they have to say, and talking about concerns and problems. Trust implies building trust and being able to talk to your friends when you want to confide in them. Alienation implies feeling lonely and alone, even with friends. Each item is rated on a four-point Likert scale ranging from "strongly disagree" (1 point) to "strongly agree" (4 points), with high scores indicating a greater degree of communication, trust, or alienation. Cronbach's αat wave1 is 0.69, and at wave 2 is 0.74.

Parental factors

Parental supervision. Parental supervision was measured using the "parenting behavior inventory" developed by Huo (29) and modified by Kim et al. (30). The questionnaire consisted of 4 items evaluated on a five-point Likert scale from "strongly disagree" (1 point) to "strongly agree" (5 points). High

scores indicated high levels of child monitoring, understood as positive parenting behavior. Cronbach's αat wave1 is 0.75, and at wave 2 is 0.82.

Parenting behavior. Parenting behavior was measured using a tool developed by Robinson et al. and translated by PSKC researchers (31). It comprises 62 items in 3 sub-domains: authoritative, authoritarian, and permissive parenting behaviors. Authoritative parenting behavior included warmth & Involvement, reasoning/induction, democratic participation and good natured/easy going. Authoritarian parenting behavior included verbal hostility, corporal punishment, non-reasoning, punitive strategies, and directives. Permissive parenting behavior included lack of follow through, ignoring misbehavior and self-confidence. Items are evaluated on a five-point Likert scale from "strongly disagree" (1 point) to "strongly agree" (5 points). High scores indicate high parenting behavior for each sub-domain. Cronbach's αat wave1 is 0.93, and at wave 2 is 0.93.

Data collection

Raw data of the PSKC are publicly downloadable from the Panel Study on Korean Children website. The first author revealed affiliation and purpose of use and received approval for data use.

Data analysis

For the characteristics of wave 1 and wave 2, descriptive statistics were applied as frequency and percentage, mean and standard deviation, and a panel logit model was used to identify factors affecting the PSU by reflecting on participant growth and development. The error term e_{it} means an error that varies according to the panel object and time. STATA/BE 17 was used for longitudinal analysis of two-year data. Data from the 10^{th} and 11^{th} years of the survey (2017 to 2018) were case merged using the sample ID. The data were then converted to long-type panel data for analysis.

The Panel Logit Equation was:

$$y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + e_{it}$$

To judge suitability of this study model, we sequentially estimated its fixed and random-effects. The Hausman test was conducted to evaluate the endogeneity problem of explanatory variables. This test of the panel logit model showed that there was no correlation between individual unobserved heterogeneity of independent variables and the null hypothesis (Ho: difference in coefficients not systematic) was not rejected at a significance level of 5% ($p = 0.419$). Thus, a random effect model was used instead of a fixed effect model. Under these circumstances, the random error is heterogeneity-specific to a cross sectional unit. Owing to this intra panel variation, the random effects model has the distinct advantage of allowing for time-invariant variables to be included among the regressors.

TABLE 1 Demographic and smartphone-related characteristics of wave 1 and wave 2 ($N = 342$).

Variables	Wave 1 *n* (%) or M (SD)	Wave 2 *n* (%) or M (SD)
Gender		
Boy	170 (49.7)	170 (49.7)
Girl	172 (50.3)	172 (50.3)
Place of residence		
Big city	139 (40.7)	137 (40.1)
Small and medium-sized cities	178 (52.0)	175 (51.2)
Rural area	25 (7.3)	30 (8.7)
Household income (dollars/month)		
< 4,000	149 (43.6)	138 (40.3)
≥ 4,000–< 7,000	164 (47.9)	170 (49.7)
≥ 7,000–< 9,000	15 (4.4)	24 (7.0)
≥ 9,000	14 (4.1)	10 (3.0)
Mother graduated college or high school	263 (77.0)	263 (77.0)
Mother's working status		
Not working	147 (43.0)	133 (38.9)
Working	195 (57.0)	209 (61.1)
Child's smartphone ownership		
No	125 (36.5)	80 (23.4)
Yes	217 (63.5)	262 (76.6)
Time on smartphone (hr/day)	1.16 (0.80)	1.48 (0.92)
Problematic smartphone use		
General group	216 (63.2)	193 (56.4)
Risk group	126 (36.8)	149 (43.6)

M, mean; SD, standard deviation.

Results

Demographic and smartphone-related characteristics of wave 1 and wave 2

A total of 342 participants, with approximately 50.3% girls and 49.7% boys with even gender distribution was considered. Children's smartphone ownership increased about 13.1% in wave 2 than in wave 1, indicating that 76.6% of participants own a smartphone. In wave 1, the daily smartphone usage time was 1.16 h, which increased to 1.48 h in wave 2. The number of participants in the high-risk group in wave 2 was 149, which was 6.8% higher than in wave 1 (Table 1).

TABLE 2 Differences in variables between the general and high-risk groups ($N = 342$).

Variables	Wave 1		Wave 2	
	General M (SD)	Risk M (SD)	General M (SD)	Risk M (SD)
Individual factors				
Overall happiness	3.38 (0.44)	3.27 (0.45)	3.40 (0.46)	3.23 (0.46)
Self-esteem	3.53 (0.40)	3.47 (0.42)	3.54 (0.46)	3.45 (0.44)
Strengths and difficulties				
Internalizing problems	1.27 (0.28)	1.30 (0.30)	1.63 (0.24)	1.67 (0.24)
Externalizing problems	1.29 (0.31)	1.38 (0.35)	1.84 (0.28)	1.96 (0.33)
Prosocial behavior	2.53 (0.48)	2.43 (0.50)	2.60 (0.43)	2.43 (0.48)
School adjustment	4.20 (0.71)	3.99 (0.72)	4.28 (0.65)	4.02 (0.69)
Peer factors				
Peer attachment				
Communication	3.16 (0.55)	3.02 (0.58)	3.19 (0.55)	3.01 (0.50)
Trust	3.26 (0.60)	3.14 (0.65)	3.30 (0.62)	3.13 (0.58)
Alienation	1.97 (0.62)	2.03 (0.66)	1.83 (0.54)	1.90 (0.58)
Parental factors				
Parental supervision	4.77 (0.35)	4.59 (0.47)	4.71 (0.40)	4.57 (0.46)
Parenting behavior				
Authoritative	3.94 (0.38)	3.72 (0.30)	3.95 (0.33)	3.75 (0.38)
Authoritarian	2.29 (0.43)	2.44 (0.45)	2.22 (0.44)	2.41 (0.42)
Permissive	2.40 (0.27)	2.54 (0.28)	2.29 (0.32)	2.47 (0.31)

M, mean; SD, standard deviation.

TABLE 3 Factors influencing problematic smartphone use in preteens ($N = 342$).

Variables	OR	SE	*p*	95% CI
Individual factors				
Overall happiness	0.84	0.40	0.704	0.33–2.11
Self-esteem	0.82	0.40	0.686	0.32–2.11
Strengths and difficulties				
Internalizing problems	0.70	0.44	0.563	0.20–2.38
Externalizing problems	3.14	1.47	0.015	1.25–7.87
Prosocial behavior	1.05	0.45	0.905	0.46–2.42
School adjustment	0.71	0.21	0.236	0.40–1.25
Peer factors				
Peer attachment				
Communication	0.42	0.16	0.023	0.20–0.89
Trust	1.05	0.37	0.882	0.53–2.10
Alienation	0.88	0.23	0.624	0.53–1.46
Parental factors				
Parental supervision	0.41	0.16	0.020	0.19–0.87
Parenting behavior				
Authoritative	0.13	0.07	0.001	0.04–0.39
Authoritarian	0.89	0.42	0.801	0.35–2.24
Permissive	6.68	4.30	0.003	1.89–23.56

OR, odds ratio; SE, standard error; CI, confidence interval.

Differences in variables between general and high-risk users

Individual factors. In wave 1 and 2, both the externalizing and internalizing problems of general and high-risk groups increased. In particular, the externalizing problems of high-risk groups increased the most.

Peer factors. In wave 1 and 2, the high-risk group had lower trust and communication scores and higher alienation scores than the general group.

Parental factors. In wave 1 and 2, the parental supervision score of the high-risk group was lower than that of the general group; authoritative parenting behavior increased, and permissive parenting behavior decreased in wave 2 compared to that in Wave 1 (Table 2).

Protective and risk factors influencing problematic smartphone use

A panel logit model analysis was conducted for a longitudinal analysis of the effects of PSU in preteens (Table 3). Externalizing problems (individual factor), peer communication (peer factor), authoritative and permissive parenting behavior, and parental supervision (parental factor) affected preteens' PSU. Risk factors influencing preteens' PSU were the child's externalizing problems ($p = 0.015$, CI: 1.25–7.87) and permissive parenting behavior ($p = 0.003$, CI: 1.89–23.56). In contrast, protective factors influencing preteens' problematic smartphone use were peer communication ($p = 0.023$, CI: 0.20–0.89), parental supervision ($p = 0.020$, CI: 0.19–0.87), and authoritative parenting behavior ($p = 0.001$, CI: 0.04–0.39).

Discussion

This study analyzed the factors affecting PSU of preteens based on the ecological model longitudinally. The results indicated that preteens' externalizing problems and permissive parenting behavior were risk factors for preteens' PSU. In contrast, peer communication, authoritative parenting behavior, and parental supervision were protective factors against PSU. These results indicate that the characteristics of children, parenting and supervision, and peer relationships have complex effects on preteens' PSU. The prevalence of PSU among preteens in the 11th PSKC was 43.6%, which is much higher than that of elementary, middle, and high school students at 28% (10), which means that preteens should be carefully considered. In addition, the PSU ratio of the participants of this study was

higher than that of 23.3% of adolescents in Europe, Asia and the United States (32). This result is considered to be related to the high global smartphone penetration rate in Korea.

Among the individual factors, externalizing problems such as hyperactivity and inattention increased the risk of PSU in preteens, whereas internalizing problems did not appear to affect the PSU of preteens. These results contradict previous studies on PSU influencing factors on adolescents (33, 34). According to a meta-analysis of the relationship between PSU and internalizing and externalizing problems in children and adolescents by age group, the internalizing problem showed a large effect size in older adolescents, and the externalizing problem showed a large effect in younger children (35). Also, looking at the longitudinal study of adolescent internalizing and externalizing problems, both problems in adolescents affect PSU at the beginning, but longitudinally, externalizing problems have a greater effect on PSU (36). Considering these results, the externalizing problem of preteens is an important factor affecting PSU, and it can be interpreted that this externalizing problem adversely affects the PSU even in later adolescents. Therefore, if there is an externalizing problem such as preteen's excessive behavior or carelessness, it will be necessary to monitor smartphone-related problems. And since these externalization problems can have a more adverse effect on PSU over time, interventions to manage externalizing problems are needed when developing programs or counseling related to PSU.

In this study, among the three components of peer attachment—trust, alienation, and communication—only peer communication was found to be a protective factor for PSU in preteens. Peer communication refers to respecting, listening to, and discussing concerns and problems with friends. This is consistent with previous studies reporting that the higher the quality of peer relationships, the lower the risk of PSU (37, 38). In contrast, another study found that the risk of PSU increases as peer attachment increases (39), which indicates that individuals excessively use smartphones to not feel isolated from their peer groups (40). On the other hand, in this study, peer trust and alienation did not appear as influencing factors on PSU, which is in contrast to the research results showing that peer trust or alienation among adolescents was a risk factor for PSU. Unlike the adolescent period, when they experience trust or alienation through peer attachment relationships, preteens appear to be different from the research results of adolescents because they are in the early stages of forming peer relationships and peer groups. Despite these conflicting results, it is important to form genuine friendships during the preteen period, when peer bonds begin to form. It is necessary to pay attention to the friendship of preteens at home and school, to examine and support them if there are any difficulties in the friendship. In addition, improving the communication skills of preteens and forming smooth friendships will help prevent PSU.

Our study found that authoritative parenting behavior, characterized as affection, participation, democratic relationship, and kindness/comfort, reduces the risk of PSU in preteens. Our findings are consistent with those of previous studies on school-age children (41–44). Authoritative parenting is a key factor in PSU because parents guide their children toward correct behavior and communicate with them about the reasons for following rules. In this study, it was found that high levels of parental supervision, monitoring children's activities, and demonstration of affection and interest in their daily activities were associated with reduced PSU in preteens. In the case of adolescents, the higher the level of parental supervision, the lower the likelihood of PSU, and the greater the degree of increased self-control (45). As such, parental supervision is identified as an important protective factor in the PSU of children and adolescents, which in turn indicates that such supervision can help children not engage in PSU by increasing their self-control. On the other hand, the permissive parenting behavior of parents increased the risk of PSU in preteens. These results are similar to those of previous studies showing that parental neglect increases the risk of PSU in children (46, 47). Based on these findings, parents should not ignore their children's misbehavior, be interested in smartphone use, communicate with their children about appropriate usage methods, and establish rules and instruct their children to follow them. In addition, it is necessary to participate in the PSU prevention program not only by the children themselves but also by the parents.

Limitation

Although we considered the rapidly changing characteristics of growth and development using panel data and identified factors affecting PSU of preteens, our study has some limitations. First, our study participants were 9–10 years old, and included only a limited number of preteen participants. Therefore, in future studies, it is necessary to expand the study to preteen age participants. Second, this study was based on the study from an ecological point of view, but did not include community or national or institutional policies or legal influences. Since Korea has a characteristic that the penetration rate and use of the Internet and smartphones is higher than that of other countries, it is thought that it will be difficult to compare these policy influences with other countries. Therefore, in future studies, it is necessary to compare how each country's internet and smartphone-related laws affect PSU.

Conclusion

In this study, we identified factors affecting problematic smartphone use in preteens, whose smartphone dependence and risk of problematic use have increased. It was found that the factors affecting the PSU of preteens in the transition period between childhood and adolescence include characteristics of

childhood such as externalization problems and characteristics of adolescents such as peer attachment. When externalizing problems such as hyperactivity or inattention of preteens appear, monitoring for smartphone-related problems is required. Parents and school teachers should guide their children to form good peer relationships. Parents' correct guidance on their children's smartphone use should pay attention to what and how often their children use their smartphones rather than forcing them to restrict or disallowing them to use them. In addition, parents should teach their children to manage problem behaviors on their own through sufficient communication with their children. In order to diagnose and control preteens, who are vulnerable to PSUs, close observation and efforts are needed at school and at home.

Data availability statement

The data used in this study is available to individual researchers or institutions upon approval of the Korea Institute of Child Care and Education (KICCE, https://kicce.re.kr).

Ethics statement

Ethical approval was not provided for this study on human participants because this study is a secondary analysis study using Panel Study on Korean Children (PSKC), and the data is disclosed without personally identifiable information and is exempt from IRB deliberation. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

JY, HS, and GH presented the idea and developed the theory. JY and HS improved the theory and supervised the study. GH conducted the initial analysis. JY conducted the further analysis and drafted the first version of the manuscript. All authors reviewed and approved the definitive version 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.

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Hyoun S. Kim,
Ryerson University, Canada

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Hyunmi Son,
Pusan National University, South Korea
Claudia M. Quaiser-Pohl,
University of Koblenz and Landau, Germany

*CORRESPONDENCE
Jung-Seok Choi
choijs73@gmail.com
Yong-Sil Kweon
yskwn@catholic.ac.kr

†These authors have contributed equally to this work and share first authorship

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Harm avoidance, daily stress, and problematic smartphone use in children and adolescents

So Young Yoo[1†], Su Mi Park[2†], Chi-Hyun Choi[1], Sun Ju Chung[3], Soo-Young Bhang[4], Jae-Won Kim[5], Yong-Sil Kweon[6*] and Jung-Seok Choi[7*]

[1]Department of Psychiatry, SMG-SNU Boramae Medical Center, Seoul, South Korea, [2]Department of Counseling Psychology, Hannam University, Daejeon, South Korea, [3]Hanseo Central Hospital, Uijeongbu, South Korea, [4]Department of Psychiatry, Eulji General Hospital, Seoul, South Korea, [5]Division of Child and Adolescent Psychiatry, Department of Psychiatry, Seoul National University Hospital, Seoul, South Korea, [6]Department of Psychiatry, College of Medicine, Uijeongbu St. Mary's Hospital, The Catholic University, Seoul, South Korea, [7]Department of Psychiatry, Samsung Medical Center, School of Medicine, Sungkyunkwan University, Seoul, South Korea

Objective: Temperament is close to susceptibility to stress and the increased level of stress may lead problematic smartphone use (PSU). In this study, the relationships between harm avoidance (HA) as a personality trait, daily traits, and PSU in children and adolescents were investigated.

Methods: At baseline, all participants (184 children and adolescents, mean age 13.15 years) completed questionnaires on PSU using the Smartphone Addiction Scale-Short Version (SAS-SV) and the Korean Smartphone Addiction Proneness Scale (SAPS). The Daily Hassles Questionnaire (DHQ) and Junior Temperament and Character Inventory (JTCI) were also administered to evaluate stress levels and personality traits. SAS-SV, SAPS, and DHQ were reassessed at 3 and 6 months.

Results: Among JTCI temperament, HA displayed robust positive correlations with SAS-SV, SAPS, and DHQ at all time points. Mediation effects of daily stress on the relationship between HA and PSU were observed at baseline, 3, and 6 months.

Conclusion: The findings suggest that managing stress may important in PSU children and adolescents with high HA.

KEYWORDS

problematic smartphone use, stress, harm avoidance, personality, mediation

Introduction

The number of smartphone users has rapidly increased around the world in recent years (1). For example, the smartphone ownership rate in South Korea was 70.4% in 2019 (2). The drastic increase in smartphone use raises questions about its risks, which include excessive use and psychological problems such as depression, anxiety, and sleep issues (3, 4). Furthermore, smartphone overuse is a risk factor for physical complications such as neck and eye problems (5, 6).

Excessive smartphone use can be categorized as a behavioral addiction, such as gambling disorder and Internet gaming disorder. Presentations commonly associated with addiction, such as preoccupation, loss of control, withdrawal, and functional impairment, have also been found in individuals engaged in excessive smartphone use (7–9). Based on these findings, smartphone addiction is defined as smartphone overuse that results in significant functional impairment. However, the term "problematic smartphone use (PSU)" is also used instead of smartphone addiction because there is insufficient evidence to confirm the existence of smartphone addiction (10). Currently, the terms smartphone addiction and PSU seem to be used synonymously in the literature.v

Children and adolescents are especially prone to PSU, which could be related to immature self-regulation and impulse control (11, 12). In 2019, a nationally representative survey of South Korea showed that 30.2% of adolescents were at risk of smartphone overdependence, which was comparable to 20.0% for all age groups (2). Furthermore, children showed the greatest increase in smartphone overdependence among all age groups (from 20.7% in 2018 to 22.9% in 2019).

Addictive behaviors can be explained by Cloninger's temperament model, which is measured by Temperament and Character Inventory (TCI) (13, 14). According to Cloninger's theory, heritable temperament is composed of the dimension of novelty seeking (NS), harm avoidance (HA), reward dependency (RD), and persistence. NS is related to the dopaminergic system which is responsible for behavioral activation to novel stimulus. On the other hand, HA is related to the system of serotonergic activity and is responsible for inhibiting behavior when encountering or anticipating aversive stimuli. RD relates to rewards in social situations, such as approval from others. Persistence involves in maintenance of a behavior. Among them, high NS and high HA have been found to be associated with PSU as well as other addictive behaviors (15–18).

Temperaments is related to cognitive evaluation of, response to, and selecting coping strategy to stressors (19). In particular, high HA is characterized as fearful, pessimistic, fatigable, and slow to recover from stress, so it has been strongly found in previous studies to be related to stress vulnerability as well as adverse psychological outcomes such as depression and anxiety (20, 21). Stress also plays an important role in PSU. One meta-analysis showed that stress was positively correlated with mobile phone use (22). Furthermore, PSU had a larger association than non-problematic phone use with stress. Academic stress, especially in adolescents, was found to be one of the risk factors for PSU (23).

In this study, we aimed to investigate relationships between HA as a personality trait, levels of stress in a daily life, and PSU in children and adolescents. We hypothesized that individuals with higher levels of stress, and high HA would show positive correlations with PSU. Additionally, we hypothesized that stress would have a mediating effect on the relationship between HA and PSU. We also explored relationships between other temperaments of Cloninger's theory, daily stress, and PSU. In order to examine whether the relationship between the HA, the daily stress and the smartphone use is stable, daily stress and PSU levels were repeatedly measured at baseline, 3 months, and 6 months later. To the best of our knowledge, this is the first study to investigate the mediation effect of daily stress on the relationship between personality traits and PSU in the pediatric population.

Methods

Participants

A multicenter clinical cohort study (clinic-cohort for the understanding of Internet addiction rescue factors in early life) was conducted in South Korea from August 2015 to August 2019 to track the natural history of the Internet, gaming, and smartphone addiction in children and adolescents, and identify protective and risk factors. A total of 194 children and adolescents were recruited and screened using the self-report Korean Scale for Internet Addiction for Adolescents (24), Smartphone Addiction Scale-Short Version (SAS-SV) (9). Korean Smartphone Addiction Proneness Scale (SAPS) (25), and the parent-report Internet Addiction Proneness Scale for Children and Adolescents (24). Participants who scored higher than the cut-off value on at least one of these screening questionnaires were enrolled in the cohort study.

The present study included 184 children and adolescents (46 girls; mean age 13.15 years) who had analyzable data for PSU level, stress level, and personality traits. Ten participants who did not respond to any of these questionnaires at baseline were excluded from the study. This study was approved by the Institutional Review Board (IRB) for Human Subjects at the SMG-SNU Boramae Medical Center (IRB No.16-2016-4). Detailed information about the study was provided to the subjects and their parents and written informed consent was obtained before participation.

Measurements

All participants completed several questionnaires including the SAS-SV, SAPS, Daily Hassles Questionnaire (DHQ), and junior TCI at baseline. PSU and stress levels were reassessed at 3 and 6 months using the SAS-SV, SAPS, and DHQ.

TABLE 1 Demographics and clinical characteristics ($N = 184$).

Variables	M or N	SD
Age (years)	13.15	2.48
Sex (male, %)	138 (75.0%)	
Developmental period (adolescents, %)	135 (73.4%)	
SAS-SV	28.75	12.09
SAPS	33.32	8.88
DHQ	66.86	18.29
JTCI		
NS	50.99	10.74
HA	49.56	12.02
RD	45.89	10.36
P	47.45	9.67
Comorbid diagnosis		
Depression	31 (16.8%)	
Anxiety	17 (9.2%)	
ADHD	56 (30.4%)	
Other	1 (0.5%)	

SAS-SV, Smartphone Addiction Scale-Short Version; SAPS, Korean Smartphone Addiction Proneness Scale; DHQ, Daily Hassles Questionnaire; JTCI, Junior Temperament Character Inventory; NS, Novelty Seeking; HA, Harm Avoidance; RD, Reward Dependence; P, Persistence; ADHD, attention deficit hyperactivity disorder.

Smartphone addiction scale-short version

The SAS is a self-reported questionnaire used to evaluate PSU (9). It comprises 33 items with a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The SAS-SV was developed to screen PSU easily (9). Ten items out of 33 questions were selected by experts. The SAS-SV showed high internal consistency ($\alpha = 0.91$) and concurrent validity. A total score of 31 or higher in boys and 33 in girls indicated the presence of PSU.

Korean smartphone addiction proneness scale

The SAPS was developed to assess PSU in children and adolescents (25). It consists of 15 items with a four-point Likert scale (1 = "strongly disagree," 2 = "disagree," 3 = "agree," 4 = "strongly agree") across four subdomains: disturbance of adaptive functions, virtual life orientation, withdrawal, and tolerance. Items related to virtual life orientation subdomain are SAPS-specific features. Higher scores reflect a greater risk of PSU. The SAPS was shown to be both valid and reliable ($\alpha = 0.88$). A score of 42 or higher in the SAPS indicated the presence of PSU.

Junior temperament and character inventory

The JTCI was developed to assess temperaments and character traits in adolescents (26, 27). Based on Cloninger's biosocial model of personality (13, 14), it consists of four temperament dimensions (novelty seeking, harm avoidance, reward dependence, and persistence) and three-character trait dimensions (self-directedness, cooperativeness, and self-transcendence). In this study, we used norm-referenced T-scores of temperament dimensions.

Daily Hassles Questionnaire

The DHQ is a well-validated questionnaire to measure daily life stresses related to factors such as parents, family, friends, academics, and school (28). It was modified and validated for adolescents in Korea (29). The Korean version of the DHQ consists of 36 items with a four-point Likert scale. Higher scores indicate greater stress levels. The internal consistency of the DHQ in this study was 0.934.

Statistical analyses

Descriptive statistics included age, gender, stress level, PSU level, and temperament variables at baseline. Relationships between variables were examined using Pearson's correlation analysis. Mediation model analyses were performed using the PROCESS macro with 5,000 bias-corrected bootstrap samples (30). All analyses were conducted using IBM SPSS Statistics version 28.0 (SPSS Inc., Chicago, IL, USA), and statistical significance was set at $p < 0.01$ for correlation analyses and <0.05 for mediation models.

Results

Demographic and clinical characteristics

In this study, we included 184 children and adolescents aged 7–18 years (Table 1). The majority of the participants were boys (75.0%). Scores of the smartphone addiction scales ranged from 10 to 56 and 15 to 55 in the SAS-SV and SAPS, respectively. The scores of the DHQ ranged from 36 to 123. The mean scores of PSU and stress level at baseline, 3 months, and 6 months are presented in Figure 1.

Correlation between personality trait, daily stress, and PSU

Table 2 show correlational results of variables at each time point of baseline, 3 months, and 6 months. All PSU levels at all time points were positively correlated with each other and daily life stress levels at all time points were positively related to PSU. Among the temperament dimensions of the JTCI, only HA robustly showed positive correlations with the SAS-SV, SAPS, and DHQ at all time points (all $ps < 0.01$). NS showed positive

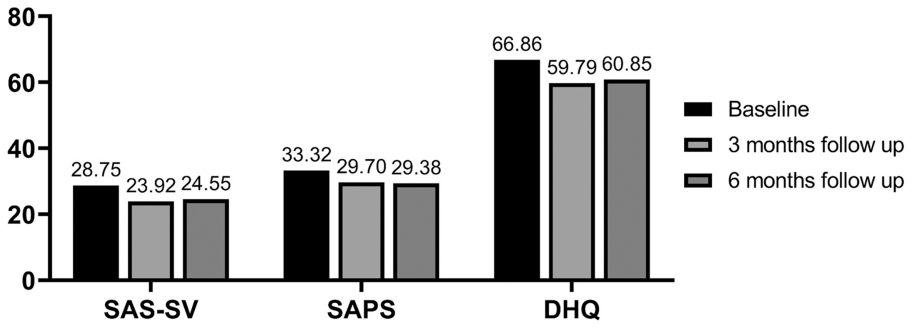

FIGURE 1
Descriptive statistics of problematic smartphone use and stress level. SAS-SV, Smartphone Addiction Scale-Short Version; SAPS, Korean Smartphone Addiction Proneness Scale; DHQ, Daily Hassles Questionnaire.

TABLE 2 Correlation between JTCI temperament, PSU, and daily Stress.

		1	2	3	4	5	6	7	8	9	10	11	12	13
Baseline	1.NS	1												
	2.HA	0.273**	1											
	3.RD	−0.053	−0.058	1										
	4.P	−0.182	−0.127	0.318***	1									
	5.SAS-SV	0.253**	0.329***	0.054	−0.143	1								
	6.SAPS	0.249**	0.333***	−0.014	−0.227**	0.864***	1							
	7.DHQ	0.211**	0.403***	−0.100	−0.204**	0.293***	0.336***	1						
3 Months	8.SAS-SV	0.117	0.305***	0.081	−0.258**	0.607***	0.557***	0.265**	1					
	9.SAPS	0.136	0.289***	0.057	−0.241**	0.575***	0.603***	0.240**	0.896***	1				
	10.DHQ	0.194	0.405***	−0.090	−0.089	0.251**	0.283**	0.614***	0.350***	0.368***	1			
6 Months	11.SAS-SV	0.099	0.395***	0.051	−0.157	0.619***	0.561***	0.355***	0.724***	0.703***	0.383***	1		
	12.SAPS	0.106	0.388***	0.005	−0.251**	0.538***	0.574***	0.418**[*]	0.660***	0.725***	0.449***	0.871***	1	
	13.DHQ	−0.081	0.270**	−0.091	0.018	0.201	0.230	0.468***	0.339***	0.287**	0.552***	0.348***	0.315***	1

**P < 0.01, ***P < 0.001. JTCI, Junior Temperament Character Inventory; NS, Novelty Seeking; HA, Harm Avoidance; RD, Reward Dependence; P, persistence; PSU, Problematic Smartphone Use; SAS-SV, Smartphone Addiction Scale-Short Version; SAPS, Korean Smartphone Addiction Proneness Scale; DHQ, Daily Hassles Questionnaire.

correlations with the SAS-SV, SAPS, and DHQ at baseline, but did not at 3 and 6 months. RD was not correlated to any PSU or stress-related variables. Therefore, we used only HA among JTCI in further mediational analyses.

Mediation effects of stress on the relationship between HA and PSU

We found significant indirect effects of daily stress on the relationship between HA and PSU at all time points (Table 3). At baseline, the effects of HA on PSU measured by SAS-SV and SAPS were partially mediated by baseline stress levels (Figure 2A). At 3 months, the baseline HA was partially mediated on the way of SAS-SV and fully mediated of SAPS by daily stress at that time point (Figure 2B). At 6 months, the effects of HA on both SAS-SV and SAPS were partially mediated by the stress (Figure 2C).

Discussion

In this study, we examined relationships between personality traits, level of stress, and PSU in children and adolescents with a prospective design. As the hypothesis for the mediation effect of daily stress, the relationships between HA and PSU were mediated by stress throughout 6 months of follow-up. Among the JTCI temperament dimensions, only HA was consistently related to both daily stress and PSU while NS, RD, and persistence did not.

HA represents the tendency to respond intensely to aversive stimuli and is related to behavioral inhibition and serotonergic activity (14, 31). Previous studies have reported that high HA

TABLE 3 Bootstrapped indirect effects of daily stress on the relationship between HA and PSU.

	Paths	Boot Indirect effect	Boot SE	LLCI	ULCI
Baseline	HA → DHQ → SAS-SV	0.0773	0.0365	0.0101	0.1549
	HA → DHQ → SAPS	0.0734	0.0275	0.0239	0.1323
3 Months	HA → DHQ → SAS-SV	0.1061	0.0440	0.0317	0.2087
	HA → DHQ → SAPS	0.0902	0.0333	0.0338	0.1686
6 Months	HA → DHQ → SAS-SV	0.0684	0.0389	0.0131	0.1702
	HA → DHQ → SAPS	0.0441	0.0265	0.0085	0.1181

HA, Harm Avoidance; PSU, Problematic Smartphone Use; SAS-SV, Smartphone Addiction Scale-Short Version; SAPS, Korean Smartphone Addiction Proneness Scale; DHQ, Daily Hassles Questionnaire; SE, standard error; LLCI, lower level confidence interval; ULCI, upper level confidence interval.

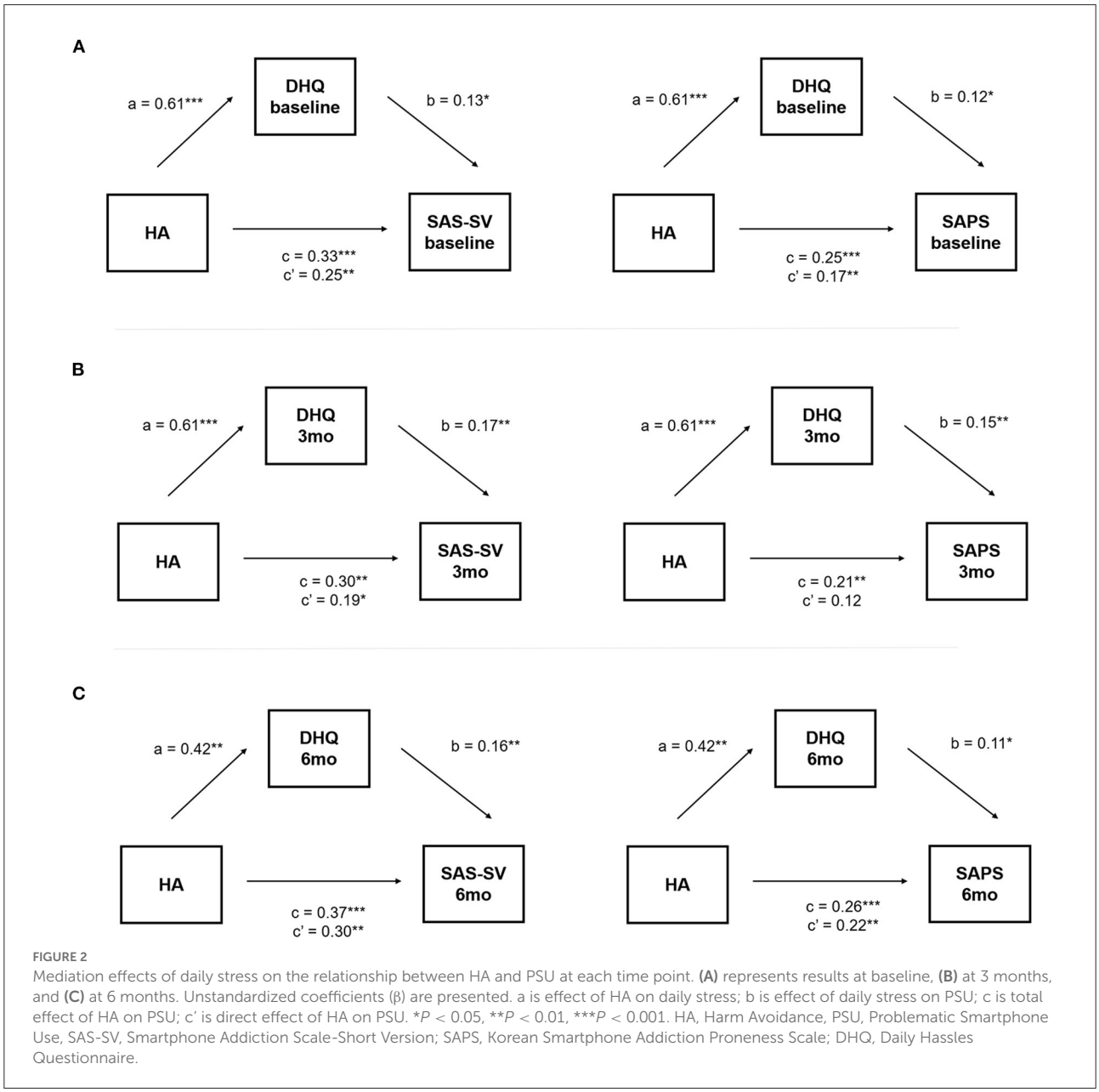

FIGURE 2
Mediation effects of daily stress on the relationship between HA and PSU at each time point. **(A)** represents results at baseline, **(B)** at 3 months, and **(C)** at 6 months. Unstandardized coefficients (β) are presented. a is effect of HA on daily stress; b is effect of daily stress on PSU; c is total effect of HA on PSU; c′ is direct effect of HA on PSU. *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. HA, Harm Avoidance, PSU, Problematic Smartphone Use, SAS-SV, Smartphone Addiction Scale-Short Version; SAPS, Korean Smartphone Addiction Proneness Scale; DHQ, Daily Hassles Questionnaire.

is a risk factor for PSU in adolescents and adults (32, 33). In addition, neuroticism of the Big Five personality which shares anxiety-related traits with HA has been found be positively associated with PSU (34, 35). Neuroticism refers to a dimension of nervousness and negative emotionality (36). Smartphone use and anxiety are positively correlated and this association is larger in PSU than in non-problematic use in adults (22). Consistent with previous studies, we found that among children and adolescents, levels of PSU and HA are positively correlated.

Individuals with high HA are likely to show strong reactions and attentional biases toward stressors (13). High HA is related with increased stress, cortisol level, maladaptive coping style, and maladaptive emotional regulation as well as depression and anxiety (37–39). Those with high HA might inevitably experience more stress in their daily life. To relieve negative emotions caused by stress, children and adolescents with HA tend to use smartphones excessively as a coping strategy (23, 40). Our findings can be explained with findings support the "Interaction of Person-Affect-Cognition-Execution" model, which is a theoretical framework to explain the process underlying an addictive behavior of Internet use (41). According to this model, specific personality traits result in affective and cognitive responses to situational triggers, and lead to addictive behavior. This finding suggests that stress plays an important role in developing and maintaining PSU among children and adolescents with high HA.

This study focused on the effect of HA and daily stress on PSU, which were found to be stable at all time points. We measured PSU and daily stress level during follow up. Thus, it is possible that the effect of the reaction tendency appearing at one time point was excluded. We did not focus on changes in the levels of daily stress and PSU within individuals, so caution is needed in interpretation. Nevertheles, the result suggests that HA could be associated with clinical conditions such as depression and anxiety as well as daily stress. According to the findings of this research team in previous internet addiction research, the behavioral inhibition system affected internet addiction through depression and anxiety, whereas the behavioral activation system closely related to NS influenced internat addiction through impulsivity as a mediator (42). Alternative explanations may be raised, such as PSU lowers stress tolerance and increase perceived stress level. The results of this study call for future study to invesigate whether managing stress in daily life may be helpful to PSU children and adolescents. For example, through non-pharmacological interventions such as cognitive behavioral therapy, it is also possible to improve various coping skills and emotional regulation skills in daily life.

This study has some limitations. First, in this study, we included only those who exceeded the cut-off values on screening questionnaires, which limits generalizing our findings to non-clinical populations. Second, because of the relatively small number of women and children, it was limited to thoroughly analyze the differences according to gender and school age. Enlarging sample with more female and children subjects is needed to become representative. Third, the result may reflect the cultural specificity of South Korea (i.e., high smartphone penetration). Fourth, levels of HA and stress were not measured by biological markers, such as functional imaging or hormones that may further explain the mechanism. Therefore, further studies with a control group and biological markers are needed to confirm our findings.

In summary, this study highlighted the role of daily stress for children and adolescents with PSU. The association between HA and PSU is mediated by the level of daily stress. This finding implies that stress management may be an important for the treatment of PSU in children and adolescents with high HA trait.

Data availability statement

The original contributions presented in the study are included in the article/supplementary materials, further inquiries about data access can be directed to the corresponding authors.

Ethics statement

The studies involving human participants were reviewed and approved by the Institutional Review Board (IRB) for Human Subjects at the SMG-SNU Boramae Medical Center (IRB No.16-2016-4). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

S-YB, Y-SK, and J-SC created and organized the study and collected the data. SY, SP, C-HC, and SC performed analysis and interpreted the results. J-WK and J-SC supervised the statistical analysis and contributed to the interpretation of data. SY and SP wrote the first draft of the manuscript. All authors critically reviewed and approved the final 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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EDITED BY
Andreas Chatzittofis,
University of Cyprus, Cyprus

REVIEWED BY
Kristen Moseley,
National Institute on Minority Health and Health Disparities (NIH), United States
Mariusz Stanisław Wiglusz,
Medical University of Gdańsk, Poland

*CORRESPONDENCE
Xia Zhu
zhuxia@fmmu.edu.cn

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Applying network analysis to understand the relationships between impulsivity and social media addiction and between impulsivity and problematic smartphone use

Zhihua Guo, Shuyi Liang, Lei Ren, Tianqi Yang, Rui Qiu, Yang He and Xia Zhu*

Department of Military Medical Psychology, Air Force Medical University, Xi'an, China

Background: Prior studies have revealed the relationships between impulsivity and social media addiction (SMA) and between impulsivity and problematic smartphone use (PSU) based on total scores on standardized self-report scales. However, there has been a lack of studies exploring how the dimensions of impulsivity and components of SMA or PSU are interrelated. The present study aimed to investigate the structural relationships between the dimensions of impulsivity and components of SMA and PSU and determine the critical bridge node using network analysis.

Methods: A total of 325 healthy adults aged 18–36 years participated in the study. SMA and PSU were assessed using the Bergen Social Media Addiction Scale (BSMAS) and Smartphone Application-Based Addiction Scale (SABAS), respectively. Impulsivity was measured by the Barratt Impulsiveness Scale Version 11 (BIS-11). Network analysis was used to construct an SMA-Impulsivity network and a PSU-Impulsivity network. Bridge centrality (bridge expected influence, BEI) was estimated to identify influential bridge nodes.

Results: In addition to relationships within each community, network analysis revealed that the dimensions of impulsivity were closely associated with the components of SMA and PSU. Particularly, I2 "motor impulsivity" had a relatively strong connection with SMA3 "mood modification" and SMA4 "relapse" in the SMA-Impulsivity network, and with PSU2 "conflict" and PSU5 "withdrawal" in the PSU-Impulsivity network. Moreover, I2 "motor impulsivity" was identified as the most critical bridge node in both networks.

Conclusion: These findings demonstrate potential pathways between different dimensions of impulsivity and the components of SMA and PSU, providing new evidence relevant to understanding the underlying mechanisms that account for how highly impulsive individuals develop

SMA and PSU, and highlight the critical bridge node—motor impulsivity—that may be a promising and effective target for the prevention and treatment of SMA and PSU.

KEYWORDS

social media addiction, problematic smartphone use, impulsivity, network analysis, bridge node

Introduction

The addictive use of social media has grown due to the exponentially increasing use of this new technology. Social media addiction (SMA) is defined as the compulsive use of social media and a maladaptive psychological dependency on social media to the extent that addictive-like symptoms and/or reduced self-regulation occur (1–3). Some researchers also use "problematic use" to distinguish such maladaptive social media use from clinically pathological conditions (4). However, in this study, we use the term "social media addiction" because it is most commonly used in the literature (3). It has been reported that approximately 70% of Americans have used any kind of social media (5). Prior studies have revealed that SMA affects about 12% of users from different online platforms (2, 6, 7). Appropriate use of social media can facilitate communication and simplify information dissemination. However, addictive-like use (i.e., SMA) is associated with poor psychological function (8), low life satisfaction (9), low self-esteem (10), loneliness and unhealthy social relationships (1, 11), feelings of depression and anxiety (12, 13), and impulsivity (1).

With the rapid development of science and technology, smartphones have gradually become an indispensable part of daily life. According to the 47th Statistical Report on Internet Development in China issued by the China Internet Network Information Center (CNNIC), it has been reported that 99.7% of Chinese netizens (986 million) use mobile phones to access the Internet as of December 2020 and that smartphones are still the dominant device for accessing the Internet (14). Although smartphones have many advantages and can greatly facilitate people's lives in a number of ways, such as surfing for information, communicating with others, and self-entertainment, there is growing evidence for the existence of a range of negative consequences and possible dangers associated with the problematic smartphone use (PSU) (15). PSU refers to undue attachment, a lack of self-control, and overuse when using a smartphone, which can often lead to negative consequences including physical and mental health problems (16). Both SMA and PSU are sometimes collectively referred to as Internet-related addiction (17, 18). Prior studies have shown that PSU has been linked to physical health problems, such as pain in the neck (19), head (20), and thumb (21). In addition, PSU is associated with anxiety and depression (22, 23), sleep disorders (24), loneliness (25), impulsivity (26–28), and many other psychological problems (29).

Impulsivity is variously defined as a preference for risky choices, lack of planning, the tendency to act prematurely, poor inhibition of initiated responses, and non-reflective selection of the immediately rewarding response (30–34). Accordingly, impulsivity is a multi-component rather than unitary construct (33–35). When extreme, impulsivity is an important personality trait associated with mental health problems (35). It is believed to be an important feature of destructive behavior and mental disorders such as addiction (36), paraphilias (37), personality disorders (38), and self-harm (39). Additionally, impulsivity often leads to many adverse results, including interpersonal and social problems such as aggression (40), juvenile delinquency and criminality (35), etc.

Importantly for this study, impulsivity potentially affects addictive behavior. Impulsive individuals often exhibit a lack of impulse control, which is a risk factor for different types of addictive behavior. At the same time, longitudinal studies show that there is a two-way relationship between impulsivity and addictive behavior (41). It has been shown that impulsivity is a robust predictor of substance use disorders (31, 42) as well as non-substance-related addictive disorders (43–45). As for the relationship between impulsivity and SMA, it has been reported that impulsivity is one of the most predictive factors of SMA and is tightly associated with SMA (46–52). A similar relationship exists between impulsivity and PSU. Prior studies have revealed that impulsivity plays an important role in PSU and is closely related to PSU (53–59). It is thus well established that impulsivity and Internet-related addiction (i.e., SMA and PSU) are closely interconnected; in particular, it is the case that impulsivity can develop, reinforce, and maintain the symptoms of SMA and PSU.

Prior studies have only examined the relationship between Internet-related addiction (PSU and SMA) and impulsivity using total scores on standardized instruments (46, 48, 52, 54, 57, 58). However, this common practice may obscure the specific relationships among individual symptoms and fail to reveal the interplay between the components of different scales on a fine-grained level (60, 61). In fact, impulsivity consists of three dimensions that involve different mechanisms.

The three dimensions include not focusing on the task at hand (inattention), acting on the spur of the moment (motor impulsiveness), and not planning and thinking carefully (lack of planning) (30, 62). Similarly, SMA and PSU are also composed of six core factors, corresponding one-to-one to six criteria of the addiction components model, namely salience (preoccupation with the behavior), tolerance (increasing engagement in the behavior over time), mood modification (mood changes brought about by the behavior), relapse (reversion to the behavior after a period of abstinence), withdrawal (negative feelings and physical symptoms when the behavior is blocked), and conflict (interpersonal and intrapersonal relationship problems because of the behavior) (63–65). In order to facilitate our understanding of the psychopathology behind impulsivity and Internet-related addiction (SMA and PSU) and determine effective therapeutic targets, it is first necessary to investigate the interplay between the specific dimensions of impulsivity and the components of PSU and SMA.

Network analysis is a promising way to satisfy this requirement. It is a novel data-driven approach to estimating and visualizing the complex interrelations and structures of individual symptoms (60, 66), or non-symptom factors that may contribute to the development and maintenance of disorders, such as biological variables, cognitive process, behaviors, and different personality traits (67, 68). In the network theory of psychopathology, the variables dynamically interact with each other and mutually reinforce to produce a complex network, thus causing psychiatric disorders (69, 70). In the network, the various variables (i.e., symptoms, cognitive processes, and traits) are regarded as nodes; the relations (e.g., partial correlations) between observed variables are represented by node-node interactions (defined as edges) (69, 71). This approach also makes it possible to identify bridge nodes, which are nodes that strongly connect two communities (71–73). The term "community" is used to represent variables grouped together on the basis of psychological theory (73). From the perspective of a psychopathological network, bridge nodes may be considered important intervention targets. In particular, targeting bridge nodes may disrupt the connection between comorbidities and reduce the adverse effects of one disorder on others (72–75). Network analysis has been widely used to analyze co-occurring constructs, including anxiety and depression (76), posttraumatic stress disorder (PTSD) and Internet gaming disorder (77), PTSD and positive emotion dysregulation (78), and executive function and disinhibited eating (72). However, to our knowledge, there has been a lack of research using network analysis to determine the relationships between the components of Internet-related addiction (SMA and PSU) and the dimensions of impulsivity.

In order to rectify this deficiency in previous studies, we examined the interactions between Internet-related addiction and impulsivity using a network approach. First, we constructed two networks to explore the links (i.e., edges) between PSU and impulsivity and between SMA and impulsivity, respectively. We then calculated the bridge expected influence (BEI) index for each node to determine the influential bridge variables in the two symptom networks. Given that impulsivity has been robustly associated with SMA and PSU (46–59), it was hypothesized that there would be cross-community edges in addition to within-community edges. We also hypothesized that there would be variables emerging as critical bridge nodes. The purpose of this study is to identify the complex links between Internet-related addiction and impulsivity in order to deepen our understanding of the psychopathology behind them, as well as to determine effective therapeutic targets to interrupt the co-occurrence of these psychological difficulties. Given that no published studies have utilized network analysis to investigate the fine-grained relations between components of Internet-related addiction and impulsivity, our study is innovative and mostly exploratory.

Materials and methods

Participants and procedure

A total of 325 healthy adults aged 18–36 years were recruited to participate in the study by using convenience sampling from 27 April 2022 to 16 May 2022. We chose relatively young adults because they are more willing to embrace new technology and are predisposed to Internet-related addiction (54). The present study used an online survey based on the Wenjuanxing program.[1] Participants gave their informed consent and were told they could withdraw from the study at any time. The anonymity of the study was emphasized to encourage honest responses in the first part of the survey. The study was reviewed and approved by the Tangdu Hospital Ethics Committee and abided by the Declaration of Helsinki.

Measurements

Bergen Social Media Addiction Scale

Social media addiction was evaluated using the Bergen Social Media Addiction Scale (BSMAS) (64). The revised Chinese version of the scale was used in this study (17). The scale is comprised of six items based on six core components of the addiction components model: salience, tolerance, mood modification, relapse, withdrawal, and conflict (63). For example, item "How often during the last year used social media to forget about personal problems?" represents the "mood modification" component. Each item is rated using a 5-point Likert type scale from 1 = *very rarely* to 5 = *very often*, and the higher the score in the BSMAS, the higher the risk of

1 www.wjx.cn

developing a SMA. The internal consistency of the BSMAS in this study was fairly good (α = 0.85).

Smartphone Application-Based Addiction Scale

The Smartphone Application-Based Addiction Scale (SABAS) was used to assess the likelihood of being at risk of developing an addiction to PSU (79). The Chinese version of this scale was used in this study (17). The scale consists of six items that are rated on a 6-point Likert type scale ranging from 1 = *strongly disagree* to 6 = *strongly agree*. A higher score indicates a higher risk of PSU. The six items were also developed based on the perspective of the six core criteria of the addiction components model (salience, conflict, mood modification, tolerance, withdrawal, and relapse) (63, 65). For example, item "Conflicts have arisen between me and my family (or friends) because of my smartphone use" represents the "conflict" component. The Cronbach's α coefficient for this scale was 0.83 in the current study.

Barratt Impulsiveness Scale Version 11

The Barratt Impulsiveness Scale Version 11 (BIS-11) is an effective self-report questionnaire employed to measure impulsivity. It consists of 30 items and is divided into three dimensions (each with 10 items): attentional impulsivity, motor impulsivity, and non-planning impulsivity (62). In the current study, we used the Chinese revised version of BIS-11 (80). Participants are asked to rate their frequency (1 = *Never,* 2 = *Rarely,* 3 = *Sometimes,* 4 = *Often,* and 5 = *Always*) for each item from motor impulsivity dimension on a 5-point Likert type scale. The dimensions of non-planning and attentional impulsivity are inverse scored items (5 = *Never,* 4 = *Rarely,* 3 = *Sometimes,* 2 = *Often,* and 1 = *Always*). The score for each dimension ranges from 0 to 100 after being converted, with higher scores indicating a higher level of impulsivity (80). The BIS-11 scale showed excellent reliability in our study (α = 0.91). Moreover, the internal consistencies of the attentional impulsivity dimension, motor impulsivity dimension, and non-planning impulsivity dimension were also fairly good (α = 0.89, 0.86, and 0.83, respectively).

Analytical procedure

We first used SPSS (version 26.0) to perform the descriptive statistics and calculate the Cronbach's α coefficient. We then utilized R (version 4.1.1) to perform network analysis.

The construction and visualization of the network structure were provided by the R-package *qgraph* (81). A Gaussian graphical model (GGM) was used to estimate the structure of the networks (82), including the SMA-Impulsivity network and the PSU-Impulsivity network. GGM is a type of undirected network with each edge representing the partial correlation between two nodes after statistically controlling to eliminate interference from all remaining nodes. We conducted the network structure estimation based on Spearman rho correlations (83). The GGM was estimated using the graphical least absolute shrinkage and selection operator (GLASSO) in combination with the extended Bayesian information criterion (EBIC) model selection (i.e., EBICglasso model). In detail, the GLASSO method was used to regularize the GGM (84). By shrinking all edges and pushing the trivially small partial correlation coefficients to zero, this regularization process helps to remove spurious edges and to obtain more stable and sparse networks (83, 84). To identify the optimal network model, the tuning parameter of the EBIC was set to 0.5 to balance the sensitivity and specificity of extracting true edges (83, 85). The visualization of the network layout was based on the Fruchterman-Reingold algorithm (86). Nodes with more and stronger connections with other nodes were placed closer together and more concentrated near the center of the network.

To identify bridge nodes connecting impulsivity and Internet-related addiction (SMA and PSU), we calculated the BEI using the R-package *networktools* (73). BEI is defined as the sum of the weights of all edges connecting a specific node with nodes in the other communities; BEI is especially suitable for networks with positive and negative edges, and a higher BEI value represents a higher impact on other communities (73). In our study, we pre-defined two communities in each network. We set the three impulsivity dimensions to constitute one community and the six components of SMA or PSU to form the other.

The robustness of the SMA-Impulsivity network and the PSU-Impulsivity network were evaluated using the R-package *bootnet* (86). The accuracy of the edge weights was first assessed by calculating the bootstrapped 95% confidence interval (with 1,000 bootstrap samples) for edges within the constructed networks. A narrower 95% confidence interval indicates a more reliable network (75). The stability of the node BEI was then estimated by calculating the correlation stability (CS) coefficient *via* a case-dropping bootstrap approach with 1,000 bootstrap samples. The CS coefficient was recommended to preferably be above 0.5 and never below 0.25 for enough stability (86). Finally, bootstrapped difference tests (with 1,000 bootstrap samples) were conducted for the edge weights and BEI.

Results

Descriptive statistics

The mean age of the participants was 21.49 ± 3.73 years (mean ± SD, range = 18–36 years). There were 147 males and 178 females in our sample. The average time the participants spent using a smartphone was 6.62 ± 3.59 h per day. Abbreviation, mean score, and standard deviation for each variable are shown in **Table 1**.

TABLE 1 Abbreviations, mean scores, and standard deviations for the study variables.

Variables	Abb	*M*	SD
Social media addiction			
Salience	SMA1	3.12	1.04
Tolerance	SMA2	3.01	1.10
Mood modification	SMA3	2.50	1.04
Relapse	SMA4	2.54	1.03
Withdrawal	SMA5	2.52	1.08
Conflict	SMA6	2.62	1.01
Problematic smartphone use			
Salience	PSU1	3.73	1.31
Conflict	PSU2	2.77	1.35
Mood modification	PSU3	3.79	1.29
Tolerance	PSU4	3.43	1.23
Withdrawal	PSU5	3.00	1.29
Relapse	PSU6	3.10	1.22
Impulsivity			
Non-planning impulsivity	I1	37.54	16.24
Motor impulsivity	I2	36.97	14.54
Attentional impulsivity	I3	37.46	12.72

Abb, abbreviation; *M*, mean; SD, standard deviation; SMA, social media addiction; PSU, problematic smartphone use.

Network analysis

The social media addiction-impulsivity network

Figure 1A shows the SMA-Impulsivity network using the EBICglasso model. There were 9 nodes and 24 non-zero edges in the network. This network showed some characteristics as described below. First, of the five strongest edges in the network, four were between SMA components, including edges between SMA1 "salience" and SMA2 "tolerance" (weight = 0.63), between SMA4 "relapse" and SMA6 "conflict" (weight = 0.29), between SMA3 "mood modification" and SMA4 "relapse" (weight = 0.25), and between SMA4 "relapse" and SMA5 "withdrawal" (weight = 0.24); the fifth edge, between I1 "non-planning impulsivity" and I3 "attentional impulsivity," had the strongest edge intensity (weight = 0.67). Second, some edges existed between impulsivity and SMA. I2 "motor impulsivity" showed more connecting edges with SMA. It was positively associated with five SMA components: SMA1 "salience" (weight = 0.02), SMA3 "mood modification" (weight = 0.12), SMA4 "relapse" (weight = 0.12), SMA5 "withdrawal" (weight = 0.04), and SMA6 "conflict" (weight = 0.01). Additionally, the edges between I2 "motor impulsivity" and SMA3 "mood modification" and between I2 "motor impulsivity" and SMA4 "relapse" had larger intensity than any other edges between SMA and impulsivity. Third, all edges were positive except the edges between SMA1 "salience" and I3 "attentional impulsivity" (weight = −0.02) and between SMA2 "tolerance" and I3 "attentional impulsivity" (weight = −0.04). Supplementary Table 1 shows all the edge weights within the SMA-Impulsivity network. The bootstrapped 95% confidence interval is narrow and indicates that the estimation of edge weights was relatively accurate and reliable (Supplementary Figure 1). The bootstrapped difference test for edge weights is shown in Supplementary Figure 2.

The BEI for each node within the SMA-Impulsivity network is shown in Figure 1B. Nodes I2 "motor impulsivity" (BEI = 0.31), SMA3 "mood modification" (BEI = 0.17), and SMA4 "relapse" (BEI = 0.12) all exhibited high BEI. Among them, I2 "motor impulsivity" was the most important bridge node. The CS coefficient of node BEI was 0.52, indicating that the estimations of node BEI had a good level of stability (see Supplementary Figure 3). Supplementary Figure 4 demonstrates the bootstrapped difference test for node BEI.

The problematic smartphone use-impulsivity network

The PSU-Impulsivity network is shown in Figure 2A. This network featured several important characteristics. First, of the five strongest edges in the network, four were between PSU components, namely the edges between PSU4 "tolerance" and PSU6 "relapse" (weight = 0.47), between PSU1 "salience" and PSU3 "mood modification" (weight = 0.34), between PSU5 "withdrawal" and PSU6 "relapse" (weight = 0.28), and between PSU3 "mood modification" and PSU4 "tolerance" (weight = 0.24); the fifth, strongest edge was between I1 "non-planning impulsivity" and I3 "attentional impulsivity" (weight = 0.66). Second, there were some connections between impulsivity and PSU. I2 "motor impulsivity" had more connections with PSU than I1 "non-planning impulsivity" and I3 "attentional impulsivity." I2 "motor impulsivity" was positively associated with four PSU components: PSU2 "conflict" (weight = 0.19), PSU4 "tolerance" (weight = 0.04), PSU5 "withdrawal" (weight = 0.1), and PSU6 "relapse" (weight = 0.09). In addition, the edges of I2 "motor impulsivity"-PSU2 "conflict" and I2 "motor impulsivity"-PSU5 "withdrawal" had larger intensity than any other edges between impulsivity and PSU. Third, all edges were positive except the edges between PSU3 "mood modification" and I3 "attentional impulsivity" (weight = −0.07) and between PSU1 "salience" and I3 "attentional impulsivity" (weight = −0.04). All edge weights within the PSU-Impulsivity network can be found in Supplementary Table 2. The bootstrapped 95% confidence interval indicates that the accuracy of edge weights was relatively reliable (see Supplementary Figure 5). Supplementary Figure 6 illustrates the bootstrapped difference test for edge weights.

The BEI for each node within the PSU-Impulsivity network is shown in Figure 2B. Nodes I2 "motor impulsivity" (BEI = 0.42), PSU2 "conflict" (BEI = 0.22), PSU5 "withdrawal" (BEI = 0.19), and PSU6 "relapse" (BEI = 0.15) all exhibited a high magnitude of BEI. I2 "motor impulsivity" was the most important bridge node among them. The CS

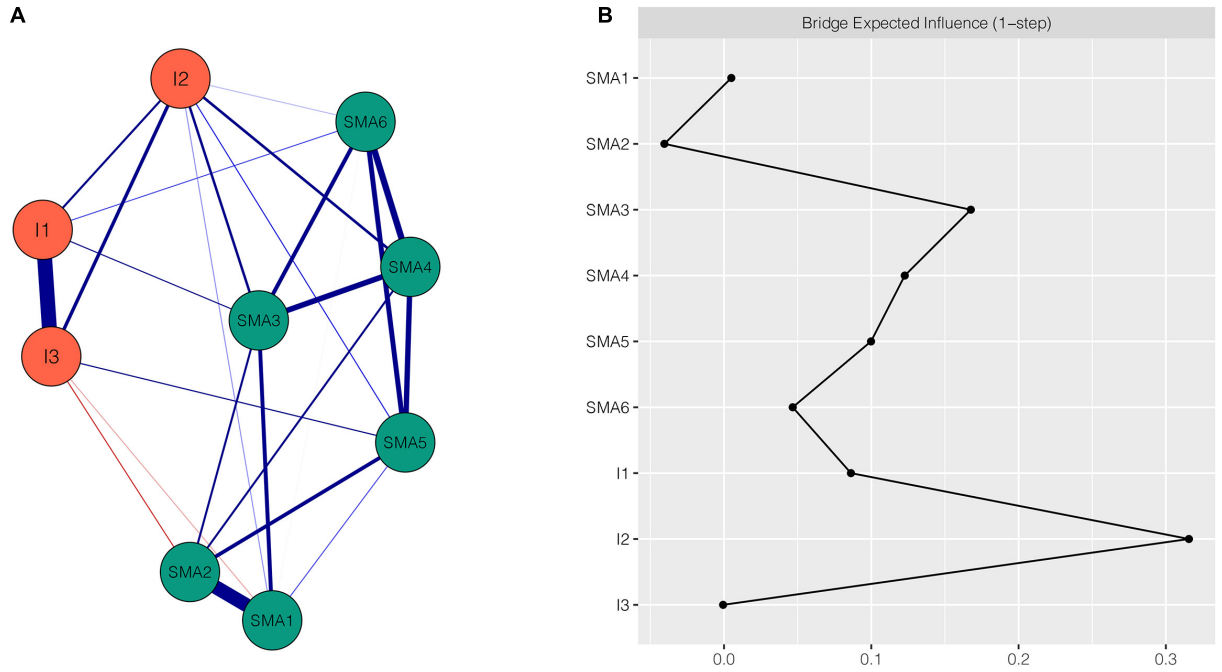

FIGURE 1
Network structure of SMA-Impulsivity variables. **(A)** EBICglasso network. Blue edges represent positive correlations, red edges represent negative correlations. A thicker edge reflects higher correlation between the nodes. **(B)** Centrality plot depicting the bridge expected influence of each node in the network (raw value). SMA1, salience; SMA2, tolerance; SMA3, mood modification; SMA4, relapse; SMA5, withdrawal; SMA6, conflict; I1, non-planning impulsivity; I2, motor impulsivity; I3, attentional impulsivity.

coefficient of node BEI was 0.67, indicating that the node bridge centrality estimations were adequately stable (see **Supplementary Figure 7**). **Supplementary Figure 8** shows the bootstrapped difference test for node BEI.

Discussion

Based on network analysis of the relationships between Internet-related addiction and impulsivity, the current study not only revealed the strongest edges within each community, but also showed that the dimensions of impulsivity were correlated with the components of SMA and PSU. Moreover, this study also identified the nodes with high BEI among the SMA-Impulsivity network and PSU-Impulsivity network. To the best of our knowledge, this is the first study to utilize network analysis to investigate the relationships between impulsivity and Internet-related addiction (i.e., SMA and PSU).

Through this network analysis, we observed that the five strongest edges existed within the impulsivity community and the SMA community in the SMA-Impulsivity network, rather than connecting the two communities. Similarly, five strongest edges were found within the impulsivity community and the PSU community in the PSU-Impulsivity network. It is reasonable to expect that the strongest edges will exist between the variables within each community rather than between different communities, because the variables of each community are sub-components of the scale. These findings are similar to those of a previous study that aimed to explore the relationships between PSU (assessed by SABAS) and the Behavioral Inhibition and Activation Systems (BIS/BAS, assessed by BIS/BAS scale) using network analysis, which also showed strongest edges between components within the PSU community and the BIS/BAS community (87). These results are similar to those of other studies that investigated the relations between different communities (i.e., scales); the strong edges appeared within each symptom community rather than connecting two communities (61, 88, 89). Moreover, the current study revealed a strong connection between "non-planning impulsivity" and "attentional impulsivity." Although previous studies have shown a positive correlation between "non-planning impulsivity" and "attentional impulsivity," and these are both regarded as components of cognitive impulsivity (90, 91), this finding has not been explored in previous network analysis studies and needs to be further investigated.

Consistent with our hypothesis that there would be cross-community edges in addition to within-community edges, the results of the current study showed connections between the dimensions of impulsivity and the components of both SMA

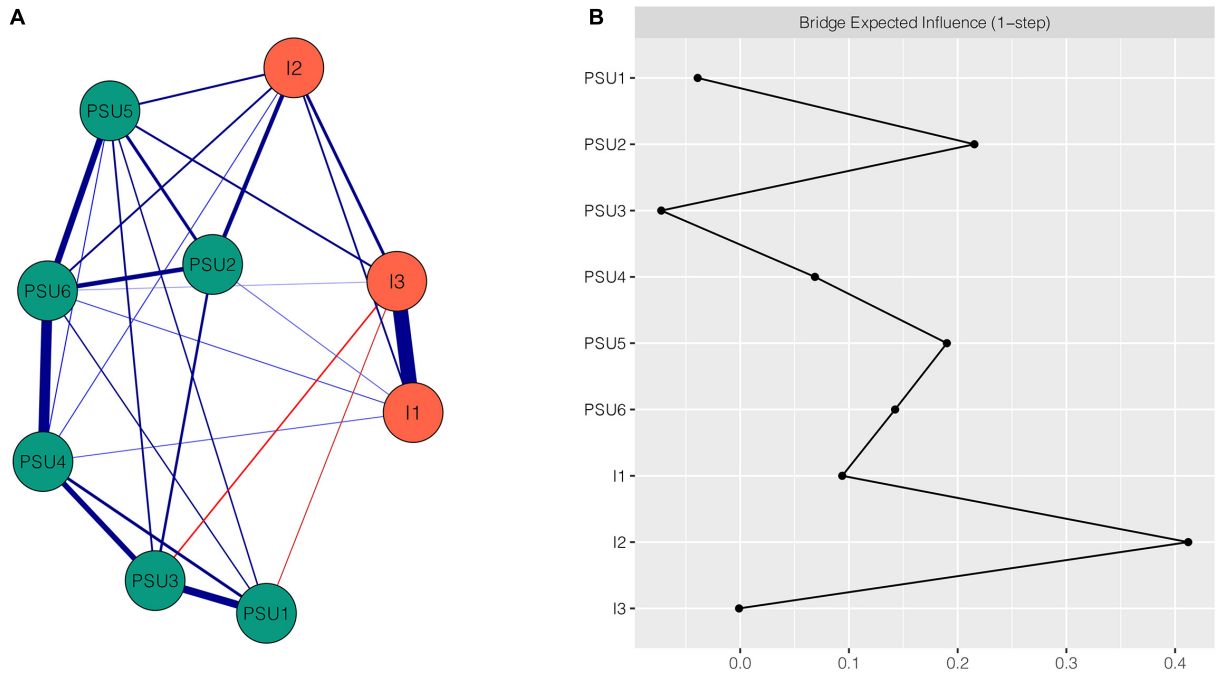

FIGURE 2
Network structure of PSU-Impulsivity variables. **(A)** EBICglasso network. Blue edges represent positive correlations, red edges represent negative correlations. A thicker edge reflects higher correlation between the nodes. **(B)** Centrality plot depicting the bridge expected influence of each node in the network (raw value). PSU1, salience; PSU2, conflict; PSU3, mood modification; PSU4, tolerance; PSU5, withdrawal; PSU6, relapse; I1, non-planning impulsivity; I2, motor impulsivity; I3, attentional impulsivity.

and PSU from a network perspective. These findings show that individuals with high impulsivity are likely to develop SMA and PSU. This is consistent with many previous studies that have shown that individuals with high trait impulsivity are prone to develop SMA and PSU (49, 50, 52–54, 92, 93). Regarding the specific dimension of impulsivity, the "motor impulsivity" dimension in impulsivity had more and stronger positive connections with components in both the SMA community and the PSU community than the other two dimensions; this explains the correlation between impulsivity and Internet-related addiction to a great extent. In detail, "motor impulsivity" showed strong and positive connections with "mood modification" and "relapse" in the SMA-Impulsivity network, while "motor impulsivity" had strong and positive connections with "conflict" and "withdrawal" in the PSU-Impulsivity network. These findings indicate that individuals with motor impulsivity are more inclined to develop some addictive components such as mood modification, relapse, conflict, and withdrawal. The connection between motor impulsivity and mood modification may result from the fact that impulse control difficulties contribute to maladaptive emotion regulation, which can lead to emotion dysregulation in response to negative life events (94, 95). As an individual's negative emotions such as depression and anxiety build up, eventually they can lead to them engaging in the virtual world provided by Internet-related technology to regulate their mood (i.e., mood modification) (63, 87). A potential explanation for the positive associations between motor impulsivity and conflict, withdrawal, and relapse may lie in the close relationship between motor impulsivity and response inhibition. Prior studies have shown that response inhibition is closely associated with motor impulsivity (96, 97). Response inhibition refers to the ability to inhibit inappropriate or irrelevant responses, or resist temptations and resist acting impulsively so as to make flexible and goal-directed behavioral responses (98, 99). Poor inhibition and failing to resist temptations may underlie the symptoms of withdrawal and relapse, and acting impulsively may lead to conflicts with family members and friends (87, 100–102).

However, this finding does not agree with a previous study that showed that the symptom severity of SMA is mainly associated with attentional impulsivity (49). There may be two potential reasons for this discrepancy. First, different measurement instruments were used for impulsivity and SMA. The previous research used the short version of the Barratt Impulsiveness Scale (BIS-15) to evaluate impulsivity and the short Internet Addiction Test modified for social-networking sites (sIAT-SNS) to assess SMA (49). In our study, BIS-11 and BSMAS were adopted. Because the different scales were based on different models, the inter-scale relationships were also

different. Second, from the methodological view, the current study utilized the network analysis method which estimates the edge strength of two nodes after considering other nodes (86), whereas the previous study used regression analyses (49). Consequently, the relationships between impulsivity and SMA in our study differ from those found in the previous study.

The bridge centrality results are consistent with our hypothesis that there would be variables emerging as critical bridge nodes. Bridge nodes can transcend the traditional psychological constructs of interest, connect theoretically independent constructs, and provide a new perspective on comorbidity (71, 73). In the current study, bridge nodes connecting dimensions of impulsivity and components of Internet-related addiction (i.e., SMA and PSU) were identified using BEI, and are crucial to understanding the development and maintenance of co-occurring psychological difficulties. They are also promising targets for prevention and intervention (70–72, 77, 88). In the SMA-Impulsivity network, the node "motor impulsivity" had the highest BEI. This indicates that "motor impulsivity" has stronger associations with components of SMA than other dimensions. Consequently, targeting the dimension "motor impulsivity" and inhibiting motor impulsivity can decrease the negative effects of motor impulsivity on SMA and thereby treat SMA. Additionally, this result implies that inhibiting motor impulsivity is a more effective way to reduce the symptoms of SMA than targeting other dimensions of impulsivity. A similar result was found in the PSU-Impulsivity network, so it is also recommended that motor impulsivity be targeted in the intervention and treatment of PSU. Coincidentally, some researchers have proposed that enhancing inhibition control could be an effective way to help decrease motor impulsivity, thereby mitigating the symptoms of SMA and PSU (2, 103). Certainly, the intervention effect of targeting motor impulsivity needs further investigation.

Although the current study provides a new perspective and fine-grained understanding of the relationships between impulsivity and SMA and between impulsivity and PSU, there are some limitations to consider. First, the study used cross-sectional data and only obtained a static network, which could not verify the dynamic changes and causality between the variables. Although the results demonstrated the important role of motor impulsivity in the prevention and treatment of SMA and PSU, we should verify the effect based on a longitudinal or experimental design in the future. Second, the results were based only on healthy young adults, and thus one should be cautious when extending the results to other age groups or clinical samples. Future studies should determine the adaptability of the results. Third, the network structure in this study was specific to the scales we used, and we utilized only BSMAS, SABAS, and BIS-11. This means that the current study did not capture all aspects of the relationships between impulsivity and SMA and between impulsivity and PSU. Consequently, it is recommended that future research analyze other aspects of the relationships between them. Fourth, using self-report data to assess both impulsivity dimensions and Internet-related addiction components is an additional limitation. Self-reports may be affected by subjective response biases, giving results that are different from the actual situation (89). This reminds us to interpret our results cautiously. Fifth, because many people may engage with social media using their smartphones, there may be an overlap between the social media use and the smartphone use. Although it did not impact the findings of this study, which investigated the fine-grained relationships between impulsivity and SMA and between impulsivity and PSU, the relationships between SMA and PSU may be worth exploring *via* network analysis in the future studies. Finally, the network structure constructed in this study was intended to examine between-subject effects on the group level, which means that the network structure may not be identical within a single individual.

Conclusion

The present study is the first to simultaneously explore the network structure between dimensions of impulsivity and components of SMA, and between dimensions of impulsivity and components of PSU. The results elucidated some potential pathways between different dimensions of impulsivity and components of SMA and PSU. Although the strongest connections were between nodes within each scale cluster, nodes of impulsivity had strong positive associations with some components in both SMA and PSU, especially for the node "motor impulsivity." This provides a fine-grained understanding of the psychopathological processes linking impulsivity and SMA, and linking impulsivity and PSU. Moreover, "motor impulsivity" was identified as the key bridge node which plays an important role in developing and maintaining SMA and PSU. This finding has important clinical implications, suggesting that motor impulsivity is a new and promising target to prevent or treat SMA and PSU.

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 Tangdu Hospital Ethics Committee. The

patients/participants provided their written informed consent to participate in this study.

Author contributions

ZG and XZ conceived the study. ZG, RQ, and YH performed the data collection. LR and TY performed data analysis. ZG and SL wrote the draft of the manuscript. XZ obtained funding and contributed to the manuscript revision. 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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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.993328/full#supplementary-material

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EDITED BY
Gallus Bischof,
University of Lübeck, Germany

REVIEWED BY
Hannah Schmidt,
University of Lübeck, Germany
Klaus Wölfling,
Johannes Gutenberg University Mainz, Germany

*CORRESPONDENCE
Rodrigo Menezes Machado
rodrigo.machado@hc.fm.usp.br

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Gender differences in psychiatric comorbidity and personality characteristics among adults seeking treatment for problematic internet use

Rodrigo Menezes Machado[1]*, Hyoun S. Kim[2], Vinicius Oliveira de Andrade[1], Lindsey A. Snaychuk[2], Carla Cavalheiro Moura[1], Cornelia Belliero Martini[1], Cristiano Ricardo Faedo Nabuco de Abreu[1], David C. Hodgins[3] and Hermano Tavares[1]

[1]Faculty of Medicine, University of São Paulo, São Paulo, Brazil, [2]Department of Psychology, Toronto Metropolitan University, Toronto, ON, Canada, [3]Department of Psychology, University of Calgary, Calgary, AB, Canada

In the present study, we investigated gender differences in personality and psychiatric correlates among adults (*N* = 115) seeking treatment for problematic internet use (PIU) at a specialized clinic in São Paulo, Brazil. All participants were assessed at the beginning of their treatment for co-occurring psychiatric conditions, other addictive behaviors, and personality characteristics. Women (*n* = 20) were more likely to present with greater rates of psychiatric comorbidity compared to men (*n* = *95*), including mood disorders, anxiety disorders, obsessive-compulsive disorder, post-traumatic stress disorder, and bulimia nervosa. Women also had a greater severity of certain behavioral addictions, such as compulsive buying and disordered eating. Gender differences were also found across personality characteristics, with women scoring higher on impulsivity, novelty seeking, and self-transcendence compared to men. To our knowledge, the present study is the first to investigate gender differences for PIU in a clinical sample. The results suggest that there are notable gender differences in individuals seeking treatment for PIU which underscores the importance of assessing for co-occurring conditions, especially in women. Understanding the characteristics associated with PIU can help serve to inform the most appropriate interventions to bolster treatment outcomes.

KEYWORDS

problematic internet use, internet addiction, behavioral addictions, gender differences, psychiatric comorbidity

Introduction

The internet, as we know it today, started in the early 1980s and has since become a worldwide phenomenon (1–3). Although the internet presents numerous uses and benefits, some people develop a problematic pattern of use that results in varying degrees of functional impairment, such as worsening academic performance, occupational losses, and lower quality of life (4). Historically, the term "Internet addiction disorder" appeared in the mid-1990s to describe a maladaptive pattern of internet use that shared characteristics present in behavioral addictions and substance use disorders (SUDs) (3, 5, 6). Despite advances in the conceptualization of this term, there is still no consensus regarding its diagnostic criteria, and internet addiction is not included in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) or the International Classification of Diseases (ICD-11). However, problematic internet use (PIU) can be classified in two ways in the ICD-11: The first is 6C5Y-Other specified disorders due to addictive behaviors or 6C5Z-Disorders due to addictive behaviors, unspecified. Divergences are also present when defining a nomenclature, and the terms "compulsive internet use," "problematic internet use (PIU)" and "internet addiction" have been used in the literature (7, 8). The term PIU (which we adopt in the present study) was designed to create a distinction in the classification of addiction until scientific evidence accumulated and there was a greater understanding of the disorder (9, 10).

Problematic internet use is characterized by "excessive or poorly controlled preoccupations, urges, or behaviors regarding computer use and internet access that leads to impairment or distress" (11). The Internet Addiction Test (IAT) developed by Young (4, 12) is one of the most frequently used instruments to identify PIU and has been shown to have strong psychometric properties (13). Based on the DSM-IV definitions of SUD and gambling disorder (GD), Young proposed the following criteria for "internet addiction": withdrawal, tolerance, preoccupation with being online again, more time than intended spent on the internet, significant risks in relationships and/or occupation, lying about internet use, and repeated and unsuccessful attempts to cut down and/or quit internet use (3, 12). A recent meta-analysis conducted by Pan et al. (14) found a prevalence rate of 7.02% (95% CI, 6.09–8.08%) in the general population suggesting that PIU is relatively common. Unfortunately, PIU is associated with negative impact on everyday functions, family relationships, and emotional stability (15, 16). In addition, PIU may be positively associated with incarceration, legal problems, and physical and mental impairments (17–19). Given the conceptualization of PIU as a behavioral addiction, it is not surprising that PIU frequently co-occurs with other psychiatric disorders, in line with previous findings of the high rates of comorbidity in gambling (18, 20). For example, previous research has found that PIU frequently co-occurs with anxiety disorders, mood disorders, addictions, and personality disorders (21–24) with almost 50% of individuals with PIU meeting criteria for another co-occurring disorder (22, 24).

Gender differences have also been found in PIU. For example, men are relatively more likely to develop generalized PIU than women, particularly in Asia, with less pronounced differences in Europe, North America, and Africa (25). Additionally, women tend to have a predilection for using social networking and online shopping, while men are more likely to use the internet for online gaming, gambling, and pornography (26, 27). In addition, although previous studies suggest that men tend to present with more severe PIU symptoms (28, 29), other studies do not find these gender differences (30) or have found that women reported greater symptoms of PIU severity (31). Gender differences have also been found in the pathways to PIU as well as in patterns of comorbidities (31, 32). In a large study of adolescents (n = 2,114), greater severity of PIU symptoms was associated with higher rates of ADHD and depression between the genders, however, higher rates of aggression were associated with increased PIU severity but only among men (33). With respect to social aspects, there seems to be a significant association between social anxiety disorder (SAD) and PIU, which is stronger for men than for women (34). Interestingly, in a large study of adolescents (35), depression significantly predicted the development of subsequent PIU in men only, suggesting that depression may be a causal factor of PIU in this population, perhaps as a maladaptive coping mechanism. Whereas, in female adolescents, PIU significantly predicted subsequent depression, suggesting important gender differences in PIU.

In summary, notable differences have been found between men and women with PIU. Unfortunately, most studies addressing PIU have used non-clinical populations with a considerably smaller number of investigations of clinical samples. Similarly, most studies investigating gender differences in PIU have done so in non-clinical samples. Indeed, to our knowledge, no study to date has examined gender differences in PIU among people who are seeking treatment for PIU. The lack of studies using clinical samples provides an incomplete understanding of PIU, given that people who seek treatment are different from those who do not (36). Given the existing literature gap addressing PIU with clinical samples, this study aimed to verify the potential associations between demographic variables, addictive behaviors and other psychiatric comorbidities, and gender differences in PIU patients who voluntarily sought treatment at a specialized healthcare service in São Paulo, Brazil.

Materials and methods

Participants and procedures

The study sample consisted of 115 individuals who voluntarily sought treatment for PIU at a specialized healthcare service in São Paulo, Brazil. Twenty participants self-identified as a woman and 95 self-identified as a man. This healthcare service is located at a university hospital that delivers treatment free of charge and is the largest specialized treatment center for impulse control disorders in Brazil. Patients can self-refer or be referred from other services within the hospital to seek treatment. All study participants were assessed at the beginning of their treatment. During the screening process, patients completed a Brazilian Portuguese version of the IAT (3, 13, 37). Patients whose scores indicated possible presence of PIU were assessed with an adapted version of the Structured Clinical Interview for DSM (ICD-SCID) with a registered psychiatrist to diagnose the presence of PIU. Following the treatment center protocol, the diagnosis of PIU was then confirmed by a licensed psychologist, who also collected additional clinical measures. The clinical measures included those relevant to the present research (addictive behaviors, personality) as well as other measures including social impairments, mental health (e.g., depression, anxiety, attention deficit, and binge eating) and measures of hostility and sexual impairment. A semi-structured (detailed below) was used to diagnosis mental health disorders.

The treatment protocol was adapted from Kimberly Young's Cognitive Behavioral Therapy – Internet Addiction (CBT-IA) (38) for use in Brazil (39). The CBT-IA was delivered in group format and consisted of 18 sessions and consisted of three treatment phases as per CBT-IA: Phase I: Behavior Modification, Phase II: Cognitive Restructuring, and Phase III: Harm Reduction. Additionally, some patients are provided with pharmacological treatments to treat co-occurring psychological disorders (e.g., depression and anxiety) when clinically appropriate.

All eligible patients were informed about participation in the research study and signed an informed consent to participate in the research. This study was approved by the Faculty of Medicine, University of São Paulo, Research Ethics Board (#12820813.5.0000.0068) and Toronto Metropolitan Universities Research Ethics Board (#2020-417).

Measures

Demographic information

A sociodemographic questionnaire used at the specialized healthcare center was used to collect standard demographic information, such as age, gender, ethnicity, and marital status. We also assessed for type of internet use behaviors that the patients rated as being problematic.

Addictive behaviors

The Brazilian Portuguese version of the Shorter PROMIS Questionnaire (SPQ) (38) was used to investigate 16 domains of addictive behaviors: use of alcohol, tobacco, recreational drugs, prescription drugs, gambling, sex, caffeine, food binging, food starving, exercise, shopping, work, relationships – dominant and submissive, and compulsive helping – dominant and submissive. In the present research we removed the relationship and compulsive helping subscales due to their lack of conceptual similarities to addictions. Each domain consists of 10 items anchored from 0 (not like me) to 5 (like me). Each subscale is summed into a continuous score from a minimum of 0 to a maximum of 50, with higher scores indicating greater severity of the related addictive behavior problem. Items assess behaviors and attitudes related to addictive behaviors and included: "I have often gone shopping to calm my nerves" and "I have tended to think of food not so much as a satisfier of hunger but as a reward for all the stress I endure." The SPQ validation study indicated that the alpha coefficients were acceptable with a mean alpha of 0.89 (40). The alpha from the present sample on the PROMIS ranged from 0.75 to 0.97.

Psychiatric comorbidities

Comorbid psychiatric disorders were assessed using the Mini-International Neuropsychiatric Interview (MINI) version validated for Brazilian Portuguese (41). The MINI is a brief, structured psychiatric interview that aims to evaluate mood and anxiety disorders, obsessive-compulsive disorder, post-traumatic stress disorder, psychosis, and SUDs. The MINI has shown strong psychometric properties when compared with those of other structured clinical interviews, such as the SCID. The MINI was validated for use in Brazil in primary centers, with kappa coefficients ranging between 0.65 and 0.85, sensitivity ranging from between 0.75 and 0.92, and specificity between 0.90 and 0.99 (41, 42).

Personality

The Brazilian Portuguese version of the Temperament and Character Inventory (TCI) (43) assessed seven dimensions of personality traits: four temperaments (reward dependence, novelty seeking, persistence, and harm avoidance) and three characters (cooperativeness, self-transcendence, and self-directedness). The Brazilian Portuguese version of the TCI has internal consistency similar to its original version, with Cronbach's alpha coefficients for all dimensions above 0.70 (44, 45). Example items on the TCI include: "I usually am confident that everything will go well, even in situations that worry most people" and "I often feel a strong spiritual or emotional connection with all the people around me." The TCI has been widely applied to assess the personality of individuals with

SUDs (46) and behavioral addictions (47). In the present study, the alpha coefficients for the TCI ranged from 0.74 to 0.90.

The Barratt Impulsiveness Scale – 11 adapted for Brazilian Portuguese (BIS-11) (48, 49) is composed of 30 items that measure different aspects of impulsivity (attentional, motor, and unplanned). It is anchored from 0 (rarely/never) to 4 (almost always/always), with higher scores indicating higher impulsivity levels. Example items on the BIS-11 include: "I plan tasks carefully" and "I buy things on impulse." The Brazilian Portuguese version of the TCI showed high correlation with the English version (r = 0.91–0.93) when tested on a bilingual sample of Brazilians in a community population with an alpha of 0.80 and test-retest reliability at 7 months of r = 0.72 (46). The Brazilian Portuguese version has been validated in several samples [e.g., adolescents (50)], and there is normative data for the general Brazilian population (51). In the present sample, the alphas ranged from 0.63 to 0.73.

Data analytic plan

First, we examined whether our continuous variables were normally distributed using the Kolmogorov–Smirnov test. Independent samples t-tests were used for normally distributed continuous variables and Mann–Whitney U tests were used for continuous variables not normally distributed. Chi-square tests were used for categorical variables. Fisher's exact tests were used when expected cell counts were less than five. For effect sizes, we calculated Cohen's d for t-tests, r for Mann–Whitney U tests and Cramer's V for Chi-square tests and Fisher's exact tests. Benjamini–Hochberg False Discovery Rate was applied to correct for multiple comparisons. Not all participants completed all the measures of interest. Little's MCAR test indicated that the data was missing completely at random χ^2 (571) = 0.507.62, p = 0.973, and thus list-wise deletion was used for missing data.

Results

Demographics

A Mann–Whitney U test did not reveal significant differences in the median ages between women (29.0) and men (25.0), U = 942.0, p = 0.486, r = −0.07. Similarly, there were no significant differences between women and men regarding ethnicity with 77.3% of women and 75.5% of men self-reporting being White, χ^2 (1) = 0.04, p = 0.848, Cramer's V = 0.02, or in marital status with 83.3% of women and 80.9% of men reporting being single, χ^2 (1) = 0.002, p = 0.965, Cramer's V = 0.004. Men (67.5%) were significantly more likely to report gaming as a problematic form of internet use compared to women (38.5%), χ^2 (1) = 4.07, p = 0.044, Cramer's V = 0.21. No other differences were found in regard to problematic forms of internet use: (i) information and search pages (42.5% men, 46.2% women), χ^2 (1) = 0.06, p = 0.805, Cramer's V = 0.03, (ii) email (16.3% men, 23.1% women), Fisher's exact test p = 0.691, Cramer's V = 0.06, and (iii) chat rooms/internet messaging services (33.8% men, 30.8% women), Fisher's exact test p = 1.00, Cramer's V = 0.02.

Addictive behaviors

The results of the Mann–Whitney U indicated that women had significantly higher median scores on shopping, food binging and food starving compared to men, which remained significant when correcting for multiple comparisons with moderate effect sizes. No differences in median scores were found between women and men in alcohol, tobacco, caffeine, recreational drugs, prescription drugs, gambling, sex, work, or exercise, ps > 0.093 (**Table 1**).

Psychiatric comorbidities

Women were significantly more likely to be diagnosed with current psychiatric comorbidities (**Table 2**). Specifically, women had higher rates of major depression, suicidality, social phobia, obsessive compulsive disorder, panic disorder, post-traumatic stress disorder, and bulimia nervosa. These results remained significant when correcting for multiple comparisons with moderate effect sizes. In contrast, no significant differences were found between genders regarding current diagnoses of agoraphobia, generalized anxiety disorder, alcohol dependence, or substance dependence ps > 0.141. No participant met diagnostic criteria for anorexia nervosa.

Personality

Women reported significantly higher scores on the BIS-motor, BIS total scores, novelty-seeking, and self-transcendence compared to men (**Table 3**). However, only BIS-motor and self-transcendence remained significant when correcting for multiple comparisons with moderate effect sizes. No differences were found regarding BIS-attention, BIS-non-planning, cooperativeness, self-directedness, reward dependence, persistence, or harm avoidance, ps > 0.065.

Discussion

The main objectives of this study were to examine gender differences in severity of PIU rates of psychiatric comorbidity, addictive behaviors, and personality characteristics among people seeking treatment for PIU. To our knowledge, the

10.3389/fpsyt.2022.1022749

TABLE 1 Comparison of addictive behaviors as measured by the Shorter PROMIS Questionnaire between women and men.

Addictive behaviors	Men (n = 72)		Women (n = 17)		U statistic	P	r
	Mean (SD)	Median	Mean (SD)	Median			
Alcohol	7.53 (8.75)	5.00	10.31 (13.76)	5.50	585.00	0.634	−0.05
Tobacco	3.67 (9.92)	0.00	6.31 (14.92)	0.00	577.50	0.797	−0.03
Caffeine	5.72 (7.18)	3.00	12.94 (17.59)	3.50	618.00	0.572	−0.06
Recreational drugs	4.99 (9.10)	0.00	4.76 (12.09)	0.00	573.00	0.647	−0.05
Prescription drugs	4.38 (8.25)	1.00	13.00 (15.73)	4.00	682.00	0.093	−0.18
Gambling	10.72 (11.78)	7.00	9.59 (14.18)	2.00	550.00	0.511	−0.07
Sex	8.82 (9.94)	5.00	8.12 (13.46)	2.00	479.50	0.187	−0.14
Work	13.70 (9.28)	12.00	20.44 (15.35)	18.50	714.50	0.108	−0.17
Exercise	10.71 (7.77)	9.00	12.88 (12.25)	11.50	587.00	0.764	−0.03
Shopping	11.25 (10.67)	7.00	25.06 (14.15)	28.50	893.00	**<0.001***	**−0.38**
Food binging	13.57 (11.03)	10.00	28.12 (15.29)	29.00	930.00	**<0.001***	**−0.38**
Food starving	6.69 (6.71)	5.00	17.29 (12.54)	18.00	934.00	**<0.001***	**−0.39**

Bold denotes significant differences. *Denotes significance when controlling for multiple comparisons.

TABLE 2 Comparison of current psychiatric comorbidities between women and men.

Psychiatric comorbidity	Men (n = 81)		Women (n = 13)		χ^2	P	Cramer's V
	n	%	n	%			
Major depressive disorder	35	43.2	11	84.6	7.69	**0.006***	**0.29**
Suicidality	25	30.9	9	69.2	7.14	**0.008***	**0.28**
Social anxiety	14	17.3	6	46.2		**0.029*^**	**0.24**
Agoraphobia	15	18.5	5	38.5		0.141^	0.17
OCD	12	14.8	6	46.2		**0.016*^**	**0.28**
Panic disorder	2	2.5	3	23.1		**0.018*^**	**0.32**
PTSD	0	0	3	23.1		**0.002*^**	**0.45**
GAD	30	37.0	6	46.2		0.552^	0.07
Alcohol dependence	4	4.9	2	15.4		0.192^	0.15
Substance dependence	7	8.6	1	7.7		1.00^	0.01
Bulimia nervosa	0	0	2	15.4		**0.018*^**	**0.37**

OCD, obsessive compulsive disorder; PTSD, post-traumatic stress disorder; GAD, generalized anxiety disorder. Bold denotes significant differences. ^Fisher's exact test was used as expected cell counts were less than 5. *Denotes significance when controlling for multiple comparisons.

present study is the first to examine gender differences in PIU in a clinical sample of people seeking treatment for PIU. The results of our study found no significant gender differences in the demographic profiles of the sample. Our study consisted of a higher proportion of men compared to women, which is in line with previous studies among non-clinical samples that find a higher preponderance of PIU among men (25, 28, 29). Additionally, we found gender differences in the type of internet use that was problematic with men reporting greater problematic use of internet gaming compared to women. Taken together, the results of our study corroborate findings with non-clinical samples regarding the difference between men and women in problematic patterns of internet use.

Overall, the rates of psychiatric comorbidity were high in our sample. For instance, nearly half of participants met the criteria for major depressive disorder. The high rates of psychiatric comorbidity in our sample could be linked to the distress associated with PIU, which may exacerbate or result in comorbid psychopathology. It is also possible that psychiatric conditions have a bidirectional relationship with PIU. For instance, excessive internet use in individuals with PIU may be a coping mechanism to alleviate distress associated with co-occurring psychopathology (9) as is seen in excessive gambling (52) and compulsive sexual behavior (53). On the other hand, PIU may lead to mental health difficulties given the interpersonal and personal harms that are associated with PIU (4). Future research that investigates the temporal relationship between PIU and

10.3389/fpsyt.2022.1022749

TABLE 3 Comparison of personality characteristics between women and men.

Personality variables	Men (n = 72)		Women (n = 17)		Test statistics	P	Effect size
	Mean (SD)	Median	Mean (SD)	Median			
BIS – attention	20.06 (4.46)	19.20	22.21 (4.14)	20.80	747.00[a]	0.079	−0.19[c]
BIS – motor	20.46 (4.95)	20.17	25.21 (6.75)	22.61	851.00[a]	**0.003***	**−0.32**[c]
BIS – non-planning	28.54 (5.60)	–	29.63 (5.64)	–	−0.70[b]	0.484	0.20[d]
BIS – total	69.56 (12.79)	68.75	76.88 (13.02)	73.13	711.00[a]	0.032	−0.23[c]
Cooperativeness	27.21 (6.35)	27.50	24.19 (6.22)	25.00	397.50[a]	0.095	−0.18[c]
Self-directedness	19.73 (7.29)	20.50	15.67 (7.21)	15.00	341.00[a]	0.061	−0.21[c]
Reward dependence	12.86 (4.42)	–	14.18 (4.33)	–	−1.09[b]	0.276	0.30[d]
Persistence	3.56 (2.01)	3.00	3.88 (1.90)	4.00	653.00[a]	0.530	−0.07[c]
Novelty seeking	20.77 (5.34)	–	24.13 (6.83)	–	−2.10[b]	0.038	0.59[d]
Harm avoidance	19.83 (6.25)	–	20.75 (7.82)	–	−0.50[b]	0.618	0.14[d]
Self-transcendence	14.29 (6.56)	13.00	22.00 (7.58)	23.50	808.00[a]	**<0.001***	**−0.38**[c]

BIS, Barratt Impulsiveness Scale. Bold denotes significant differences. *Denotes significance when controlling for multiple comparisons. [a]Mann–Whitney U test; [b]t-test; [c]r; [d]Cohen's d.

psychiatric comorbidities would be highly informative and aid in development prevention and treatment initiatives for PIU and associated psychopathologies.

In terms of gender differences in rates of psychiatric comorbidity, women were more likely to meet the criteria for major depressive disorder, suicidality, anxiety disorders, OCD, PTSD, and bulimia nervosa. In many cases, the rate was at least double in women compared to men. Women were also more likely to score higher on addictive behaviors including shopping and disordered eating, which is consistent with previous research on behavioral addictions (54). Taken together, these results may suggest that women with PIU present with greater clinical complexities and that the higher levels of distress and functional impairment, caused by excessive use of the internet or comorbid psychopathology, may be a particularly important factor in seeking treatment for PIU. Future research that examines the importance of addressing the comorbid psychopathology in treatment outcomes for PIU would be highly informative.

Finally, gender was associated with several personality characteristics in the current study. For example, women tended to score higher on impulsivity than men, particularity on motor impulsiveness. Though scores on impulsivity measures tend to be relatively similar across genders in the general population (55), some research suggests that women may score higher in populations with addictive and/or impulse control disorders (56), which is in line with the results of the present research. Further, women in the sample scored higher on self-transcendence than men, which tends to be stable between genders in cross-national research (57). Self-transcendence contains elements of spirituality and identification with the universe and has been associated with increased psychopathology including behavioral addictions such as gambling (58) and mood disorders (59). Thus, the higher self-transcendence in our sample of women seeking treatment for PIU may partially help to explain the higher rates of psychopathology in women.

The results from the present study not only contribute to the limited body of literature on PIU, but they also have important implications on its assessment and treatment. Although men are more likely to seek treatment for PIU, women who present with PIU are likely to present with greater clinical complexities. Indeed, women are more likely to report greater rates of psychopathology. As such, clinicians should be diligent about screening for a wide variety of disorders known to be linked to PIU, especially among women. Further, interventions should be individualized and aim to target co-occurring conditions where possible to optimize treatment outcomes. Specifically, transdiagnostic treatment options tend to yield more favorable outcomes (60, 61) and may be a good option to target both PIU and co-occurring psychological processes. Additionally, given the findings of greater psychiatric co-morbidities of women (and in the sample generally), an integrated treatment approach that targets both PIU and co-occurring mental health disorders may be of particular benefit. This approach would involve the treatment of PIU and co-occurring psychiatric disorders occurring simultaneously, and by the same team of practitioners (62). Previous studies have found integrated treatment options to lead to superior clinical outcomes and are more cost effective than non-integrated treatments (63).

Limitations

A limitation of the present research is the relatively small sample size overall and in particular the small sample of women.

Although correcting for multiple comparisons and the moderate effect sizes may provide some confidence in our findings, future research should include a more representative sample of women and other gender identities. Furthermore, although there were no significant differences in age between men and women, future studies that use an age matched design between men and women with PIU would be informative. A third limitation of the present research is that not all participants completed all measures of our interest. However, we conducted missing data analysis, which indicated that the data was completely missing at random. Though a strength of this study is its use of a clinical population to fill a gap in the existent literature, this could also be considered a limitation given that participants were all seeking treatment for their PIU and therefore are not likely representative of the general population. For example, the greater problem severity in the women in our sample may reflect that these women are more reluctant than men to seek addiction treatment and only do so when greatly impaired. They may, in contrast, be seeking treatment for comorbid conditions such as depression or anxiety. Fifth, we used a self-report measure of personality rather than an in-depth diagnostic tool. Lastly, given the exploratory nature of this study, the results presented here should considered preliminary evidence for future investigation of potential gender differences in PIU, particular among clinical samples. Specifically, future studies that examine more focused dimensions of psychopathology and personality would be beneficial.

Conclusion

Our results ultimately suggest that there are notable gender differences in PIU severity and associated psychiatric and personality factors, with women presenting with greater PIU severity and increased psychiatric comorbidity. These findings may have implications on the clinical assessment and treatment of PIU in the future. Future research should seek to further investigate the nature and course of PIU in clinical populations to ensure timely prevention, identification, and treatment, especially amongst women.

Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors pending approval from the authors' Research Ethics Board.

Ethics statement

The studies involving human participants were reviewed and approved by the Faculty of Medicine, University of São Paulo's Research Ethics Board and Ryerson's Universities Research Ethics Board. The patients/participants provided their written informed consent to participate in this study.

Author contributions

RM, HK, VO, and LS wrote the first draft of the manuscript. HK conducted the formal analyses. HT provided supervision and resources. LS and DH substantially edited the manuscript. All authors contributed to the conceptualization of the research 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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EDITED BY
Hyoun S. Kim,
Ryerson University, Canada

REVIEWED BY
Vanessa Montemarano,
Ryerson University, Canada
Gustavo Medeiros,
Johns Hopkins Medicine, United States

*CORRESPONDENCE
Octavian Vasiliu
octavvasiliu@yahoo.com

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Therapeutic management of buying/shopping disorder: A systematic literature review and evidence-based recommendations

Octavian Vasiliu*

Department of Psychiatry, Dr. Carol Davila University Emergency Central Military Hospital, Bucharest, Romania

The prevalence of buying/shopping disorder (B/SD) has been increasing in the last two decades, and this disorder has a substantial negative impact on general functioning and quality of life. Therefore, a systematic review of the studies dedicated to the efficacy and tolerability of therapeutic interventions, both psychological and pharmacological, might help clinicians to decide on the most evidence-based treatment for these patients. In order to further increase the clinical usefulness of the current review, GRADE-based recommendations were formulated, where enough evidence was found to support such an approach. A number of five electronic databases were searched for single case reports, case series, open-label and double-blind, placebo/active intervention-controlled trials, but other secondary reports (i.e., systematic reviews and meta-analyses) were also included in this analysis. Studies with unspecified designs or those that do not report either qualitatively or quantitively the evolution of B/SD core manifestations were excluded. All data included in the secondary analysis were evaluated using the Joanna Briggs Institute critical appraisal checklists. A total number of 24 manuscripts (i.e., 12 clinical trials, eight case reports, and four reviews) were included. Most of the reviewed studies were of moderate quality, representing a certain limitation of this review and preventing the formulation of high-validity recommendations. Psychotherapy, especially cognitive behavioral therapy (CBT) seems to be the main intervention supported by the current evidence, followed by the combination of antidepressants and CBT, and serotoninergic antidepressants as monotherapy. There is an obvious need to further develop good-quality trials with a more significant number of participants with B/SD and longer follow-up periods.

KEYWORDS

compulsive buying, shopping addiction, behavioral addictions, psychotherapy, antidepressants, mood stabilizers, atypical antipsychotics

Introduction

"Compulsive shopping/buying" (CS/CB), also known as "buying/shopping dependence/addiction," "pathological buying," or "oniomania" represents a behavioral addiction defined by excessive financial investments (either online or in the real world), which cause distress or significant dysfunctions to the patients (1, 2).

While some authors consider CS/CB an addiction, others include this condition in the "impulse-control disorders" category or within the obsessive-compulsive disorders (OCD) spectrum (Figure 1) (1–3). For the objectives of this review, the term "buying/shopping disorder" (B/SD) will be used in order to avoid insufficiently proven categorizations and to highlight that reviewed therapies are dedicated to patients with significant impairments due to their behaviors, not to the shoppers who may occasionally overbuy and later regret their investments. This terminology is far from being redundant because of the continuum model several authors suggested, a model that states the difference between normality and pathology is based on the frequency and intensity of the problematic behavior and on its various dysfunctional consequences (e.g., professional, social, academic, legal, financial) (4). Also, the DSM-5 uses the same terminology, i.e., "gambling disorder" and "Internet gaming disorder" for other pathologies with intricate, addictive, compulsive, and impulsive mechanisms (5).

B/SD may be conceptualized as a behavioral addiction (BA) due to the shared core manifestations between this pathology and substance use disorders (SUDs), and also based on the presumed common hyperstimulation of the dopamine reward system (6). The overvaluation of the shopping process/objects purchased was considered similar to the high importance attributed to the drugs by patients with SUD. Also, impulsivity and lack of inhibition during drug use or shopping are shared features of these two disorders (6). This rationale is similar to other BAs, e.g., food addiction, physical exercise addiction, Internet addiction, etc. (7). Cultural factors might contribute to the pathogenesis of B/SD because it has been reported mainly in developed countries (3), but this could be a bias due to the higher income and increased accessibility to the products when compared to low and medium-income countries. According to the tenth version of the International Classification of Mental Disorders (ICD-10), B/SD may be considered an "impulse control disorder, not otherwise specified" because of the repeated acts of buying without a well-defined motivation, lack of control over these behaviors, and the presence of functional negative consequences (8). There is no mention of the B/SD in the last edition of the same classification (9).

Diagnostic criteria for B/SD have been created (10), with the accent being placed upon irresistible impulses and frequent preoccupation with buying, but also on discomfort, and time-consuming or negative financial and social consequences, in the absence of mania or hypomania. Also, a type of "co-dependent buyer" has been described in the literature, and this term is reserved for those who are driven by the desire to purchase items for other individuals based on their wish to obtain approval, to be validated emotionally, or to avoid rejection (11).

B/SD has been diagnosed as a comorbidity in patients who have SUDs, mood disorders, personality disorders, or obsessive-compulsive spectrum disorders (OCSD) (1). Compulsive hoarding, anxiety disorders, and various other impulse control disorders may also be diagnosed in patients with B/SD (12). This pathology has been associated with a high prevalence of suicidal ideation, reaching 18.4% in a study that included 4,404 patients with different behavioral addictions (out of which 158 presented B/SD) (13). Suicide attempts were detected in 7.6% of the B/SD patients, and female gender, lack of family support, and unemployment were associated with the greater risk for suicide (13). According to a case series ($N = 20$ patients) that used structured evaluation for patients with problematic buying behavior, 95% had lifetime diagnoses of major mood disorders, 80% associated anxiety disorders, 40% presented impulse control disorders, and 35% also suffered from eating disorders (14). Also, it was observed that first-degree relatives presented a high prevalence of mood disorders (14).

The prevalence of B/SD in the United States was estimated to be 5%, and the most vulnerable individuals to B/SD onset were adolescents and young adults (1). Women are dominant in this group, with a proportion reaching 80% in clinical samples (10). Some authors consider this difference artificial, based on research that women are more open to admitting their pathological behavior (15). A meta-analysis with 49 articles included focused on the prevalence of CS in 16 countries ($N = 32,000$) and reported a 4.9% pooled prevalence in adults, with higher rates in university students (up to 11.5%) (16). The prevalence of CS in shopping-specific populations (e.g., individuals shopping in supermarkets or malls) had a value of up to 27.8% (16). European surveys reported an increase in B/SD in the adult population over the last two decades, indicating the necessity to develop adequate strategies for early detection and treatment (17).

Several instruments have been created for the structured evaluation of the B/SD, e.g., the Compulsive Buying Scale (CBS), Yale-Brown Obsessive-Compulsive Scale-Shopping version (YBOCS-SV), Pathological Buying Screener (PBS), and Compulsive Buying Follow-up Scale (CBFS) (18–22). CBS includes seven items representing activities, motivations, and feelings associated with buying, and a score $\leq$-1.34 indicates a possible compulsive nature of this behavior (18). Another version of the CBS included 29 items, distributed on five factors ("tendency to spend," "compulsion/drive to spend," "feelings about shopping and spending," "dysfunctional spending," and "post-purchase guilt"), and allows the classification of individuals across a compulsive buying spectrum- from

Behavioral addiction	Overvaluation of the bought products
	Craving for buying
	Possible tolerance, represented by increased time and money invested in the buying-related activities
	Functional negative consequences of the addictive behavior
	Continuous engagement in the behavior, although there is an insight into its negative functional consequences
	Spending much time in this activity than initially intended
	Positive feelings may accompany in the first stage the addictive behavior
Obsessive-compulsive spectrum disorder	Recurrent thoughts about buying different, unneccessary products
	The engagement in the buying activities may be compulsions, because they decrease the anxiety induced by obsessions
	The manifestations are egodystonic, but may become egosyntonic,m due to variable insight
Impulse control disorder	Impulsive or compulsive buying
	There is an inner pression to engage in this behavior
	The focus of attention is represented by unneccessary products
	After the shopping episode, the inner tension decreases

FIGURE 1
Compulsive shopping disorder—clinical hypotheses.

normal, recreational, or borderline, to compulsive, or addictive shopping patients (19). YBOCS-SV was designed to evaluate the cognitions and behaviors related to compulsive buying, instead of assessing obsessions and compulsion, as in the original YBOCS, and it includes 10 items, with a total score interval between 0 and 40 (20). PBS has 20 items, but another, 13-item version with two factors ("loss of control/consequences" and "excessive buying behavior"), has also been created (21). CBFS is a self-administered instrument with six self-reported items that evaluate aspects of CS in the last 4 weeks, and it proved a strong sensitivity to change and recovery, with a cut-off score of 22 (22).

Regarding the pathogenesis, elevated impulsivity due to poor response inhibition was found to play an important role in experimental conditions, assessed by patients themselves or investigators, both in CS and in pathological gambling (PG) vs. healthy controls (2). Another trial ($N = 103$ patients with B/SD) supported a closer relationship between B/SD and BA than between B/SD and obsessive-compulsive symptoms, based on two delayed discounting tasks as markers of behavioral impulsivity (23). Mental disengagement could significantly predict vulnerability toward B/SD, according to a study based on an online questionnaire ($N = 189$ participants), which evaluated the main coping mechanisms used by these patients (24). Denial and substance use were also dysfunctional coping methods with predictive value for B/SD onset (24). A poorly developed, ambivalent, or contradictory self-image may create a vulnerable terrain for dysfunctional object attachment behaviors that may predict the B/SD onset (25). This disorder may be considered a chronic and repetitive failure in self-regulation, with cognitive, affective, and behavioral factors involved in different phases of the pathogenesis (26). Although these observations may have a significant impact on the therapy, there are many confounding factors that may limit their relevance for B/SD patients (e.g., research in laboratory settings vs. real-life conditions, lack of control for significant variables in the case of online questionnaires, or absence of culturally-defined variables that may contribute to the onset of B/SD in the explored studies). However, it is expected that the analysis of these outcomes (e.g., dysfunctional coping mechanisms, self-image distortions, and behavioral impulsivity) could be useful from the perspective of finding the most evidence-based therapies for patients with B/SD.

The neurobiological dimensions of B/SD have been hypothesized to involve serotoninergic, dopaminergic, and opioidergic neurotransmission, similar to other behavioral addictions, OCD, and substance use disorders (10). Based on these presumed mechanisms, the potential benefits of psychopharmacological agents (i.e., selective serotonin reuptake inhibitors-SSRIs, serotonin and norepinephrine reuptake inhibitors—SNRIs, opioid receptors antagonists—ORAs, or mood stabilizers) have been inferred. However, studies exploring the direct correlations between specific neurotransmitters or neuroanatomic pathways and the onset of B/SD are still lacking.

A genetic component of B/SD has been suggested, even if the available data support more of a vulnerability toward psychiatric

disorders in first-degree relatives of B/SD patients than a specific tendency for CS (10). For example, CS/CB has been reported more frequently in descendants of individuals presenting with depression or substance use disorders (10).

In conclusion, the necessity of investigating the available treatments for B/SD is derived from multiple factors: the use of excessive buying as a way to cope with stress or isolation (27); negative functional consequences and risk of a chronic course (28); and the relatively high and increasing prevalence of problematic buying in the general population (1, 16). The need to assess the efficacy of psychotherapeutic, pharmacological and combined therapies in BAs or SUDs is also motivated by the high societal and personal costs associated with healthcare in B/SD, high risk of psychiatric or somatic comorbidity, and lower quality of life (29).

Objectives

The main objective was to review the available data regarding the efficacy and tolerability of therapeutic interventions in the treatment of B/SD.

The second objective was to assess the validity of evidence-based recommendations, according to the GRADE system (30), for the therapeutic management of B/SD.

Methodology

A systematic review was conducted in order to find the effects of therapeutic interventions dedicated to adult patients with B/SD. Primary and secondary reports, i.e., clinical reports, clinical and epidemiological studies, and reviews, were included in the analysis. The data extraction was guided by the PRISMA 2020 statements (31–33), and the corresponding steps are represented in Table 1. No automation tool was used in the process of data extraction.

Design and research strategy

Five electronic databases (PubMed, PsychInfo, Cochrane, EMBASE, Clarivate/Web of Science) were included in the primary search. Also, the register of clinical trials run by the US National Library of Medicine (NLM) (www.clinicaltrials.gov) was explored for potential data regarding clinical trials dedicated to this topic. Also, websites and organizational websites dedicated to patients with B/SD were included in the sources exploration, and citation searching was also allowed.

The search paradigm used was "compulsive buying" OR "buying addiction" OR "shopping addiction" OR "shopping/buying dependence" AND "psychotherapy" OR "pharmacotherapy" OR "antidepressants" OR "mood stabilizers" OR "opioid antagonists" OR "medication". All papers published between January 1990 and July 2022 were included in the primary search.

Inclusion and exclusion criteria

Based on the SPIDER criteria (34), the retrieved sources were evaluated to see if they may be considered suitable for review (Table 2). The main sets of criteria referred to the characteristics of the sample, type of intervention, design of the research, methods of outcomes evaluation, and type of study (34).

Study quality assessment

The quality of trials, case reports, and systematic reviews included in this analysis was assessed according to the Joanna Briggs Institute (JBI) critical appraisal checklists (57). These criteria were preferred because primary and secondary reports were allowed to enter the reviewing stage, and both qualitative and quantitative data were expected to result from the primary search. According to the JBI checklists, the sources may be included, excluded, or seeking further information is recommended (35, 36).

Formulation of the therapeutic recommendations

The GRADE criteria for assessing the strength of recommendations based on the found evidence were applied to the final conclusions (31–33).

Results

Out of the initial 861 papers collected through the primary search, only 24 reached the final stage of selection (Figure 2). Eight case reports, 12 clinical studies, and four systematic reviews/meta-analyses were reviewed in detail, and the results are presented in Table 3. JBI Critical Appraisal Checklists for Case Reports, Randomized Studies, Quasi-experimental design studies, and Systematic Reviews were used in order to evaluate the quality of the research (35, 36).

Case studies

A case study with a cross-over design that compared *cognitive-behavioral therapy* (CBT) and *person-centered experiential therapy* (PCE) in a 40-year-old B/SD patient found beneficial results for both interventions (37). These favorable effects were detected on ideographic (i.e., amount

TABLE 1 PRISMA 2020 checklist (31).

Section and topic	Item #	Checklist item	The location where the item is reported
Title			
Title	1	Identify the report as a systematic review.	Line 1
Abstract			
Abstract	2	See the PRISMA 2020 for the Abstracts checklist.	Lines 14–32
Introduction			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Lines 133–141
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Lines 144–147
Methods			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Table 2, lines 173–176
Information sources	6	Specify all databases, registers, websites, organizations, reference lists, and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Lines 163–167
Search strategy	7	Present the full search strategies for all databases, registers, and websites, including any filters and limits used.	Lines 167–170
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and, if applicable, details of automation tools used in the process.	Lines 160–161
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and, if applicable, details of automation tools used in the process.	Only one reviewer
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g., for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Table 2
	10b	List and define all other variables for which data were sought (e.g., participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Table 2
Study risk of bias assessment	11	Specify the methods used to assess the risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Lines 182–187
Effect measures	12	Specify for each outcome the effect measure(s) (e.g., risk ratio, mean difference) used in the synthesis or presentation of results.	N/A
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis [e.g., tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)].	N/A
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling missing summary statistics or data conversions.	N/A
	13c	Describe any methods used to tabulate or visually display the results of individual studies and syntheses.	Table 3
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	N/A

(Continued)

TABLE 1 (Continued)

Section and topic	Item #	Checklist item	The location where the item is reported
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g., subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess the risk of bias due to missing results in a synthesis (arising from reporting biases).	Table 4, lines 182–187
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Table 4, lines 182–187
Results			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 2
	16b	Cite studies that might appear to meet the inclusion criteria but which were excluded, and explain why they were excluded.	Figure 2
Study characteristics	17	Cite each included study and present its characteristics.	Table 3
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Table 4
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g., confidence/credible interval), ideally using structured tables or plots.	Table 3
Results of syntheses	20a	For each synthesis, briefly summarize the characteristics and risk of bias among contributing studies.	Lines 238–253, 309–315, and 339–345
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g., confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Table 4
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Table 4
Discussion			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Lines 361–369
	23b	Discuss any limitations of the evidence included in the review.	Lines 373–382
	23c	Discuss any limitations of the review processes used.	Lines 373–382
	23d	Discuss the implications of the results for practice, policy, and future research.	Lines 383–389 and 395–398
Other information			
Registration and protocol	24a	Provide registration information for the review, including the register name and registration number, or state that the review was not registered.	N/A

(Continued)

TABLE 1 (Continued)

Section and topic	Item #	Checklist item	The location where the item is reported
	24b	Indicate where the review protocol can be accessed or state that a protocol was not prepared.	Lines 409–410
	24c	Describe and explain any amendments to the information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review and the role of the funders or sponsors in the review.	Line 406
Competing interests	26	Declare any competing interests of review authors.	Lines 402–403
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

TABLE 2 SPIDER algorithm for systematic reviews.

Dimension	Inclusion criteria	Exclusion criteria
Sample	Patients ≥18 years old were included.	Unspecified demographic parameters of the study population (clinical research).
	Patients were currently receiving at least one active intervention and/or placebo.	Lack of specifics about the therapeutic intervention administered.
	The presence of compulsive buying was defined as one of the main diagnoses in the explored population.	Insufficiently specified psychiatric diagnoses for clinical populations and/or compulsive buying was not specified as one of the main diagnoses in the recruited individuals.
Phenomenon of interest	The effects of short- or long-term psychotherapeutic or pharmacological intervention. Combined, psychotherapy and pharmacologic treatment was allowed.	Other interventions or not well-defined therapeutic strategies.
Design	Clinical trials, prospective or retrospective, randomized or not, controlled or not, single/double-blinded or unblinded.	Lack of well-defined design of the research.
	Case reports, systematic reviews, and meta-analyses.	Epidemiological studies. Research with different objectives (i.e., not including changes in compulsive buying or associated consequences) or contained poorly defined outcomes.
Evaluation	Efficacy and tolerability of therapeutic interventions explored population.	Lack of pre-defined measurements for the research's outcomes.
	Structured instruments administered by specialists and subjective reports.	Qualitative research, if they did not present clear references to the main objective of the review.
Research type	Qualitative and quantitative methods	Imprecise or loosely methodology of research.

of money spent daily, time invested in B/SD, time spent on talking about buying, and B/SD-related cognitions and emotions) and nomothetic (i.e., scores on CBS, Compulsive Acquisition Scale, Beck Depression Inventory-II, Inventory of Interpersonal Problems-32, and Brief Symptom Inventory) outcomes related to B/SD severity, with no relapse over the follow-up period (99 days) (37). Another single-case report supports the therapeutic effect of *the fluvoxamine and CBT combination* in a female patient with B/SD during 52 weeks of unstructured monitoring, but no information about the duration of the psychotherapy or the antidepressant treatment was provided in this report (38). The same authors reported positive effects of *the fluvoxamine* (up to 150 and 200 mg daily, respectively) *and psychodynamically-oriented psychotherapy*

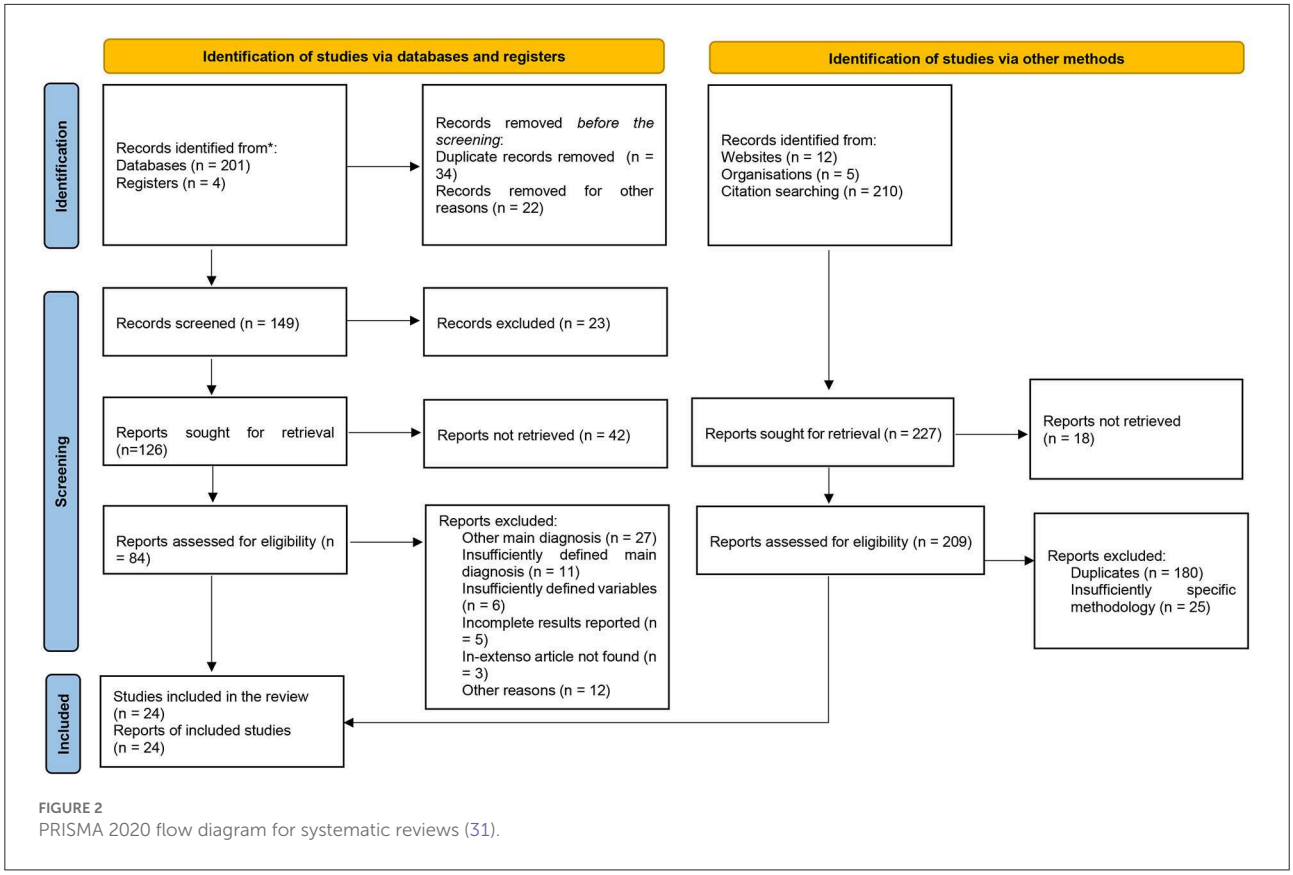

FIGURE 2
PRISMA 2020 flow diagram for systematic reviews (31).

(weekly sessions) in two female patients with B/SD and binge eating disorder (BED) after 3 weeks of combined treatment (39). No systematic methods were used to assess B/SD, but craving for buying and compulsive acts (e.g., shopping for large quantities of food, designer clothes or jewelry, acquiring antique objects, and compulsive eating) decreased based on patient self-report and clinician's observation (39).

Topiramate was explored as a potential treatment for B/SD in a 37-year-old female diagnosed with persistent B/SD and depression who was non-responsive to fluoxetine and venlafaxine. Topiramate was also selected based on previous reports of its efficacy in treating mood disorders and OCD (40). In this study, topiramate was added to venlafaxine up to 150 mg/day. The compulsive behavior (i.e., excessive shopping, mainly clothes) subsided in a month (but no objective measurement was provided by the authors), while depression was fully remitted (according to the Beck Depression Inventory scores) (40). Another case study explored the effect of topiramate (titrated up to 350 mg/day) as an augmenting agent in a 42-year-old female diagnosed with OCD, type II bipolar disorder, generalized anxiety disorder, obesity, trichotillomania, and B/SD (41). This patient also received lamotrigine and aripiprazole, which were added to topiramate, and the compulsive behaviors declined gradually for 6 months (according to the YBOCS-SV scores), with a slower pace of improvement for the anxiety and depressive manifestations (41).

The augmentation of *mirtazapine* (30 mg/day) with *bupropion* (300 mg/day) in a 60-year-old female patient diagnosed with a severe form of B/SD (i.e., high CBS score, spent family's money, ran into debt) and comorbid MDD led to clinical and psychometric improvements by week 8 (42). The compulsive behavior (assessed with CBS) remained significantly decreased at the end-point (week 28) (42). The assessment of the associated symptoms included the use of the Hamilton Anxiety Rating Scale (HAMA), Hamilton Depression Rating Scale (HAMD), Symptom Checklist-90-Revised (SCL-90-R), and Barratt Impulsiveness Scale (BIS-11) (42). All these scales recorded improvements (i.e., the severity of associated anxiety, depressive, and impulsive symptoms decreased). Also, the global overall clinical status, determined by the use of Clinical Global Impression (CGI), improved significantly at the final visit (42). The overall tolerability was good, with only a 4% increase in weight gain (42).

A combination of *sertraline, topiramate, and group and individual CBT* was associated with favorable results after discharge in a 53-year-old patient diagnosed with pathological buying and collecting behaviors, obsessive-compulsive personality disorder, and alcohol use disorder

TABLE 3 The main data reviewed for the evaluation of the efficacy and tolerability of therapeutic interventions in patients with B/SD.

Authors	Design	Intervention	Outcomes	Results	Conclusions
Case reports					
Kellett et al. (37)	Single case experimental study, cross-over design, 40-year female with B/SD, 350-day monitoring duration	Single CBT vs. PCE, CBT-13 out-patient sessions, then PCE- 6 out-patient sessions	Ideographic B/SD parameters were assessed *via* a diary, and nomothetic measures (CBS, CAS, BDI-II, IIP-32, BSI) were also used	The frequency and duration of CB episodes decreased during treatment. CBT and PCE were both effective vs. baseline. Shopping obsessions, excitement about shopping, and CS improved. Self-esteem also improved.	Both interventions were effective, but no significant differences were detected between them.
Marčinko and Kalovič (38)	Case report, a 32-year-old woman	Fluvoxamine and CBT, 52 weeks	The evolution of compulsive buying episodes	No compulsive buying episodes were reported at the follow-up (1-year).	No comorbid psychiatric disorders, but the assessment was of poor quality.
Marčinko et al. (39)	Two case reports, a 33 years old male, and a 41-year-old male, diagnosed with B/SD and BED	Fluvoxamine+ psychodynamic psychotherapy, 52 weeks	Pathological behaviors severity	Compulsive behavior decreased within 4 weeks and persisted at 52 weeks.	The BED comorbidity could influence the evolution of these patients.
Guzman et al. (40)	Case report, 37-year-old Caucasian woman with B/SD	Venlafaxine 225 mg/day plus topiramate 150 mg/day	Compulsive behavior, depressive symptoms	After 1-month compulsive behavior decreased in severity, and depression remitted.	The patient responded to a combination of SNRI and mood stabilizer, but there was no structured evaluation of the outcomes.
Ye et al. (41)	A 42-year-old woman diagnosed with type II BD, OCD, GAD, obesity, chronic trichotillomania, and B/SD. Six months of monitoring.	Topiramate was titrated to 100 mg/day and added to lamotrigine (50 mg QD) and aripiprazole (15 mg QD). The topiramate dose was further increased to 350 mg/day.	YBOCS-SV	Compulsive behavior has improved since day 4. YBOCS-SV score improved at week 6, declining from 31 (baseline) to 5. The compulsive behavior improvement was maintained after 6 months. Depressive/anxiety symptoms improved only when 300 mg/day of topiramate and 150 mg/day of lamotrigine were administered.	The compulsive behavior improved early, and it was not paralleled by depressive/ anxiety symptoms evolution.
Sepede et al. (42)	A 60-year-old woman, severe B/SD + MDD, SSRI-resistant, partially responsive to mirtazapine	Mirtazapine + bupropion	HAMA, HAMD, CGI, CBS, SCL-90-R, BIS-11	At week 28, the overall clinical status improved, with all the outcome measures significantly reduced with respect to baseline. No serious AE and only mild weight gain were recorded at the end-point.	The anti-craving and anti-withdrawal effects of bupropion may be explained by its anti-dopaminergic properties.

(Continued)

TABLE 3 (Continued)

Authors	Design	Intervention	Outcomes	Results	Conclusions
Braquehais et al. (43)	A 53-year-old male patient presented compulsive buying and collecting behaviors, alcohol use disorder, and obsessive-compulsive personality disorder.	Alcohol detoxification, followed by sertraline (100 mg/day) + topiramate (200 mg/day) + individual and group CBT-4 weeks hospitalization + follow-up for an unspecified period	Un-structured evaluation methods (no validated instruments were used); clinical observation was the only method of assessment	At the discharge, the therapy was considered successful because the patient reported a lower incidence of obsessive thoughts and lower debts acquired.	A pharmacological and psycho-therapeutical combination may lead to positive responses in patients with B/SD and multiple comorbidities.
Donahue et al. (44)	A 30-year-old patient	Motivational interview + imaginal desensitization	Self-reports	Increased self-control over buying behaviors, decrease in pathological impulses. At 6 months the improvement was stable.	A combination of behavioral, cognitive, psychoeducational, and motivational techniques may be useful in B/SD patients.
Di Nicola et al. (45)	Case report, a 42-year-old man diagnosed with B/SD, physical exercise addiction, and type I BD	Quetiapine titrated up to 600 mg/day was added to the maintenance treatment with divalproex 1,000 mg/day	CBS, EAI	Improvements in compulsive behaviors (CBS, EAI) were reported at week 12. The tolerability was good, and no significant AEs were reported.	This case signals the possible efficacy of adding quetiapine to the divalproex treatment, but the pathology of this patient is complex, with dual behavioral addiction and type I BD. Therefore, the efficacy of a certain drug over the B/SD, in this case, is difficult to delineate.
Clinical trials					
Filomensky and Tavares (46)	A clinical trial, $N = 9$ B/SD patients	20-week group CBT program	YBOCS-SV—cognitive, behavioral, and overall scores	All outcomes were significantly improved after CBT.	The results of the CBT therapy were favorable. However, the rate of comorbid mood disorders was high, and there was no control group.
Mitchell et al. (47)	A pilot trial, $N = 28$ patients with compulsive buying	Group CBT vs. waiting list	Number of compulsive buying episodes, time spent buying, YBOCS-SV, and CBS scores	CBT was associated with significant advantages in the ITT analysis vs. waiting list in all the outcomes, and the improvements persisted at 6 months.	CBT was efficient, but this was just an uncontrolled pilot study.
Müller et al. (48)	RCT, $N = 56$ patients with compulsive buying, 10 weeks for each intervention + 6-month follow-up	Group CBT vs. telephone guided self-help vs. waiting list	Primary outcome measure: CBS. Other outcome measures: YBOCS-SV, BDI	CBT was superior to the active comparator and to the placebo, but not significantly (primary outcome). Guided self-help had a superior efficacy when compared to the waiting list.	These results are preliminary, based on the small groups. No significant group-by-time interaction was found in the YBOCS-SV or BDI scores, but only in the CBS scores.

(Continued)

TABLE 3 (Continued)

Authors	Design	Intervention	Outcomes	Results	Conclusions
Mueller et al. (49)	$N = 60$ patients with B/SD, 12 weeks treatment + 6 months follow-up	CBT vs. waitlist control	The primary outcomes: YBOCS-SV, CBS, and German-CBS scores. Secondary outcomes: SCl-90-R, BIS-11, SI-R	The primary outcome-by-time-by-group effect was demonstrated between active and control groups. At 6-month the improvements were maintained in the primary outcomes. Other comorbidities were not affected by the treatment.	CBT could be effective vs. waitlist in the medium term.
Black et al. (50)	Open-label trial ($N = 10$ non-depressed patients with compulsive buying), 1-week placebo run-in + 9 weeks of active drug	Fluvoxamine up to 300 mg/day	CGI, YBOCS-SV	9 out of 10 patients became less interested in shopping, spent less time shopping, and they have lost less money in CS.	Fluvoxamine was efficient, but the trial was open-label and had a short duration.
Black et al. (51)	RCT, $N = 23$ patients with B/SD, 1-week single-blind placebo washout + 9 weeks active drug vs. placebo	Fluvoxamine vs. placebo	YBOCS-SV, CGI, HAMD, MOI	No significant differences between the active drug and placebo at the end of the trial. Both groups improved starting from week 2 and their favorable evolution persisted up to week 9.	Fluvoxamine did not distinguish itself from the placebo, and AEs were more frequent in the SSRI group (nausea, decreased motivation, sedation). This study evaluated treatments only in the short term.
Ninan et al. (52)	RCT, DB, 13-week, $N = 23$ B/SD patients who completed the study out of 42 screened	Fluvoxamine vs. placebo	YBOCS-SV, CGI, GAF, HAMD, patients' diaries	No significant differences were found between groups in any of the outcomes.	A high placebo rate was recorded in this study. However, fluvoxamine failed to distinguish itself from placebo.
Koran et al. (53)	A 1-week wash-out + a 7-week OL phase + a 9-week DB discontinuation phase, $N = 26$ adult patients with baseline YBOCS-SV ≥ 7	Escitalopram 10 mg/day OL, increased to 20 mg/day after four weeks	CGI-I, YBOCS-SV, MADRS	In the OL phase, YBOCS-SV decreased significantly (with almost 70%), and 19 patients were responders (by YBOCS-SV and CGI-I).	The DB phase did not confirm the OL escitalopram response. AEs were similar in the two groups during the DB phase.
Koran et al. (54)	A 7-week OL phase + a 9-week DB, placebo-controlled discontinuation phase, $N = 24$ patients with baseline YBOCS-SV ≥ 17	Citalopram 20 mg/day, gradually increased to 60 mg/day	YBOCS-SV, CGI-I	YBOCS-SV scores decreased significantly at week 7, with 15 patients being responders. Three discontinuations due to AEs (headache, rash, and insomnia). In the DB phase, five of the placebo-treated patients relapsed vs. none in the active drug group.	Citalopram was effective and well-tolerated for B/SD in the short term.

(Continued)

TABLE 3 (Continued)

Authors	Design	Intervention	Outcomes	Results	Conclusions
Koran et al. (55)	A 12-week OL trial, with follow-up visits for 12 months, $N = 24$ B/SD adult patients	Citalopram 20 mg/day initially, and increased every 2 weeks by 20 mg/day up to a maximum dose of 60 mg/day, depending on tolerability and responsivity.	YBOCS-SV, CGI-I	Citalopram led to marked, rapid, and sustained improvements on both scales. The response rate was 71%. Two patients were discontinued for AEs (sedation and agitation).	After 6 months, patients who continued citalopram therapy were less likely to relapse than those who discontinued the treatment. Therefore, both acute and long-term treatment with citalopram seems efficient.
De Mattos et al. (56)	RCT, DB, 12 weeks, $N = 50$ B/SD patients	Topiramate vs. placebo	Main outcome measure: YBOCS-SV. Secondary outcome scale: CB-FUS	No difference between groups in the drop-out rate or in the declining rate of B/SD symptoms (on YBOCS-SV). Topiramate significantly decreased the secondary outcome scores. Hoarding and impulsivity were reduced at a trend level in patients treated with topiramate.	The efficacy of topiramate vs. placebo was not supported by the primary outcome measure.
Grant et al. (57)	OL trial, $N = 9$ patients with B/SD, 10 weeks	Memantine (10-30 mg/day)	The primary outcome: YBOCS-SV	The YBOCS-SV score decreased significantly. Hours spent with CS and money spent decreased significantly. Impulsive buying and cognitive task performance improved, also.	The mean effective dose of memantine was 23.4 $\pm$ 8.1 mg/day. The overall tolerability was good, and its efficacy was confirmed at week 10. Still, this is an open-small-group group study.
Systematic reviews and meta-analyses					
Hague et al. (58)	A systematic review, $n =$ 29 studies, only five were considered good-quality trials	Psychotherapy, pharmacotherapy	B/SD severity	Large effects were demonstrated for group psychotherapy and medication. Pharmacotherapy may improve outcomes in the long term in the B/SD population.	Group therapy is efficient, and pharmacotherapy may be an option due to its long-term favorable effects.
Leite et al. (59)	A systematic review, $n =$ 23 articles	All types of interventions	B/SD severity	Only studies focused on CBT efficacy showed a significant response. Methodological flaws were found in the psychodynamically-oriented studies (no structured outcome assessment).	CBT may be the only efficient type of intervention. This conclusion was based mainly on case reports.

(Continued)

TABLE 3 (Continued)

Authors	Design	Intervention	Outcomes	Results	Conclusions
Soares et al. (60)	A systematic review of 21 studies	Pharmacological interventions	B/SD severity	Fluvoxamine was not efficient in PCTs ($n = 3$). Citalopram was efficient in OLTs. Escitalopram was effective in an OLT but not in the DB phase. Memantine was effective in a pilot OLT. Fluoxetine, bupropion, nortriptyline, clomipramine, topiramate, and naltrexone were effective in case reports.	Citalopram/ escitalopram may be effective, but the overall quality of the reviewed trials methodology was poor (mostly OLT).
Goslar et al. (61)	A meta-analysis focused on the treatment of Internet addiction, sex addiction, and B/SD ($n =$ 91 studies, $N = 3531$ patients)	Psychotherapy, pharmacological treatment, and combined therapy	Structured and unstructured measurements of efficacy	Large-size pre-post reduction of the global severity of the B/SD symptoms by both psychological and pharmacological therapy. Psychological interventions were effective in decreasing compulsive behaviors especially if applied face-to-face and for longer periods of time. Combinations of CBT and medications led to advantages over monotherapies.	The therapy is effective in the short term, but the quality of most trials is poor.

AE, adverse events; BD, bipolar disorder; BDI, Beck Depression Inventory-II; BED, binge eating disorder; BIS-11, Barratt Impulsiveness Scale; B/SD, buying/shopping addiction; BSI, Brief Symptom Inventory; CAS, Compulsive Acquisition Scale; CB, compulsive buying; CBFUS, Compulsive Buying Follow-Up Scale; CBS, compulsive buying scale; CBT, cognitive-behavioral therapy; CGI-I, Clinical Global Impression-Improvement; CS, compulsive shopping; B/SD, compulsive shopping disorder; DB, double-blind; EAI, Exercise Addiction Scale; GAD, generalized anxiety disorder; GAF, Global Assessment of Functioning Scale; HAMA, Hamilton Anxiety Rating Scale; HAMD, Hamilton Depression Rating Scale; IIS-32, Inventory of Interpersonal Problems-32; ITT, intention-to-treat; MADRS, Montgomery-Asberg Depression Rating Scale; MDD, major depressive disorder; MOCI, Maudsley Obsessive-Compulsive Inventory; OCD, obsessive-compulsive disorder; OLT, open-label; PCE, person-centered experiential therapy; PCT, placebo clinical trials; RCT, randomized controlled trial; SCL-90-R, Symptom Checklist-90-Revised; SI-R, Saving Inventory-Revised; SNRI, serotonin and norepinephrine reuptake inhibitors; SSRI, selective serotonin reuptake inhibitors; YBOCS-SV, Yale-Brown Obsessive-Compulsive Scale- Shopping Version.

(43). The initial stage of the therapeutic management consisted of alcohol detoxification, followed by the combined intervention previously mentioned, that targeted both addictive and compulsive behaviors (43). No clinically validated scales were used to assess either hoarding or B/SD; the authors based their conclusions solely on clinical observation and patient reports (i.e., involvement in excessive shopping and hoarding, debt amount, and obsessions) (43).

Motivational interviewing and *imaginal desensitization* were successfully combined in a 30-year-old patient diagnosed with B/SD because they succeeded in increasing self-control over buying behaviors while decreasing the manifestation of pathological impulses (44). At 6 months, the improvement of the overall status was considered stable, assessed by clinicians' observations (44). Motivational interviewing helped the patient to develop intrinsic motivation for change, while the desensitization techniques were useful for confrontation and controlling impulsive behaviors (44).

The combination of quetiapine and divalproex was used as maintenance treatment in a 47-year-old male patient who presented with type I bipolar disorder comorbid with two behavioral addictions- B/SD and physical exercise addiction (45). After 12 weeks, the CS severity decreased under quetiapine (titrated up to 600 mg/day), according to the CBS scores, and the overall tolerability of this antipsychotic was good (45). The

physical exercise addiction severity also decreased, according to the Exercise Addiction Inventory (EAI) scores (45).

Based on eight case reports, which evaluated the efficacy of pharmacological, psychotherapeutic, or combined interventions in nine patients presenting B/SD with psychiatric comorbidities (bipolar disorder $N = 2$, other BAs $N = 2$, personality disorders $N = 1$, substance use disorders $N = 1$, depressive disorders $N = 2$, OCD $N = 1$, anxiety disorders $N = 1$, impulse control disorders $N = 1$, eating disorders $N = 1$)/without such comorbidities ($N = 1$), the short-term prognosis of these individuals may be improved if treatment is initiated. The overall quality of data is low because there was no control group, not all reports have used structured and validated instruments for the monitoring of B/SD severity, concomitant medication was added in several cases, and there is a high degree of comorbidity, which may lead to a number of biases. Fluvoxamine combined with psychotherapy is supported by most data in this chapter, followed by various antidepressants (i.e., mirtazapine, venlafaxine, bupropion, and sertraline) either administered alone or in combinations, were associated with improved B/SD symptoms. Mood stabilizers (e.g., lamotrigine, topiramate, and divalproex) and atypical antipsychotics (i.e., aripiprazole and quetiapine) have been used especially in patients with B/SD and mood disorders, which make difficult to distinguish the impact of each disorder's impact over the clinical evolution. Very few reports on psychotherapy as the only intervention for these patients exist, therefore it is impossible to draw any conclusion on this topic for now.

Clinical trials

A 20-week *group CBT program* was evaluated in a pilot study ($N = 9$ B/SD patients, mean age 41.8 years old) (46). Group therapy dedicated to the detection of specific shopping cognitive distortions and restructuring led to improvements in the cognitive, behavioral, and total scores of the YBOCS-SV after the therapy ended (46). Seven of the included patients currently presented with comorbid depression, and two of them had bipolar disorder, therefore, the results may be influenced by these comorbidities, which is impossible to establish without a control group (46).

The authors state, however, that "loss of control over shopping was not better explained by mood disorders since shopping bouts also occurred during periods of euthymia" (46).

A pilot study enrolled 28 compulsive buyers recruited through mass-media advertisements who subsequently received 12 sessions of group CBT over 10 weeks. Participants undergoing CBT had superior outcomes compared to the wait-list control in all the outcomes (both clinical variables and structured evaluation scores) at the end of treatment and 6-month follow-up (47). The main outcomes assessed were the number of compulsive buying episodes, time spent buying, YBOCS-SV, and CBS scores (47). Although this was just a pilot study, the results support the efficacy of group CBT on compulsive buying in outpatients with B/SD. Its main limitation is the absence of a comparison treatment, which prevents the causal correlation between this specific intervention (i.e., group CBT) and the outcome (i.e., improvement of the B/SD severity) (47).

Another pilot study included 56 patients with B/SD who were randomized on group CBT, telephone-guided self-help, or waiting list and monitored for the 10 weeks of the treatment, with a 6-month follow-up (48). Group CBT was superior to the self-help intervention and to the waiting list in reducing compulsive behaviors, and the favorable results were still present after 6 months (48). The CBS and YBOCS-SV scores declined significantly when compared to the baseline values for both active interventions, but the end-point differences between groups were not significant (48).

Another CBT trial focused on interruption and control of CS behaviors, training of healthy coping skills, and cognitive restructuring and enrolled 60 B/SD patients who were monitored for 12 weeks, with a 6-month follow-up (49). Significant improvement was detected in patients who received CBT vs. patients assigned to a waiting list at week 12, according to the primary outcome variables (YBOCS-SV, CBS, German-CBS) (49). Also, the improvement persisted at 6 months, but other psychopathology variables (i.e., compulsive hoarding, general psychopathology, impulsivity) were not significantly changed by the CBT vs. placebo (49).

A 9-week open-label trial with *fluvoxamine* (up to 300 mg/day) had a 1-week placebo run-in phase and included 10 non-depressed patients with CS (50). At the end of the trial, 9 patients presented improvements in their preoccupations, time spent, and money spent with these compulsive behaviors (50). Another 9-week trial, this time with a randomized, double-blind design following a 1-week single-blind placebo washout phase, did not find significant differences between fluvoxamine and placebo in any of the outcome measures, except for Maudsley Obsessive-Compulsive Inventory (MOCI) (51). In this second trial, fluvoxamine was associated with more adverse events than placebo, mainly nausea, insomnia/sedation, and decreased motivation (51). Yet another trial that evaluated fluvoxamine used a randomized, double-blind, placebo-controlled design and recruited 42 patients, out of which 23 completed the study after 13 weeks (52). No significant differences between groups were detected in any of the outcomes- YBOCS-SV, CGI, Global Assessment of Functioning (GAF), HAMD, and patients' self-reported compulsive behaviors (52).

In two trials conducted by the same team that used the same design (7-week open-label phase of active drug administration, followed by 9 weeks of double-blind, active drug vs. placebo), *citalopram* proved itself efficient in decreasing the YBOCS-SV scores and inducing higher response rate than placebo, but escitalopram was associated with favorable results only in the open-label phase (53, 54). However, these trials included small groups for each arm and relatively short durations of monitoring, therefore, their results should be interpreted with

caution. In yet another trial, citalopram was administered open-label for 12 weeks in B/SD patients ($N = 24$), and it led to rapid, significant, and sustained improvements in both YBOCS-SV and CGI-I scores (55). Citalopram was associated with positive effects at 12 months of follow-up when compared to lack of treatment due to discontinuation (55).

A randomized, double-blind, controlled trial evaluated the efficacy of *topiramate* (up to 300 mg/day in the ninth week, if tolerated) vs. placebo for 12 weeks in 50 patients with B/SD (56). The superiority of topiramate vs. placebo was not confirmed by the main outcome measure (YBOCS-SV), and only clinical variables (hoarding, impulsivity) and Compulsive Buying Follow-Up Scale (CB-FUS) scores confirmed the efficacy of topiramate vs. placebo (56). However, the follow-up analysis suggested that topiramate may begin to distinguish itself from placebo after 10 weeks, which indicates the need for a longer duration of monitoring (56).

Memantine (23.4 ± 8.1 mg/day mean effective dose) improved the YBOCS-SV scores in a 10-week open-label trial that enrolled nine B/SD patients (57). The overall tolerability of memantine was good (57), but it should be mentioned that this was an open-label, small-group study, therefore, the efficacy results should be confirmed in larger trials.

According to the analysis of 12 clinical trials ($N = 153$ patients), mostly of moderate quality, group CBT benefits from consistent evidence of efficacy at 6 months, while the results supporting pharmacological interventions are scarce. Fluvoxamine led to negative results ($n = 3$ trials, $N = 56$ patients) on the main outcomes (i.e., CS severity and related variables, determined by either self-reported or clinician-rated scales) and possible low tolerability (reported in one trial), while citalopram and escitalopram ($N = 74$ participants) were associated with mixed results. Topiramate and memantine were evaluated only in one trial each (50 and nine patients, respectively), therefore, it is difficult to formulate clear conclusions about their efficacy in B/SD patients.

Systematic reviews and meta-analyses

A systematic review of the *psychotherapy* ($n = 17$ studies) *and drug treatments*n=12 studies) concluded, based on mostly moderate and low-quality data (according to the criteria applied by the authors), that large effects were present for group psychotherapy and medication (58). Long-term treatment was correlated with better outcomes during pharmacotherapy but not when psychotherapy was administered (58).

Another review ($n = 23$ studies) concluded that *CBT* might be the only efficient method for the treatment of B/SD patients (59). However, this conclusion was based on case reports, and it must be mentioned that other psychotherapies did not use structured and validated instruments for the outcome measurements.

A review of 21 studies evaluating different pharmacological interventions found that placebo-controlled trials with *fluvoxamine* did not show effectiveness vs. placebo in B/SD patients, open-label trials with *citalopram* favored the active intervention vs. placebo, *escitalopram* was effective in an open-label trial, but not in the double-blind phase, and *memantine* was efficient only in a pilot open-label study (60). The authors of this review concluded that there is not enough evidence to support the recommendation of a specific agent for B/SD treatment (60).

In a meta-analysis dedicated to the pharmacological and psychological interventions for various behavioral addictions (Internet/sex/shopping dependence) that included 91 studies ($N = 3531$ participants), the results supported the efficacy of both types of therapy in the short-term (61). For B/SD, a large-sized pre-post decrease in the global severity of pathological behaviors was calculated: Hedge's $g = 1.00$ for psychotherapy and 1.52 for pharmacotherapy (61). *The combined psychotherapy and pharmacological approach* led to superior results to monotherapies, but the efficacy was demonstrated only in the short term (61).

The four systematic reviews/meta-analyses previously presented have formulated contradictory conclusions: while one found psychotherapy to be associated with the highest effect size (based on the results of 29 studies), another reported a superior effect size for pharmacotherapy (based on 91 studies) (58, 61). In the two reviews that evaluated only psychotherapeutic interventions and only pharmacotherapy respectively (based on 23 and 21 studies), CBT was considered the only efficient method (59), while no pharmacological agent could be recommended yet as monotherapy for B/SD patients (60).

Conclusions

B/SD is a very complex pathology, which integrates elements from BAs, OCD spectrum, and impulse control disorders, which raises the question of the heterogeneity of the populations included in the reviewed reports. It could be conceived that some of them are more close to a BA, some of them are more impulsive, while still others associate elements from the OCD spectrum. Various combinations of these dimensions in the same patient are also theoretically possible, and the high rate of comorbidity reported in this population may support this perspective.

Based on reviewing 24 distinct sources, representing case reports ($n = 8$), clinical trials ($n = 12$), and systematic reviews/meta-analyses ($n = 4$), it may be concluded that psychotherapy, and especially group CBT may be recommended for B/SD patients (supported by the results of two reviews, one case study, and four clinical trials) (Table 5). Combined, pharmacotherapy and psychotherapy, may be recommended, but the data in favor of this strategy is less significant (supported

TABLE 4 Assessment of the quality of evidence.

Case reports

Source	Quality assessment criteria								Conclusion
	1	2	3	4	5	6	7	8	
(18)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Include
(22)	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Include
(23)	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Include
(26)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Include
(32)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Include
(36)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Include
(38)	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Include
(39)	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Include
(43)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Include

Quasi-experimental studies

	Quality assessment criteria									Conclusion
	1	2	3	4	5	6	7	8	9	
(20)	Yes	N/A	N/A	No	No	Yes	N/A	Yes	Yes	Include
(24)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
(27)	Yes	N/A	N/A	No	No	Yes	N/A	Yes	Yes	Include
(31)	Yes	N/A	N/A	No	Yes	Yes	N/A	Yes	Yes	Include
(34)	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Include
(40)	Yes	N/A	N/A	No	Yes	Yes	Yes	Yes	Yes	Include
(41)	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Include

Randomized clinical trials

	Quality assessment criteria													Conclusion
	1	2	3	4	5	6	7	8	9	10	11	12	13	
(28)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
(29)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
(30)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
(33)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
(35)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include

Systematic reviews/meta-analyses

	Quality assessment criteria											Conclusion
	1	2	3	4	5	6	7	8	9	10	11	
(19)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
(21)	Yes	Unclear	Yes	Yes	No	No	No	Unclear	Unclear	Yes	Yes	Include
(25)	Yes	Yes	Yes	Yes	No	No	No	Unclear	Unclear	Yes	Yes	Include
(42)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include

by three case reports, and one meta-analysis). No specific recommendations for pharmacological agents could be made, although positive results with serotonergic antidepressants and topiramate exist. In patients with associated mood disorders, mood stabilizers (topiramate, lamotrigine, divalproex) and atypical antipsychotics (aripiprazole, quetiapine) have been correlated with positive results in case studies.

The GRADE recommendations formulated were A (high), B (moderate), C (low), or D (very low) (42, 55), according to the level of confidence that therapeutic interventions will improve the outcome of patients with B/SD.

The strengths of the current review rely on the inclusion of both primary and secondary reports detected through a systematic literature search and on the formulation of

TABLE 5 Summary of GRADE recommendations for B/SD treatment.

Therapeutic intervention	GRADE recommendations	Supporting reports	Observations
Cognitive-behavioral therapy	**B+**	(37, 46–49, 59, 61)	Most of the explored studies are short-term. Supporting data are derived from case reports and poor- to moderate-quality trials.
Pharmacotherapy plus psychotherapy	**B** for BS/D **B+** in patients with psychiatric comorbidities	(38, 39, 43, 61)	The positive effects of this strategy were demonstrated in the short term.
Serotonergic antidepressants	**C** for B/SD **C+** for patients with B/SD and mood disorders	(50, 54, 55, 60)	Escitalopram/citalopram may be efficient, but the reviewed trials were of low quality.
Moodstabilizers	**D** for B/SD **C** for patients with B/SD and mood disorders	(40, 41, 56)	Topiramate seems promising, but larger trials are needed. The association of venlafaxine to topiramate has been also associated with positive results in a case report.
Memantine	**C–**	(57)	Only one trial support this intervention.
Atypical antipsychotics	**C–** for patients with dual diagnosis, B/SD and mood disorder	(45)	Quetiapine may be efficient as an add-on in this specific population. However, data to support its efficacy is very limited.
Motivational interview plus imaginal desensitization	**D+**	(44)	Low level of support for this combination.

evidence-based recommendations with potential clinical utility. The reports were assessed for methodological quality using validated checklists (JBI), and the recommendations were made in accordance with GRADE criteria.

As limitations of the current review, it must be mentioned that conclusions integrated data derived from studies with multiple comorbidities, but since not all the researchers have made a thorough screening for psychiatric comorbidity at baseline, it is possible that other pathologies might be escaped, and yet influenced the outcomes. Due to the high rate of dual diagnosis in B/SD, screening for other psychiatric disorders is needed initially and periodically in this population. The high rate of SUDs and behavioral addictions with other psychiatric disorders has been reported in many sources (1, 15, 18, 19, 36, 62). It is difficult to interpret data resulting from the treatment of patients with multiple comorbidities, especially in case reports. The quality of the reviewed data is heterogenous, with case reports not using structured methods of monitoring, and a short duration of observation. Another limitation derives from the fact that data extraction and quality assessment were conducted by only one researcher.

Regarding the specifics of the recommendations for patients with B/SD, fewer sessions of group therapy and more severe pre-treatment hoarding features were significant predictors for nonresponse to the CBT (63). The risk of poor adherence to the individual CBT program was 28% in a study that enrolled 97 B/SD patients (63). Also, a significant discontinuation rate of 46.4% was reported, and the predictors of poor therapy adherence were male gender, more severe depression and obsessive-compulsive symptoms, lower anxiety level, high persistence, high harm avoidance, and low self-transcendence (63).

The prognosis of B/SD management is dependent on the adequate treatment of comorbid psychiatric conditions, psychological vulnerability factors, and sufficient time for monitoring. Therefore, an initial comprehensive evaluation of the patients presenting CS/CB is granted.

It is expected that further research will evaluate larger populations and more homogeneous participants. Also, a longer duration of clinical trials is needed, in order to confirm the efficacy of therapeutic interventions in patients with a known high rate of relapse.

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.

Author contributions

OV contributed to the article and approved the submitted version.

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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EDITED BY
Hyoun S. Kim,
Ryerson University, Canada

REVIEWED BY
Arif Yüce,
Eskisehir Technical University, Turkey
Will Shead,
Mount Saint Vincent University, Canada

*CORRESPONDENCE
Igor Yakovenko
igor.yakovenko@dal.ca

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Changes in sports gambling behavior during the COVID-19 pandemic in Canada

Elijah Otis[1], Andy J. Kim[1], Sherry H. Stewart[1,2], Simon B. Sherry[1] and Igor Yakovenko[1,2]*

[1]Department of Psychology and Neuroscience, Dalhousie University, Halifax, NS, Canada, [2]Department of Psychiatry, Dalhousie University, Halifax, NS, Canada

Sports betting is one of the most popular forms of gambling in Canada; recent prevalence estimates indicate that 7.9% of Canadian adults endorsed gambling on sports in the past year. The ongoing COVID-19 pandemic led to the temporary closure of most major sports leagues worldwide beginning in March of 2020. These sudden closures created a dramatic decrease in the availability of sports betting opportunities in the early stages of the pandemic, followed by a subsequent increase in availability as most sport leagues returned during the summer of 2020. Using a retrospective self-report measure of gambling participation, the present study investigated how the gambling behaviors of N = 85 past-year sports gamblers changed over the course of the pandemic. It was hypothesized that sports gamblers would report an initial decrease in gambling behaviors from pre-pandemic baseline levels to the early stages of the pandemic in May of 2020 when the availability of sports gambling was heavily restricted, followed by an increase in gambling behaviors from May to August, in accordance with the re-emergence of live sporting events. The general pattern of results supported the hypotheses, though gambling behaviors did not completely return to baseline levels. Beyond quantifying the changes in gambling behaviors over the early stages of the pandemic in Canada, results may have implications regarding the utility of voluntary gambling exclusion programs as well as legislation concerning gambling access.

KEYWORDS

gambling, COVID-19, availability hypothesis, Canada, adults, sports betting

Introduction

Sports betting, broadly defined as the wagering of money on the prediction of some outcome of a sporting event (1), is one of the most popular formats of gambling, both worldwide and in Canada (2). Sport gamblers tend to be overwhelmingly young men in the 18–34 years age range (3, 4). Sports bettors are at particularly high risk for problem

gambling, particularly when motivated by monetary, socialization, and enhancement motives (5, 6). Some structural elements of sports betting can carry especially high risk for problem gambling, including engaging in live in-play wagers (i.e., betting on the outcome of an event in progress), betting on micro-outcomes of sporting events, and betting on Daily Fantasy Sports contests (7–10).

Availability hypothesis

The "availability hypothesis" posits gambling involvement is closely tied to the availability of gambling opportunities in an environment, such that increases in the availability of gambling opportunities lead to increases in gambling participation and, by extension, increases in the prevalence of problem gambling (11–14).

One limitation to most of the research on the availability hypothesis is that almost exclusively, studies focus on the impact of *expansion* of gambling availability on gambling involvement. This leaves open the question of what happens to gambling involvement in response to the *reduction* of available gambling opportunities. This is likely in part due to the fact that the past several decades has seen almost universal expansion of legal gambling availability, leaving few opportunities to study how gamblers react to decreases in availability (15). One such rare opportunity occurred in 2007, when Norway instituted a complete ban on virtually all electronic gaming machines (EGMs), a form of gambling which previously dominated the Norwegian gambling market (16). Lund (17) studied the impact of this ban on Norwegians' gambling behaviors and found a sharp decline in the prevalence and frequency of EGM play after the ban, as well as in the prevalence of problem gambling.

Disruption of sports betting due to the COVID-19 pandemic

The ongoing COVID-19 pandemic had a profound impact on the availability of sports betting. The World Health Organization (WHO) initially classified COVID-19 as a pandemic on March 11th, 2020 (18). In the wake of the WHO declaration and global implementation of pandemic control measures, virtually all major sports leagues worldwide suspended play or postponed events indefinitely from March to April 2020 (19).

By May 2020, a limited number of major sports leagues had begun to resume holding live sporting events, including the UFC (May 9th), NASCAR (May 17th), and the Bundesliga, the top tier league in German soccer (May 16th). By the beginning of August, most major sports leagues with large global followings had resumed play, including Major League Baseball (July 23rd), the National Basketball Association (July 30th), and the National Hockey League (August 1st), allowing for sports bettors to resume wagering on some of the sports leagues with the largest international audiences.

Given the widespread popularity of sports betting, the sudden scarcity of live sporting events on which to gamble in the early months of the COVID-19 pandemic presented a rare opportunity to observe how sports gamblers' gambling behaviors were affected, akin to the natural experiment investigated by Lund (17) in the wake of EGM bans in Norway. The resumption of sports leagues after the restrictions also provides an opportunity to examine whether the returned availability of betting opportunities led sports betters to resume their pre-pandemic levels of betting behavior, consistent with the availability hypothesis.

Since the onset of the pandemic in March 2020, several studies have investigated the impact of the COVID-19 pandemic on gambling behaviors during the early months of the pandemic, with multiple reviews finding an overall reduction in gambling behaviors during the first lockdown period, consistent with the availability hypothesis (20–22). Given the incongruent manner by which early pandemic public health restrictions reduced access to some forms of gambling (e.g., live sports betting, land-based casinos) compared to other forms of gambling (e.g., online casino games), it is worthwhile to consider whether gamblers with reduced access to their primary modality of gambling during lockdown (e.g., sports gamblers) responded by substituting their gambling toward other modalities that were more accessible. Additionally, there has been some speculation that the temporary absence of traditional live sporting events may have fueled an increase in the popularity of electronic sporting events (e.g., online video game competitions), for traditional sports fans and sports gamblers alike (23). Evidence regarding the existence of such a "substitution effect" has been mixed in the extant literature, with some studies finding an increase in the prevalence and expenditure in online casino gambling during the initial lockdown period, suggestive of a substitution effect (24–26), and others finding no such evidence (27–29).

Despite sports betting being the modality of gambling perhaps most restricted by early lockdown measures, only three known studies have specifically investigated changes in sports gamblers' gambling habits during the COVID-19 pandemic. Auer et al. (27) found an overall reduction in online expenditure among sports bettors from February 2020 to April 2020, and no evidence for substitution from sports betting to other forms of gambling, such as online casino games. Conversely, Wardle et al. (30) found that a significant minority of sports bettors in their sample initiated new forms of gambling during the lockdown. Moreover, nearly a third of sports bettors increased their frequency of gambling on at least one gambling activity during lockdown, suggesting the possibility of some substitution toward gambling modalities which remained easily accessible. Similarly, Nosal and Lopes-Gonzalez (28) found that 87.5%

of Polish sports bettors surveyed in early May 2020 had substantially reduced their gambling compared to before the pandemic, though their results also indicated some evidence of substitution toward gambling on e-sports and non-traditional sports leagues that were still operational during restrictions. Though these studies provide important information regarding the impact of the pandemic on sports bettors in a European context, it is not clear that these results necessarily generalize to North American sports gamblers. Moreover, these studies did not control for several important correlates of gambling involvement that may have influenced the outcomes such as personality traits and gambling motives (31, 32).

While a general pattern of a decrease in gambling behaviors during the early months of the pandemic has now been well established in the literature, relatively few studies have examined changes in gambling behaviors past this initial lockdown period, as restrictions limiting the availability of gambling opportunities began to ease. To date, only three known studies (26, 29, 33) have evaluated changes in gambling behaviors across multiple timepoints of the pandemic. Biddle compared gambling prevalence data from three separate population surveys on Australian adults collected during April 2019, May 2020, and November 2020. Biddle found a decrease in past year gambling prevalence, both for overall gambling and for sports betting specifically, between April 2019 and May 2020, as well as a subsequent partial rebound in gambling prevalence from May 2020 to November 2020. Similarly, a study by Fluharty et al. (26) in the UK found the majority of gamblers surveyed reported no change or a decrease in their gambling behaviors during the first lockdown period. These authors also noted a small proportion of their sample typified by greater stress, alcohol use, depression, and anxiety reported increasing gambling during this period despite the restricted availability of gambling opportunities. This troubling pattern is consistent with findings conducted in Swedish and German samples (25, 34, 35). Moreover, nearly half of the respondents in the Fluharty et al. (26) study who had reported increased gambling during lockdown maintained or increased their gambling as lockdown restrictions were lifted in early August 2020. Lastly, Månsson et al. (29) also found that most of their sample of Swedish gamblers surveyed across the first and second waves of the pandemic reported no change or a decrease in their gambling behaviors, though again, a significant minority of gamblers increased their gambling behaviors over this time frame. To date, no studies have investigated changes in gambling behaviors across multiple stages of the pandemic in a Canadian sample.

The present study

The present study sought to address these gaps in the literature by investigating how sports bettors' gambling habits were broadly affected by the initial suspension and subsequent resumption of major sports leagues during the ongoing COVID-19 pandemic. In accordance with previous literature (33) and the availability hypothesis (11), it was hypothesized that there would be a significant decrease from the beginning of sports league closures in February/March, 2020 to May, 2020 in both gambling frequency (number of days gambled) and intensity (total duration of gambling, total gambling expenditure), followed by a subsequent increase (rebound) in gambling frequency and intensity between May and August, 2020 when the leagues fully reopened. The present study also sought to explore the possibility of substitution from sports-based gambling modalities to non-sports related gambling across these three timepoints. Given the inconsistencies in the literature to date regarding the existence of substitution from sports gambling to non-sports gambling during the pandemic, no specific hypotheses were made for this objective. In summary, we aimed to address the following two research questions: (i) how did sports gamblers' betting habits change in response to changes in the availability of gambling opportunities during the initial phase of the pandemic?; and (ii) did sports gamblers react to the decreased availability of sports gambling by gambling more on non-sports modalities?

Materials and methods

Participants and procedure

The sample consisted of sports gamblers recruited from two sources: a university student participant pool (n = 46) and online advertisements in the community (n = 54). To be eligible, individuals needed to confirm that they were: (1) over the age of 16, and (2) had gambled on a sporting event, and/or played Daily Fantasy Sports, at least once in the past 12 months.

Undergraduate psychology students were recruited through a large Eastern Canadian university's online research participation system. Participants were given access to the survey link administered via the survey hosting platform REDCap immediately after signing up for the study online. Community members were recruited through online advertisements posted to Facebook, Twitter, and Kijiji; they were asked to contact the lab to confirm their participation and subsequently were emailed a survey link.

One hundred and ninety-one individuals responded to the survey. All participants were required to complete a brief eligibility screener before proceeding to the main survey; n = 34 respondents were excluded at this stage due to ineligibility. A series of data quality checks were also conducted prior to analysis, and an additional n = 39 respondents were excluded from analyses according to the following criteria: inconsistent responding (n = 11), having no data past the eligibility screen (n = 16), and responding more than once (identified using their IP address; n = 12). All participants were given the

option to exclude their data from analyses upon completing the survey, which n = 18 participants did by responding no to the question: "do you think we should include your responses in our data?" This latter question was included in order to help eliminate those participants who may not have been paying full attention while completing the survey. These exclusions left a final sample size for analyses of N = 100. An institutional research ethics board approved the study. Participants provided informed consent and were compensated by a partial course credit (for university-recruited participants) or a $10 CAD gift card to Amazon.ca (for community-recruited participants). Data were collected between September and December of 2020.

Materials

Demographics questionnaire

Demographic data were collected with respect to participants' age, sex, relationship status, and monthly spending (i.e., monthly disposable income in thousand $CAD) through author-compiled survey questions.

Gambling timeline followback

The Timeline Followback (TLFB) method was originally developed by Sobell and Sobell (37) to increase the accuracy of retrospective reporting of alcohol consumption behaviors. The G-TLFB (36) is an adaptation of the TLFB to allow for the accurate measurement of gambling behaviors. In the G-TLFB, participants are given a calendar corresponding to a specific period and asked to first indicate on which days they gambled, the duration of their gambling for each day, and the amount of money they spent gambling. The G-TLFB was modified for the present study to also ask what type(s) of gambling (e.g., poker, sports betting) participants engaged in, for each day they gambled. Participants completed the G-TLFB for three distinct 14-day time periods. The first period, from February 26th to March 10th, 2020, was chosen to establish a pre-pandemic "baseline" of gambling behaviors in the 2-weeks prior to the WHO declaring COVID-19 a pandemic on March 11th, 2020. The second period, from May 1st to May 14th, 2020, was chosen to represent an early pandemic timepoint during which most sports leagues worldwide had suspended play temporarily (19). The third and final period, from August 1st to August 14th, 2020, was chosen to represent a later timepoint during the pandemic by which most major sports leagues had resumed play (38). To facilitate recall, participants were encouraged to use memory aids such as a personal calendar or bank statements, and referencing important events (e.g., birthdays, holidays). Participants were also encouraged to take their best guess if they could not remember the exact day on which they gambled (36).

Test–retest reliability calculated by Weinstock et al. (36) for recall of gambling variables during the past 6-months is in the adequate to high range, ranging from r = 0.74 to r = 0.96. Weinstock et al. also found that scores on the G-TLFB variables to be moderately to highly correlated with scores on a daily diary form asking participants to report their daily gambling over the same period as the G-TLFB.

Mini-international personality item pool

The Mini-IPIP (39) is a 20 item five-factor model (FMM) measure of personality that assesses neuroticism, extraversion, intellect/imagination (synonymous with openness to experience), agreeableness, and conscientiousness. Internal reliabilities for the subscales are adequate for short scales, ranging from α = 0.67–0.77 (39). The MINI-IPIP was included in the present study to allow for control of individual differences in the five-factor personality traits that have been consistently linked to gambling outcomes (40).

Problem gambling severity index

The PGSI (41) is a nine-item screener used to measure severity of gambling-related problems. The PGSI has high internal reliability (α = 0.84), as well as high concurrent validity with scores on other disordered gambling measures such as the South Oaks Gambling Screen (r = 0.83) (41). The PGSI was included in the survey to allow for a description of the sample in terms of overall level of problem gambling severity and to control for individual differences in problem gambling severity.

Gambling motives questionnaire

The GMQ (31) is a 15-item self-report measure designed to measure motivations for gambling, and is divided into three subscales measuring social motives, coping motives, and enhancement motives. Stewart and Zack (31) demonstrated high internal consistency ($\alpha > 0.80$) for each of the three GMQ subscales. Moreover, the GMQ has been validated in both community-recruited adult gamblers and university student gamblers including evidence of structural, concurrent, and predictive validity (31, 42).

Data analysis

Linear mixed models were used to evaluate all hypotheses concerning changes in gambling behaviors across timepoints on gambling behavior outcomes of interest. These outcomes were defined as follows: G-TLFB total time spent gambling measured in minutes (Duration), G-TLFB total frequency of gambling measured in days (Frequency), and G-TLFB total spending measured in $CAD (Expenditure). The present study also examined each of these outcomes in relation to sports gambling (e.g., sports betting, E-sports betting, horse race betting, Daily Fantasy Sports) or non-sport related gambling (e.g., casino games, poker). Time 1 was used to refer to the 14-day period of February 26th–March 10th, 2020 (pre-pandemic baseline); Time 2 for the 14-day period of May 1st–May 14th,

2020; and Time 3 for the 14-day period of August 1st–August 14th, 2020. To examine the potential substitution of sports gambling to other forms of gambling (non-sports), and vice versa, the opposite gambling outcome and its interaction with timepoint were entered as predictors in the model. For example, when examining Duration for sports gambling as the outcome, Duration for non-sports gambling and its interaction with timepoint (coded as Time 1, Time 2, and Time 3) were entered as predictors; significant interactions indicated substitution effects. Covariates for all models included demographic variables (age, sex, monthly spending, marital status, recruitment source) and psychological variables (PGSI score, five mini-IPIP subscale scores, and three GMQ subscale scores). These covariates were selected to control for known associations with gambling behavior. Linear mixed models were estimated using the nlme package (version 3.1-153) in R (version 4.2.1), and estimated marginal means were calculated using the emmeans package (version 1.7.2).

Models were specified using random intercepts. For each model, timepoints were entered as both a fixed factor and a random slope and analyzed as a categorical variable to allow for the examination of changes in gambling behavior across individual timepoints. Restricted maximum likelihood estimation (REML) was used to estimate parameters. The correlation structure of each model was Continuous Autoregressive (CAR1). Extreme values were winsorized rather than excluded from analyses (43).

Results

Descriptive information for community (n = 54) and university-recruited participants (n = 46) appear in Table 1. A series of t-tests were conducted to determine if community participants significantly differed from university participants on continuous study variables. Chi-square tests were used for categorical variables (gender, marital status). Community participants reported significantly higher levels on age, proportion of males, monthly spending, all three gambling motives, and several gambling outcomes (for sports gambling, especially) than university participants (see Table 1). The average PGSI scores for community participants (mean = 7.30, SD = 5.38) were near the threshold for problem gambling [≥8; (44)] and at significantly higher levels than university participants (mean = 4.36, SD = 6.58). Given the differences in the samples, recruitment source was used as a control variable in linear mixed models.

Descriptive information for the total sample (N = 100) is in Table 1. The sex distribution was n = 63 male, n = 37 female, and ages ranged from 18 to 45 years, with a mean (SD) age of 25.49 (6.50) years. The mean monthly disposable income in thousand Canadian dollars for the total sample was 1.20 (SD = 2.13). In terms of their current relationship status, n = 55 participants reported being single, and n = 45 reported being in a romantic relationship. Fifteen participants were missing data on one or more covariates and thus were excluded from all linear mixed models (resulting in N = 85).

Main effects of time period on overall gambling

Estimated marginal means by gambling outcome appear in Figure 1. Results from the linear mixed model evaluating the main effect of timepoint on G-TLFB Duration (total minutes spent gambling), Frequency (total days spent gambling), and Expenditure (total amount of money spent gambling) per 14-day G-TLFB reporting period appear in Table 2. Consistent with hypotheses, there was a significant negative main effect of timepoint between Time 1 and Time 2 and between Time 1 and Time 3, and a positive main effect of timepoint between Time 2 and Time 3, across all outcomes (see Table 2). The one exception was a non-significant positive effect of timepoint (p = 0.071) between Time 2 and Time 3 for duration.

These results indicate that participants engaged in gambling for less time in minutes, on fewer days, and spent less money during the pandemic in May and August 2020 than they did before the pandemic in late February and early March 2020. They also engaged in greater levels on two of the three gambling indices (Frequency and Expenditure) when major sports leagues had resumed play in August 2020 relative to when sports leagues worldwide had suspended play in May 2020, though values remained lower in August 2020 than pre-pandemic levels, suggesting only a partial return to baseline of gambling behavior. The model predicted approximately 21% of the variability in gambling duration (*McFadden's Pseudo* R^2 = 0.21), 26% of the variability in gambling frequency (*McFadden's Pseudo* R^2 = 0.26), and 24% of the variability in gambling expenditure (*McFadden's Pseudo* R^2 = 0.24).

Main effects of time period on sports gambling outcomes

Results from linear mixed models evaluating the main effect of timepoint on G-TLFB Duration, Frequency, and Expenditure of sports gambling per 14-day G-TLFB reporting period appear in Table 3. Consistent with hypotheses, there was a significant negative main effect of timepoint between Time 1 and Time 2 and between Time 1 and Time 3, and a positive main effect of timepoint between Time 2 and Time 3, across all outcomes (see Table 3). These results indicate that participants engaged in sports gambling for less time in minutes, on fewer days, and spent less money during the pandemic in May and August 2020 than they did before the pandemic in late February and

TABLE 1 Demographics of community and university-recruited participants.

	Community participants		University participants			Total sample
	n = 54 Mean (SD)	*n*	*n* = 46 Mean (SD)	*n*	*P-value*	*N* = 100 Mean (SD)
Demographics						
Age	29.31 (5.91)	52	21.09 (3.82)	45	<**0.001**	25.49 (6.50)
Gender	39 (72%) males	54	24 (52%) males	46	**0.038**	63 (63%) males
Marital status	26 (48%) single	54	29 (63%) single	46	0.136	55 (55%) single
Gambling						
PGSI	7.30 (5.38)	46	4.36 (6.58)	42	**0.025**	5.90 (6.13)
Monthly spending	1.37 (0.96)	54	1.00 (2.97)	46	0.420	1.20 (2.13)
MINI						
Openness	3.44 (0.50)	46	3.54 (0.42)	42	0.333	3.49 (0.46)
Conscientiousness	3.49 (0.72)	46	3.50 (0.72)	42	0.925	3.49 (0.71)
Extraversion	3.20 (0.79)	46	3.06 (0.84)	42	0.418	3.13 (0.81)
Agreeableness	3.65 (0.64)	46	3.84 (0.64)	42	0.169	3.74 (0.65)
Neuroticism	2.90 (0.58)	46	2.76 (0.64)	42	0.288	2.84 (0.61)
GMQ						
Enhancement	2.98 (0.90)	45	2.18 (0.81)	42	<**0.001**	2.59 (0.94)
Social	2.68 (0.85)	45	1.92 (0.72)	42	<**0.001**	2.31 (0.88)
Coping	2.51 (1.05)	45	1.56 (0.87)	42	<**0.001**	2.05 (1.07)
Overall gambling						
Duration–T1	336.70 (355.23)	54	171.49 (372.89)	46	**0.029**	260.71 (375.55)
Frequency–T1	6.40 (5.18)	54	1.87 (2.94)	46	<**0.001**	4.31 (4.84)
Expenditure–T1	258.24 (373.95)	54	226.69 (726.93)	46	0.791	243.73 (561.52)
Sports gambling						
Duration–T1	237.15 (311.96)	54	98.62 (322.18)	46	**0.032**	173.42 (322.64)
Frequency–T1	4.86 (4.74)	54	1.20 (2.30)	46	<**0.001**	3.17 (4.22)
Expenditure–T1	153.89 (285.01)	54	164.26 (644.06)	46	0.920	158.66 (481.73)
Non-sports gambling						
Duration–T1	97.10 (209.38)	54	63.86 (172.13)	46	0.386	81.81 (192.91)
Frequency–T1	1.57 (2.12)	54	0.67 (1.41)	46	**0.013**	1.16 (1.87)
Expenditure–T1	100.83 (230.01)	54	36.52 (139.28)	46	0.089	71.24 (195.39)

Significant *p*-values (<0.05) are in bold.

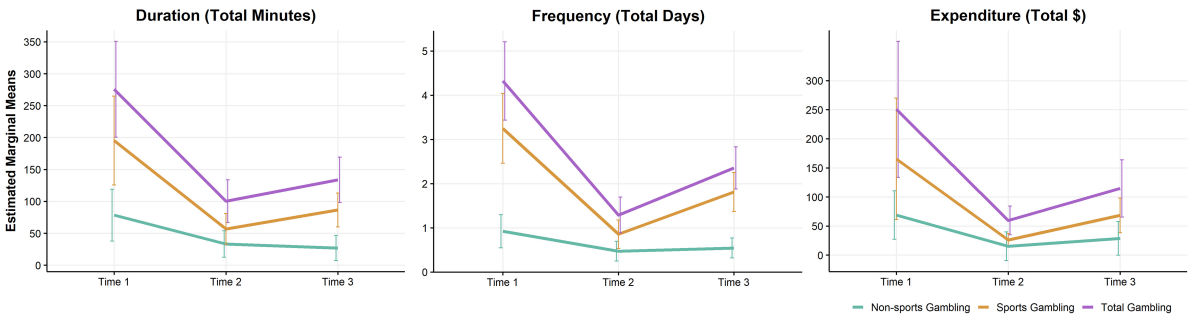

FIGURE 1
Estimated marginal means by gambling outcome. Time 1 refers to the pre-pandemic baseline reporting period of February/March 2020, while Time 2 and Time 3 refer to the mid-pandemic periods of early May and August 2020, respectively. Error bars represent the lower and upper limits of a 95% confidence interval; they are slightly dodged as to not overlap for improved clarity.

10.3389/fpsyt.2022.1018234

TABLE 2 Linear mixed-model results for overall gambling outcomes.

	Duration		Frequency		Expenditure	
	b	95% CI	*b*	95% CI	*b*	95% CI
Time 2 (May)[a]	**−175.33*****	−248.59; −102.08	**−3.03*****	−3.86; −2.21	**−191.16****	−304.56; −77.77
Time 3 (August)[a]	**−141.76*****	−213.27; −70.26	**−1.97*****	−2.70; −1.24	**−135.98****	−227.40; −44.56
Time 3 (August)[b]	33.57	−2.94; 70.08	**1.07*****	0.55; 1.58	**55.18***	13.36; 97.01
Demographics						
Age	**6.90***	0.57; 13.23	0.06	−0.02; 0.13	3.85	−1.56; 9.25
Gender	58.29	−4.86; 121.44	−0.29	−1.04; 0.46	17.24	−36.64; 71.11
Marital status	−36.74	−97.75; 24.28	−0.08	−0.81; 0.65	0.49	−51.56; 52.55
Recruitment source	−8.92	−87.53; 69.69	−0.80	−1.74; 0.13	15.15	−51.92; 82.21
Gambling						
PGSI	**9.56****	3.53; 15.59	0.01	−0.06; 0.08	**10.22*****	5.07; 15.37
Monthly spending	1.48	−11.34; 14.29	0.01	−0.14; 0.16	0.56	−10.37; 11.49
MINI						
Openness	60.66	−10.73; 132.05	0.60	−0.25; 1.45	42.57	−18.33; 103.48
Conscientiousness	**−60.98****	−105.99; −15.96	−0.41	−0.95; 0.12	−35.06	−73.47; 3.35
Extraversion	−20.92	−59.51; 17.67	−0.39	−0.85; 0.07	−11.12	−44.04; 21.81
Agreeableness	31.07	−25.28; 87.42	0.41	−0.26; 1.08	14.31	−33.76; 62.39
Neuroticism	−2.24	−54.94; 50.45	0.17	−0.46; 0.80	12.35	−32.61; 57.30
GMQ						
Enhancement	19.14	−37.14; 75.41	0.03	−0.64; 0.70	−14.83	−62.85; 33.18
Social	**59.71***	5.48; 113.93	0.55	−0.10; 1.20	45.84	−0.42; 92.10
Coping	31.18	−79.83; 17.48	0.16	−0.42; 0.74	−20.83	−62.33; 20.68
N participants	85		85		85	
Observations	255		255		255	
Pseudo R^2	0.21		0.26		0.24	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Significant effects ($p < 0.05$) are in bold. 95% CI values indicate the lower and upper limits of a 95% confidence interval. [a]Reference point is pre-pandemic baseline. [b]Reference point is Time 2 (May).

early March 2020. They also engaged in greater levels of all three gambling indices in August 2020 when major sports leagues had resumed play relative to May 2020 when sports leagues worldwide had suspended play, though values were significantly lower in August 2020 compared to pre-pandemic levels, indicating only a partial return to baseline. No evidence for substitution effects was found in that no interactions of non-sport gambling and time were evident. The model predicted approximately 22% of the variability in gambling duration (*McFadden's Pseudo* R^2 = 0.22), 26% of the variability in gambling frequency (*McFadden's Pseudo* R^2 = 0.26), and 28% of the variability in gambling expenditure (*McFadden's Pseudo* R^2 = 0.28).

Main effects of time period on non-sports gambling outcomes

Results from linear mixed models evaluating the main effect of timepoint on G-TLFB Duration, Frequency, and Expenditure of all non-sports related gambling activities appear in Table 4. A negative main effect of timepoint between Time 1 and Time 2 was observed across all outcomes, and between Time 1 and Time 3 on Duration (see Table 4). These results indicate that participants engaged in non-sports gambling for less time in minutes, on fewer days, and spent less money during the pandemic in May 2020 than they did before the pandemic in late February and early March 2020. They also reported spending less time gambling on non-sports related activities in August 2020 compared to before the pandemic. In contrast to sports gambling analyses, no significant main effect of timepoint between Time 2 and Time 3 was observed across any of the outcomes. Although there was a significant negative interaction effect of sports gambling expenditure and timepoint between Time 1 and Time 3, we found weak evidence to support a potential substitution effect. As the amount of money spent on sports gambling decreased in August 2020 relative to February/March 2020, the amount of money spent on non-sports gambling was unchanging over that same interval (see Figure 1). The model predicted approximately 22% of the variability in gambling duration (*McFadden's Pseudo* R^2 = 0.22), 24% of the variability in gambling frequency (*McFadden's*

10.3389/fpsyt.2022.1018234

TABLE 3 Linear mixed-model results for sports gambling outcomes.

	Duration		Frequency		Expenditure	
	b	**95% CI**	***b***	**95% CI**	***b***	**95% CI**
Time 2 (May)[a]	**−143.28*****	−215.97; −70.59	**−2.34*****	−3.20; −1.49	**−138.99***	−246.80; −31.18
Time 3 (August)[a]	**−103.86****	−174.89; −32.83	**−1.26****	−2.01; −0.51	**−94.88***	−177.12; −12.65
Time 3 (August)[b]	**39.42***	7.18; 71.66	**1.08*****	0.56; 1.60	**44.11****	12.16; 76.06
Demographics						
Age	**6.77****	2.44; 11.09	0.06	−0.00; 0.12	**3.13****	0.87; 5.40
Gender	39.32	−3.69; 82.33	0.18	−0.44; 0.80	14.06	−8.65; 36.77
Marital status	−17.53	−59.22; 24.16	−0.16	−0.75; 0.43	−0.15	−22.02; 21.72
Recruitment source	−18.78	−72.40; 34.84	−0.64	−1.40; 0.12	−1.05	−29.32; 27.21
Gambling						
PGSI	**4.31***	0.10; 8.52	−0.01	−0.07; 0.05	**3.97****	1.66; 6.28
Monthly spending	0.07	−8.65; 8.80	0.01	−0.12; 0.13	−0.15	−4.74; 4.45
MINI						
Openness	**61.86***	13.30; 110.42	0.68	−0.01; 1.37	21.52	−4.19; 47.24
Conscientiousness	−29.27	−60.30; 1.77	−0.18	−0.62; 0.26	−12.35	−28.66; 3.96
Extraversion	−1.91	−28.71; 24.89	0.03	−0.36; 0.41	2.73	−11.17; 16.64
Agreeableness	9.01	−29.40; 47.42	0.26	−0.28; 0.81	6.14	−14.08; 26.35
Neuroticism	6.20	−29.66; 42.07	0.03	−0.48; 0.55	−2.47	−21.46; 16.51
GMQ						
Enhancement	17.04	−21.24; 55.32	0.03	−0.51; 0.57	−6.76	−27.01; 13.49
Social	26.32	−10.77; 63.42	0.20	−0.33; 0.72	**21.97***	2.23; 41.70
Coping	−13.04	−46.25; 20.16	0.29	−0.19; 0.76	−6.51	−24.02; 11.00
Non-sports gambling	−0.20	−0.55; 0.16	0.26	−0.12; 0.65	−0.03	−0.36; 0.30
Non-sports gambling × time 2[a]	0.10	−0.30; 0.51	−0.07	−0.56; 0.42	−0.01	−0.39; 0.37
Non-sports gambling × time 3[a]	−0.10	−0.52; 0.31	−0.24	−0.69; 0.21	−0.05	−0.33; 0.23
Non-sports gambling × time 3[b]	−0.21	−0.56; 0.14	−0.17	−0.64; 0.30	−0.04	−0.22; 0.15
N participants	85		85		85	
Observations	255		255		255	
Pseudo R^2	0.22		0.26		0.28	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Significant effects ($p < 0.05$) are in bold. 95% CI = values indicate the lower and upper limits of a 95% confidence interval. [a]Reference point is pre-pandemic baseline. [b]Reference point is Time 2 (May).

Pseudo R^2 = 0.24), and 20% of the variability in gambling expenditure (*McFadden's Pseudo* R^2 = 0.20).

Discussion

The present study investigated the effect of the suspension and subsequent resumption of play in major sports leagues worldwide during the COVID-19 pandemic on Canadian sports bettors' gambling behaviors. In accordance with the availability hypothesis, it was predicted that a general decrease in both gambling frequency and intensity would be observed across all variables of interest between the baseline (pre-pandemic) reporting period in February/March 2020 and the second reporting period in May 2020 when accessibility to sports gambling opportunities were at their minimum, followed by a subsequent rebound in gambling frequency and intensity corresponding with the increased availability of sports gambling opportunities as major sports leagues resumed live play in August 2020.

With respect to changes in gambling activity, the general pattern of results was largely consistent with hypotheses. Based on retrospective recall, participants reported a significant decrease in their frequency, duration, and expenditure on any type of gambling (sports or non-sports) from the February/March baseline period to early May. The observed drop in these three gambling behaviors during the early stages of the pandemic in Canada is consistent with findings on gambling behavior during the COVID-19 pandemic in other countries (21). Moreover, this uniform decrease across gambling behaviors between baseline and May mirrors the results of Lund (17) in providing support for the predictions of the availability hypothesis in the case of decreased gambling availability, while extending these findings by showing similar results in the

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TABLE 4 Linear mixed-model results for non-sports gambling outcomes.

	Duration		Frequency		Expenditure	
	b	**95% CI**	***b***	**95% CI**	***b***	**95% CI**
Time 2 (May)[a]	**−47.15****	−76.77; −17.53	**−0.37***	−0.73; −0.02	**−39.83***	−72.65; −7.02
Time 3 (August)[a]	**−47.57****	−80.72; −14.42	−0.29	−0.68; 0.10	−27.84	−61.38; 5.70
Time 3 (August)[b]	−0.42	−18.28; 17.43	0.08	−0.15; 0.31	11.99	−11.83; 35.82
Demographics						
Age	0.57	−2.89; 4.03	−0.01	−0.05; 0.03	−1.30	−5.45; 2.85
Gender	−1.78	−35.91; 32.35	−0.37	−0.76; 0.01	−17.80	−58.75; 23.16
Marital status	−4.45	−37.17; 28.27	0.10	−0.27; 0.47	14.04	−25.06; 53.13
Recruitment source	5.91	−36.17; 47.99	−0.10	−0.58; 0.38	13.67	−36.90; 64.23
Gambling						
PGSI	2.31	−0.98; 5.61	0.03	−0.00; 0.07	**5.87****	1.87; 9.86
Monthly spending	1.34	−5.51; 8.19	−0.00	−0.08; 0.08	2.05	−6.16; 10.27
MINI						
Openness	−5.63	−44.43; 33.17	−0.11	−0.54; 0.33	26.95	−19.03; 72.93
Conscientiousness	−12.88	−37.11; 11.35	−0.13	−0.40; 0.15	−18.08	−47.11; 10.96
Extraversion	**−21.27***	−41.94; −0.60	**−0.30***	−0.53; −0.06	−6.68	−31.44; 18.08
Agreeableness	24.03	−6.13; 54.18	0.10	−0.24; 0.45	3.50	−32.69; 39.68
Neuroticism	0.36	−27.85; 28.57	0.21	−0.11; 0.53	13.74	−20.10; 47.58
GMQ						
Enhancement	−6.66	−36.85; 23.53	−0.04	−0.38; 0.30	−17.04	−53.24; 19.15
Social	11.95	−17.24; 41.13	0.26	−0.07; 0.59	**35.59***	0.50; 70.68
Coping	−0.48	−26.52; 25.57	−0.17	−0.47; 0.12	−12.41	−43.67; 18.85
Sports gambling	−0.01	−0.08; 0.06	0.06	−0.01; 0.13	−0.02	−0.08; 0.04
Sports gambling × time 2[a]	0.02	−0.10; 0.13	−0.04	−0.15; 0.06	−0.16	−0.43; 0.11
Sports gambling × time 3[a]	−0.04	−0.15; 0.08	−0.05	−0.14; 0.05	**−0.14***	−0.28; −0.01
Sports gambling × time 3[b]	−0.06	−0.18; 0.07	−0.00	−0.11; 0.10	0.02	−0.27; 0.30
N participants	85		85		85	
Observations	255		255		255	
Pseudo R^2	0.22		0.24		0.20	

*$p < 0.05$, **$p < 0.01$. Significant effects ($p < 0.05$) are in bold. 95% CI = values indicate the lower and upper limits of a 95% confidence interval. [a]Reference point is pre-pandemic baseline. [b]Reference point is Time 2 (May).

context of an unplanned decrease in gambling availability related to the COVID-19 pandemic.

Significant increases in gambling behaviors between May and August were also observed, as public health measures limiting the availability of both sports and non-sports gambling were eased, with some variation according to gambling type. Unsurprisingly, participants reported large, significant increases in their frequency, duration, and expenditure related to sports gambling activities, corresponding to the return of most major live sporting events by August 2020 (38). Conversely, participants reported no significant increases in their non-sports related gambling behaviors over this same period. This pattern of findings is largely supportive of hypotheses, with the exception of finding no significant difference between May and August with respect to the frequency, expenditure, and duration of non-sports gambling. A plausible explanation for why a significant difference was observed in non-sports gambling from baseline to May, but not from May to August, has to do with the fact that most land-based casinos in Eastern Canada were closed from mid-March to early October (45). Given that most of the present study's sample were from Eastern Canada, the retrospective report timepoints used likely captured the initial decrease in the availability of non-sports gambling opportunities (casino closures) but not any substantial increase in availability between May and August, as casinos remained closed. It is possible that a rebound effect consistent with the general pattern of results would have been observed had non-sports gambling frequency been measured at a time-point after which casinos in Eastern Canada had reopened. Alternatively, these results may indicate sport gamblers focus quite exclusively on resuming their sport gambling when the opportunities resume, rather than engaging in more non-sports related gambling.

Notwithstanding the absence of a rebound effect in gambling outcomes on non-sport activities in the data, the

partial rebound observed for all other variables provides support for the availability hypothesis. Notably, this rebound effect was only partial in nature for all variables on which it was observed, such that gambling frequency, time spent gambling, and expenditure were statistically higher at baseline even after this partial rebound in August. There are several possible explanations for this. First, while the August timepoint for reporting was chosen to capture the effect of a return in the availability of sports betting as well as overall gambling, this choice of time-period was nonetheless somewhat arbitrary. The present study's findings of only a partial rebound in gambling behaviors are consistent with similar findings in different populations using different time periods and reporting methods (33, 46). Thus, it is possible the partial rebound effect observed could be evidence of a sustainable shift toward a new, lower baseline of gambling behaviors. It may be that the initial drop in gambling behaviors experienced during the early stages of the pandemic led participants to modify their desire to gamble accordingly, making them less sensitive to the increased availability of gambling opportunities in August. This would represent a significant, unintended positive side-effect of the pandemic in terms of public health, as involvement in gambling behaviors is positively associated with the experience of gambling related harms (47–49). Indeed, there is evidence on voluntary self-exclusion (VSE) supporting this idea. VSE programs allow individuals concerned about their gambling to voluntarily sign themselves up to be banned from accessing gambling venues (50). These programs appear to be effective in reducing gambling behaviors and improving the psychological wellbeing of those involved (51). Moreover, these programs have lasting effects on gambling-related cognitive distortions, gambling behaviors, and problem gambling symptoms that can persist even after the VSE term is complete (50, 52, 53). In terms of the results of the present study, the decreased accessibility of gambling during the early stages of the pandemic may have acted as a natural self-exclusion program for sports gamblers that could very well have lasting effects on their gambling behaviors and desire to gamble going forward. Follow-up research in the aftermath of the pandemic is necessary to evaluate if this observed decrease from baseline in gambling involvement is sustained, and if so, for how long.

Substitution to non-sports gambling

A plausible outcome of the pandemic would be that sports gamblers would increase their participation in non-sports gambling activities that were still widely available online as a means of "substituting" their gambling consumption. The interaction effect observed indicates that while sports gambling expenditure decreased from time 1 to time 3, non-sports gambling expenditure remained the same from time 1 to time 3. Thus, participants were spending a relatively larger proportion of their money on non-sports gambling at time 3 relative to time 1 (which could represent substitution), but they were nonetheless still spending more on sports gambling than non-sports gambling at time 3 (inconsistent with substitution). Moreover, the data did not take the form of a classic substitution effect as the interaction was not observed at baseline vs. time 2 (when sports gambling availability was most restricted), and since no increase in absolute expenditure on non-sports gambling was observed during the pandemic restrictions. Though we did not observe such a predicted interaction from time 2 relative to time 1, detection of small interaction effects in psychological research in mixed-effects models usually require sample sizes of $N > 300$ (54). Given the final sample size of $N = 85$, the present study was likely underpowered to detect small interaction effects. Nonetheless, any interpretation of our observed interaction effect as evidence of substitution must be made with caution, as this effect was observed at one timepoint comparison (time 3 relative to time 1) and for only one outcome (expenditure).

Aside from the interaction effect observed with respect to relative changes in sports vs. non-sports gambling expenditure at time 3, results regarding changes in the frequency of sports-related and non-sports gambling during the early stages of the pandemic (between baseline and time 2) do not provide any evidence that a substitution from sports gambling to non-sports gambling occurred. The present study's failure to find strong, consistent evidence of substitution toward non-sports gambling is not entirely unexpected, as the evidence for substitution in the literature is relatively limited, with most studies finding little or no evidence suggestive of substitution to alternative forms of gambling following restricted availability of gambling opportunities (17, 24, 27). However, a study by Close et al. (55) found evidence of a large, significant increase in video-gaming involvement and problem gaming scores during the first lockdown period in the UK; this suggests some gamblers substituted their gambling consumption by increasing involvement in another potentially harmful and addictive activity. This notion is supported by a study conducted by Xuereb et al. (56), who found that while gambling involvement significantly decreased during the first lockdown period, drug use (alcohol, tobacco, cannabis) and other potentially addictive behaviors (video-gaming, pornography use) significantly increased over this same period.

Implications for public health policy and treatment

The present study's findings have implications for public health policy, providing support for findings connecting the availability of gambling opportunities to gambling outcomes, particularly with respect to sports gambling. The fact decreases in gambling involvement were observed across all gambling

behavior outcome variables of interest speaks to the strength of the association between availability of sports gambling opportunities and degree of gambling involvement. Given that greater gambling involvement contributes to greater population level harms (49), the results from the present study suggest there is a case to be made for decreasing the availability of gambling in Canada as a means of reducing the significant public health burden of problem gambling (57). One way this could be achieved is through legislation designed to reduce accessibility of unregulated online gambling providers hosted in other countries that up until recently dominated the market for single event sports betting in Canada (58). Unfortunately, the current trajectory appears to be headed in the opposite direction, as the recent passing of Bill C-218 in the Canadian House of Commons paved the way for a legal single event sports betting market in Canada, thus greatly increasing the availability of sports gambling in the country. This may lead to greater gambling involvement and, in turn, higher rates of disordered gambling. It is important policymakers consider the potential negative consequences of expanded gambling availability and implement measures to balance out the expansion of legal sports gambling, such as by placing limits on offshore gambling providers.

In terms of clinical implications for treatment, results of the present study lend theoretical support to the efficacy of stimulus control methods to reduce the availability of gambling such as VSE programs in the treatment of problem gambling and gambling disorder. The present study's finding of a substantial drop across all gambling behavior outcomes measured provides naturalistic evidence that the external imposition of strong restrictions to one's access to gambling opportunities leads to large decreases in gambling behaviors associated with problem gambling severity (41). Given that substandard enforcement of VSE at gambling venues has been shown to lead to poorer treatment outcomes (51), the present study's results suggest that stronger efforts to identify self-excluded gamblers and enforce their bans from access to gambling venues could lead to more potent treatment effects for VSE programs. Similarly, the present study's findings support other stimulus control methods in the treatment of problem gambling, such as strictly enforced spending limits that are difficult to remove once gamblers have voluntarily agreed to enter a spending restriction program (53).

Limitations

One of the primary limitations of the present study pertains to the length of time elapsed between retrospective report periods and actual data collection. Given that data were collected between September and early December of 2020, participants were required to report on their day-to-day gambling behaviors from between 1 and 3 months in the past for the August reporting period, between 4 and 6 months in the past for the May reporting period, and between 7 and 9 months in the past for the pre-pandemic baseline reporting period. The psychometric properties of the G-TLFB have only been evaluated for use in recall periods up to 6-months in the past (36). Though Weinstock et al. found the past 6-month recall version of the G-TLFB to exhibit strong reliability comparable to that of a past 3-month version of the G-TLFB, it is difficult to dispute the contention that accuracy of recall will diminish over more temporally distant periods. Interestingly, when evaluating the convergent validity of the G-TLFB with a daily diary measure of the same gambling behaviors, Weinstock et al. (36) found that the G-TLFB led to consistent underreporting of gambling outcomes. The fact that outcomes measured by the G-TLFB in the present study were highest at baseline, the most temporally distant reporting period, does allay some of the concerns about recall accuracy that arise from using this measure somewhat past its validated reporting length of 6 months. Nonetheless, results from the present study, particularly those from baseline data, must be interpreted with caution given the potential for retrospective recall bias.

Another limitation of the present study is our sample characteristics. As discussed, the relatively small sample size of this study indicates that we were likely significantly underpowered for detecting interaction effects in our model, which may have hindered our ability to detect substitution effects. Moreover, a small sample size restricted our ability to investigate possible substitutions between forms of sports related gambling that differed in their availability during the initial lockdown phase (e.g., from betting on team sports to e-sports to horse racing). Low sample size, coupled with our method of convenience sampling from a mixed population of adults in the community and university students, casts doubt on the generalizability of our results to the overall population of Canadian gamblers.

Future directions and conclusion

There is much that remains unknown about how the ongoing COVID-19 pandemic has affected gambling behaviors. One area for future research is the identification of factors that moderate the relationship between gambling availability and gambling behaviors. Though existing research indicates most people gambled less in response to the pandemic, a subset of individuals responded by increasing their gambling, and these individuals may experience more psychological distress and engage in more risky behaviors (34, 59–61). It is important to identify how these individuals differ from the majority who reduce their gambling, to facilitate early identification and intervention for those whose mental health has been negatively affected during the pandemic. As noted by Claesdotter-Knutsson and Håkkanson (61), baseline problem gambling severity and psychological distress scores may be associated with an increase in gambling during the pandemic.

However, a study by Gainsbury et al. (62) found only moderate risk gamblers increased their gambling during the pandemic and these authors reported no association between psychological distress and increased gambling, highlighting the need for additional research on this topic. Additional variables that are good candidates for investigation as potential moderators include coping motives, trait impulsivity, and neuroticism, as these have all been well established in the literature as risk factors for the development of problem gambling (63–65) and thus might similarly confer vulnerability to resistance to decreasing gambling even when gambling opportunities become less available.

Additionally, there is a need for continued longitudinal research to observe trajectories of change in gambling behaviors over the later stages and in the aftermath of the pandemic. Currently, Fluharty et al. (25), Månsson et al. (29), Biddle et al. (33), and the present study are the only known investigations of gambling behaviors that allow for comparisons between a pre-pandemic baseline and multiple periods corresponding to both early and later stages of the pandemic, and the present study is the first to extend this work to a population of Canadian gamblers.

Lastly, the evidence with respect to the existence or absence of a substitution from sports gambling to other forms of gambling amidst restricted availability remains inconclusive. Research is needed to determine whether sports gamblers substituted toward other forms of gambling in response to reduced availability of gambling opportunities during the pandemic. This research should also examine if gamblers are instead substituting gambling behaviors with substance use (e.g., alcohol, or cocaine) or other potentially addictive behaviors (e.g., excessive internet gaming, pornography use), in essence swapping one addictive activity for another. This concept of "addiction substitution" has been theorized (66), and is consistent with findings of increases in substance use and non-gambling related addictive behaviors during lockdown (55, 56).

The present study contributes to the literature concerning the impact of the COVID-19 pandemic on gambling by presenting the first known examination of dynamic changes in gambling behaviors across multiple stages of the pandemic in a Canadian sample. The present study replicated and extended the literature by demonstrating both an initial decrease and later partial rebound on a range of sports gamblers' gambling behaviors during the pandemic, and in doing so provided support for the utility of the availability hypothesis in predicting change in gambling behavior as a function of gambling opportunities. Though the present study's failure to find strong, consistent evidence of a shift from sports gambling to non-sports gambling over the course of the pandemic may allay concerns that the pandemic introduced sports gamblers to potentially riskier forms of gambling, continued monitoring of post-pandemic trends will be essential to fully understanding the lasting impact of the COVID-19 pandemic on gambling habits.

Data availability statement

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

Ethics statement

This study involving human participants was reviewed and approved by Health Sciences Research Ethics Board, Dalhousie University, REB#: 2020-5044. Written informed consent was received from all participants prior to their completion of study measures.

Author contributions

EO: responsible for project conceptualization, survey construction, data collection, conducting analyses, literature review, writing entire first draft of manuscript, and introduction/discussion of final manuscript. AJK: responsible for conducting analyses and writing methods/results of final manuscript. SHS: EO's research supervisor, collaborated with EO and IY for project conceptualization, heavily involved in decisions regarding data analyses, and editing of manuscript. SBS: AJK's research supervisor, assisted AJK with analyses/provision of supervision related to project, and involved in editing manuscript. IY: EO's research supervisor, collaborated with EO and SHS in project conceptualization, provision of research supervision to EO throughout project completion, including advising on writing of manuscript and consultation with respect to statistical methods necessary for data analysis, heavily involved in data collection, analyses, and editing of 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.

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EDITED BY
Andreas Chatzittofis,
University of Cyprus, Cyprus

REVIEWED BY
Melinda Reinhardt,
Eötvös Loránd University, Hungary
Irene Caro,
University Hospital Fundación Jiménez Díaz, Spain
Benjamin Norman Johnson,
Fairleigh Dickinson University, United States

*CORRESPONDENCE
Xuebing Liu
107768791@qq.com
Jun Ma
majun0313@msn.cn

†These authors have contributed equally to this work

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Factors influencing the addiction characteristics of non-suicidal self-injurious behaviors in adolescents: A case-control study

Junhong Zhu[1,2†], Rui Qian[1,2†], Hao Zhong[1,2†], Yi Li[1,2], Xuebing Liu[1,2*] and Jun Ma[1,2*]

[1]Department of Psychiatry, Wuhan Mental Health Center, Wuhan, China, [2]Wuhan Hospital for Psychotherapy, Wuhan, China

Background: Many studies have shown that in the context of public health emergencies, the incidence rate of adolescent non-suicidal self-injury (NSSI) patients increased dramatically. This paper aims to characterize the behavioral characteristics of adolescent NSSI and analyze the influencing factors of NSSI behavior addiction characteristics.

Methods: Our research was a case-control study which included 84 adolescents with NSSI (female *vs*. male: 59 *vs*. 25) and 84 healthy controls (female *vs*. male: 53 *vs*. 31). All the participants enrolled were aged 12-18 years. The differences in the scores of the following five scales were compared between the case and control groups: Egna Minnen Barndoms Uppfostran (EMBU), Perceived Social Support Scale (PSSS), Perceived Stress Scale (PSS); Bergen Social Media Addiction Scale (BSMAS) and Video Game Dependence Scale (VDG-S). The characteristics of NSSI behavior of the study group were evaluated using the Ottawa Self Inventory Chinese Revised Edition (OSIC). And a binary logistic regression model was developed to analyze the factors that influence adolescent NSSI behavioral addiction characteristics.

Results: In the study group, the emotional warmth scores in the father's and mother's rearing style scores in the EMBU were significantly lower than the controls. The BSMAS and VDG-S scores were significantly higher than those in the control group. 38 cases of NSSI with addiction characteristics accounted for 45.24% in the study group. The risk factors for NSSI addiction traits were as follows: female, single-child, high level of VDG-S scores, high scores of excessive interferences in father's rearing style, and high scores of punishments and excessive interferences in mother's rearing style score.

Conclusion: Female, only child, internet addiction, and negative parenting styles were predictors of NSSI behavioral addiction characteristics in adolescents. Targeted coping strategies should be developed to reduce the

occurrence and development of self-injurious behavior, especially for female adolescents with Internet dependence in one-child families with negative parenting styles.

KEYWORDS

adolescent, NSSI, behavioral addiction, parental rearing style, social media dependency, video game addiction

Introduction

The term non-suicidal self-injury (NSSI) refers to behaviors that do not aim to end a person's life but intentionally cause body tissue damage by themselves and are not recognized by society (1), which is especially common in adolescence (2). NSSI is described as having an addiction characteristics or functions (3, 4), which means the behavior is out of control and recurring. As with substance dependence, NSSI causes abnormalities in a wide range of amygdala circuits (5). The reported prevalence of NSSI in adolescents ranges from 11.5 to 47.1% (6–8), and continues showing a gradual increase (6). Although the ultimate goal is not to end life, the abnormal mortality of adolescent NSSI patients in the future is about 9 times higher than that of the general population, the risk of suicide increases by 17.5 times, and acute alcohol and drug poisoning increases by 34 times (9). Despite the seriousness of the risk, the etiology of NSSI remains unknown and the factors associated with the etiology are complex, which make it difficult to provide targeted interventions.

The global pandemic of Coronavirus disease 2019 (COVID-19) has had a broad and far-reaching impact on the general population's mental health (10). Adolescents are more vulnerable to the negative impact of the epidemic spread than adults because of their immature development of psychological defense mechanisms and lacking the experience of dealing with major public health and safety emergencies. A report confirmed 23 emergency services for children and adolescents in 10 countries between March and April 2020, which found that the number of children and adolescents seeking emergency psychiatric services due to self-harm increased by 33% compared with the same period in 2019 (10). Before the epidemic, the overall prevalence of non-suicidal self-injury (NSSI) among Chinese middle school students was 22.37% (11). In contrast, during the COVID-19 outbreak (February 28 to March 11, 2020), data from the Taiwan Province of China found that the prevalence of NSSI among junior high school students was 40.9% (12). Simultaneously, the proportion of NSSI among hospitalized adolescents with mental disorders in China has increased from 29.2% in 2016 to 92.5% in 2020 and 95.9% in 2021 (13).

Another important phenomenon that accompanied the epidemic secondary to the epidemic was the more frequent interactions between the general population and the Internet. During the COVID-19 outbreak, the overall prevalence of Internet addiction in the general population was 36.7% (14), with nearly 50% of subjects reporting increased dependence on Internet use (15). In China, adolescents need to be taught online during the epidemic. They are exposed to the Internet longer than usual, and as a result, the proportion of Internet addiction and gaming behavior among them has changed (16). A 2019 study showed that the prevalence of Internet addiction among Chinese adolescents has reached 15.3% (17), while the prevalence among junior high school students after the epidemic was 24.4–31.2% (18, 19).

Negative parenting styles and adverse childhood experiences have been reported to contribute to the emergence of NSSI behaviors in adolescents. For example, a large cross-sectional study from Yunnan Province, China, with school-based secondary school students, reported that negative parenting styles were associated with adolescent NSSI behavior (7). Inadequate social support is another crucial correlate of NSSI (20). In contrast, a good social support system can also be an essential measure in improving the mental health of adolescent students (21). In addition to the above reasons, another relatively well-reported one is the negative impact of excessive Internet use on adolescent NSSI behavior (22, 23). Offline social support is reported to show a negative association with NSSI (24). However, in Chian, during the outbreak and at a time when the epidemic is being managed on a regular basis, online instruction is the only or primary way for adolescents to maintain their education, which increases the risk of their overuse of the Internet and increases the risk that Internet addiction and NSSI behaviors are intertwined and affect each other.

It is regretful that most of the current research on adolescent NSSI behaviors is based on epidemiological surveys, and relatively few studies have been conducted on adolescent patients hospitalized as a result of NSSI behaviors. In the context of the rapidly increasing prevalence of NSSI in adolescents, the authors hypothesized that the addictive characteristics of inpatient adolescent NSSI behavior are influenced by a variety of factors including parenting style, individual perceptions of stress and social support, and Internet addiction. The purpose of this paper is to explore the factors that influence the behavioral addiction characteristics of hospitalized adolescents with NSSI

and to provide some effective and reasonable recommendations for the treatment of NSSI.

Materials and methods

Subjects

A total of 84 adolescent patients with NSSI who were admitted to Wuhan Mental Health Center for treatment from February 2021 to April 2022 were included in this study.

Inclusion criteria

(1). The Ottawa Self-Injury Inventory Chinese Revised Edition (OSIC) (25) self-injury frequency score: the frequency of self-injury behavior in the past month is not less than 2 points (frequently), and the frequency of self-injury behavior in the past 6 months is not less than 2 points (once a month).
(2). Adolescent patients admitted to the hospital for "self-injury" or accompanied by significant "self-injury behavior."
(3). Participants are 12–18 years old.
(4). Middle school students who are in school and who are temporarily suspended because of "self-injury behavior."

Exclusion criteria

There are explicit and typical psychotic symptoms such as hallucinations, delusions, and catatonia at the time of admission or a clear history of severe mental diseases such as schizophrenia and bipolar disorder. Patients with intellectual disability, autism, and other reasons for not completing the questionnaire were excluded.

Healthy controls

From nearby communities and middle schools, we recruited 84 healthy controls matched with the research group regarding age, gender ratio, education level, the proportion of single-child, and parents' marital status. We excluded 'healthy cases' with self-injury but not seeking medical treatment.

The ethics committee of the Wuhan mental health center approved this study. Informed consent was obtained from the participants themselves and signed by their families or guardians for this study.

Instruments

The electronic medical record system was used to extract general clinical data from the included patients, such as age, gender, number of siblings, parents' marital status, education level, household registration type, site of self-injury, and age of first self-injury, which was then recorded item by item in Excel spreadsheet.

Egna Minnen Barndoms Uppfostran (EMBU) is a self-assessment scale that asks subjects to evaluate their parents' parenting style through recall (26). This scale consists of the father's and mother's scales. The father's scale contains six dimensions: understanding of emotional warmth, severe punishment, excessive interference, preference for subjects, rejection, denial, and overprotection. However, the mother's scale includes five dimensions compared with the father's scale, in which overprotection was not included.

The Perceived Social Support Scale (PSSS) (27) is used to measure respondents' self-reported support from family, friends, and others. This scale has 12 items, and each item is scored on a 7-point scale (1 = strongly disagree; 7 = strongly agree), with higher scores indicating higher levels of perceived support.

The Perceived Stress Scale (PSS) is a self-assessment scale for measuring perceived stress, which has been adapted for use in China by Yang et al. (28). The scale consists of 14 questions reflecting stressful tensions and feelings of loss of control, with items rated on a scale of 0 (never) to 4 (always), with higher scores indicating greater perceived stress.

The Bergen Social Media Addiction Scale (BSMAS) assessed patient dependence on social media. According to the study by Luo et al., we defined a BSMAS score greater than or equal to 24 as social media addiction among Chinese adolescents (29).

The Video Game Dependence Scale (VDG-S) is used to assess patients' reliance on online games (16). VDG-S primarily assesses subjects' video game behavior over the past 12 months. The entire scale contains 18 items; each item is scored on a 4-point scale (1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree). The 18 items were further divided into 9 dimensions in each of two items, and at least one item was determined as "strongly agree" by the subjects; the dimension was scored as 1, and the denial was scored as 0. The total score is approximately 5 points to be determined as internet gaming disorder (IGD).

The Ottawa Self-Injury Inventory Chinese Revised Edition (OSIC) is used to assess the specific characteristics of patients' self-injury behaviors, and this revised version was completed by Chen et al. (13). The text of the revised scale is more concise and efficient and suitable as a clinical and scientific evaluation tool for studying the NSSI behavior of Chinese adolescents. The OSIC can evaluate NSSI thought and behavior frequency, addiction characteristics, and function scale. NSSI thought, and behavior frequency includes three items corresponding to the frequency of NSSI thought and behavior in the past month, the past 6 months, and the past 12 months, respectively. The higher the overall score of the 7 items measuring addiction characteristics, the more addictive the person's NSSI behavior. Defined three or more of the seven NSSI behaviors with a score of greater than or equal to 2 belonging to the characteristics of addiction. The functional scale consists of three parts: social

influence reflects motivations to evoke responses or changes in social contexts, which could enable individuals to attract others' attention, seek help and gain others' understanding (items 2, 4, 6, 10, and 14), external emotion regulation is the regulation of emotions through external factors (items 1, 3, 8, 11, and 13) and internal emotion regulation is the regulation of an individual's own emotions through his or her own internal activities (items 5, 7, 9, 12, and 15). Divided the original total score of the three subscales by the number of items in the subscale to obtain their respective average scores. The scale with the highest average score reflects the most important reason for the individual to engage in non-suicidal self-injury behavior.

We specially designed a web-based questionnaire to collect healthy control data, including demographics, EMBU, PSSS, PSS, BSMAS, and VDG-S.

Procedures

This study was designed as a case-control study. Except for the type of household, the demographics of the controls and the cases were all matched to each other.

We began evaluating adolescent patients who met the inclusion criteria with relevant questionnaires and scales in February 2021. Data collection was generally completed within 3 days after admission for cooperative patients. For emotionally unstable patients who often cry and cannot cooperate, and patients who cannot be diagnosed, the scale evaluation and data collection would be completed within 14 days at the latest. Patients who were unable to be complete the collection of relevant information within 14 days of admission for any reason were excluded from the study. The average time of data collection for all included patients was 2.96 ± 1.87 days after admission.

While collecting the data of the case group, our self-made online questionnaire was used to collect relevant data on the controls in the community and schools. Participants in the controls were all volunteers. The process for recruiting the controls in the community and nearby schools was as follows: for participants who agreed and were able to sign the informed consent form, they would enter the process of providing relevant information by scanning a pre-made two-dimensional code via their smartphones. Once in the program, participants were first asked to fill in the monthly self-injury frequency and semi-annual self-injury frequency, and if both items were 0, they entered the process of demographic information giving and assessment of target self-reported scales other than OSIC. Otherwise, they were automatically launched from the program.

Data analysis

The normally distributed continuous measurement data obtained were expressed as the mean and standard deviation, and the categorical variables as counts. The chi-square test was used for comparing rates, the independent samples t-test was used for comparing two groups of continuous data, and one-way analysis of variance (ANOVA) was used for comparing the differences among the scores of the three OSIC functional scales. A binary logistic regression model was developed to analyze the influencing factors of NSSI behavioral addiction characteristics. The significance level of all statistical tests was set to $p < 0.05$. Data analysis was performed using the IBM SPSS (version 26.0, SPSS Inc., Chicago, IL, USA), and the figure was plotted using the GraphPad Prism software (version 8.4.3; GraphPad Software Inc., La Jolla, CA, USA).

Results

Demographics and general clinical data

At the end point of this study in April 2022, 84 participants were included in the study group that met the inclusion

TABLE 1 Participants' demographics and general clinical data.

Index	Patients ($n = 84$)	Controls ($n = 84$)
Age (years)		
Mean (SD)	15.37 (1.76)	14.89 (3.26)
Range	12-18	12-18
Gender (n, %)		
Female	59, 70.2%	53, 63.1%
Male	25, 29.8%	31, 36.9%
Single-child	39, 46.4%	42, 50.0%
Non-single-child	45, 53.6%	42, 50.0%
Educational background (n, %)		
Junior high school	35, 41.67%	38, 45.24%
Senior high school	49, 58.33%	46, 54.76%
Type of household (n, %)		
Urban status	58, 69%	84, 100%
Rural status	26, 31%	0, 0%
Parents' marital status (n, %)		
Divorced	19, 22.6%	22, 26.19%
Non-divorced	65, 77.4%	74, 73.81%
Age at first self-injury		
Mean (SD)	12.60 (1.47)	
Range	9-15	
Self-injured site (n, %)		
Arm part	74, 88.10%	
Arms and Legs	10, 11.90%	
Frequency of NSSI behavior		
Last 1 month	2.43 (0.52)	
Last 6 months	2.42 (0.50)	

criteria, and 84 healthy controls were recruited from the community and nearby middle school students. For the controls recruitment, a total of 142 participants participated in our questionnaire, of whom 58 were excluded due to incomplete data, and finally, 84 participants were included in the analysis, with a response rate of 59.15%. The demographics and general clinical data of all participants were shown in Table 1.

Differences in target scales scores between groups

Compared with the controls, the emotional warmth scores in the father's and mother's rearing style scores in the EMBU of the study group were significantly lower ($t = -3.22$, $p = 0.02$). Meanwhile, the punishment score for the mother's rearing style was considerably higher than that of the controls ($t = 5.03$, $p < 0.001$). The score of the study group in support within the family in the PSSS was significantly lower than that of the controls ($t = 5.33$, $p < 0.001$). Finally, the BSMAS scores and VDG-S scores of the study group were significantly higher than those of the controls ($t = 2.27$, $p = 0.01$; $t = 2.44$, $p = 0.02$, respectively) (Table 2).

Differences in the proportion of addiction by group: Based on the Bergen Social Media Addiction Scale scores and the Video Game Dependence Scale scores

Based on the scoring principles of the BSMAS and VDG-S, we calculated the number of individuals eligible for social media addiction and video game addiction and compared the group differences in the prevalence of addiction. Further, we observed no significant difference in prevalence of addiction between the study group and the controls (Table 3).

Assessment and analysis of Ottawa Self Inventory Chinese Revised Edition and its functional subscales

According to the scoring rules of the subscale of OSIC addiction characteristics, we found 38 cases of NSSI with addiction characteristics in the study group which accounting for 45.24%. When the average scores of the three OSIC subscales were compared pairwise, it was found that the average score of internal emotion regulation was significantly higher than that of external emotion regulation ($F = 5.84$, $p = 0.03$) (Figure 1).

TABLE 2 Differences between the study group and the control group in EMBU, PSSS, PSS, BSMAS, and VDG-S.

	Study group	Control group	*t*	*d*	*p*
EMBU					
Father's rearing style score					
Emotional warmth	43.71 ± 11.10	45.18 ± 9.98	−3.22	−0.14	0.02*
Punishment	22.85 ± 7.06	21.35 ± 9.20	1.36	0.18	0.11
Excessive interference	21.24 ± 5.01	22.05 ± 7.23	−2.06	−0.13	0.08
Partialism	9.00 ± 3.14	9.02 ± 4.10	−1.00	−0.01	0.29
Rejection	11.38 ± 3.78	10.11 ± 2.96	1.23	0.43	0.54
Overprotection	8.1 ± 2.51	8.31 ± 1.99	−0.98	−0.09	0.39
Mother's rearing style score					
Emotional warmth	43.04 ± 11.03	48.35 ± 11.43	−2.81	−0.47	0.01*
Punishment	16.37 ± 7.60	13.30 ± 8.83	5.03	0.37	<.001*
Excessive interference	38.97 ± 9.90	39.19 ± 11.21	−2.00	−0.02	0.36
Partialism	16.37 ± 6.80	18.35 ± 6.60	−3.07	−0.30	0.06
Rejection	8.83 ± 3.00	9.12 ± 2.88	−1.01	−0.10	0.40
PSSS					
Total score	49.02 ± 13.19	51.89 ± 10.38	−1.57	−0.24	0.12
Support within the family	16.02 ± 5.67	20.70 ± 5.70	−5.33	−0.82	<.001*
Support outside the family	33.00 ± 9.26	31.19 ± 10.22	1.20	−0.19	0.23
PSS	29.32 ± 5.50	27.15 ± 5.48	2.10	0.40	0.15
BSMAS	16.88 ± 6.05	14.79 ± 5.11	2.27	0.37	0.01*
VDG-S	30.24 ± 14.11	25.87 ± 8.36	2.44	0.38	0.02*

EMBU, egna minnen barndoms uppfostran; PSSS, perceived social support scale; PSS, perceived stress scale; BSMAS, bergen social media addiction scale; VDG-S, video game dependence scale; * $p < 0.05$.

10.3389/fpsyt.2022.1033242

TABLE 3 The prevalence of addictive behaviors between the two groups: Based on BSMAS and VDG-S scores.

	Study group (*n*, %)	Control group (*n*, %)	χ^2	*p*
BSMAS ≥ 24	14, 16.67%	8, 9.52%	1.88	0.17
VDG-S ≥ 5	6, 7.14%	5, 5.95%	0.10	0.76

BSMAS, bergen social media addiction scale; VDG-S, video game dependence scale.

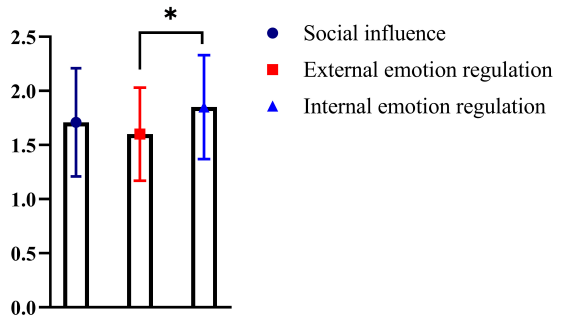

FIGURE 1
Comparison of differences between scores of three functional scales of OSIC. The average score for internal emotion regulation was significantly higher than external emotion regulation ($p = 0.03$) *$p < 0.05$.

Factors influencing behavioral addiction characteristics of non-suicidal self-injury: Binary logistic regression

Addiction characteristics of NSSI behavior as dependent variable (addiction characteristics = 1, otherwise = 0), gender (0 = female, 1 = male) and age, age at first self-injury, single-child or not (0 = non-single-child, 1 = single-child), type of household (0 = urban status, 1 = rural status), parents' marital status (0 = divorced, 1 = non-divorced), and the scores of the target scales were used as independent variables (Table 4). Our results found that the risk factors for NSSI addiction characteristics were as follows: female (B = −2.59, $p = 0.02$, OR = 12.50), single-child (B = 2.58, $p = 0.04$, OR = 13.20), VDG-S (B = 0.16, $p = 0.001$, OR = 1.18), excessive interference (B = 0.24, $p = 0.03$, OR = 1.27) for father's rearing style score, punishment (B = 0.89, $p = 0.04$, OR = 2.43) and excessive interference for mother's rearing style score (B = 0.12, $p = 0.02$, OR = 1.12).

Discussion

To our knowledge, in China, this is the first study to analyze the factors influencing the addiction characteristics of NSSI behaviors in hospitalized adolescents with NSSI. Compared to adolescents of the same age who did not exhibit NSSI behaviors, NSSI patients had insufficient emotional warmth from both parents, insufficient social support from within the family, and higher levels of maternal punishment. Previous reports have shown that negative parenting practices are direct or indirect contributors to the development of NSSI behaviors (7, 30). Another cross-sectional study from Brazil found that lack of emotional warmth is significant risk factor for common mental disorders in adolescence (31). Although the findings of these studies are exemplary of our results, significant increases in the prevalence of NSSI among adolescents during the COVID-19 outbreak compared to the pre-epidemic period have been reported in both the United States (32) and China (33). That is, a pure explanation of NSSI behaviors with adolescents' negative parenting styles from their parents is inadequate. Therefore, to explain this phenomenon in more detail, we conducted a preliminary exploration of the relationship between NSSI and behavioral addiction. The results of our study reported the study group has a higher absolute number of internet addiction and a higher level of internet dependence than the controls. We reported 45.24% of cases with addictive features in the study group and that the behavior was mainly used for internal emotion regulation. In turn, internet dependence is reported to be a known factor associated with NSSI (23). In summary, it is reasonable to assume that both are behavioral addictions, NSSI and Internet addiction may have had a complex interrelationship during the epidemic outbreak, resulting in each being more severe than usual.

Behavioral addiction, the idea that behaviors are self-reinforcing and become repetitive and fixed over time, is affirmed by the four-function model of the NSSI (34). This model assumes that the NSSI is maintained by both positive and negative self-reinforcement processes. These self-reinforcement processes include interpersonal positive reinforcement (producing positive affective or cognitive states and eliciting attention and seeking help), and interpersonal negative reinforcement (reducing negative affective or cognitive states and promoting removal from aversive social situations or reducing interpersonal demands) (35).

We found that female, single-child, video game addiction, excessive interference in father's rearing style, punishment, and excessive interference in mother's rearing style are all risk factors for NSSI behavior in adolescents. There is no conclusive information on whether there are gender differences in the prevalence of NSSI in adolescents. A large-scale cross-sectional study from Sweden found that a higher proportion of females reported NSSI behavior (36). But there are no gender differences in the prevalence of NSSI, as reported from non-clinical samples and from studies in the United States (37, 38). Another study showed that NSSI is more common in women aged 16–19 (39). Our research primarily focused on 12–18 years of adolescents with NSSI. In the included cases, it was found that female patients were more likely to have addictive characteristics of NSSI. Wang et al. and Xu et al.

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TABLE 4 The factors of addiction characteristics of NSSI behavior: Logistic regression model.

	B (SE)	Wald	OR	95% CI	*p*
Constant	−19.56(7.79)	6.30	0.00		0.01
Gender	−2.59(1.14)	5.11	12.50	0.01-0.71	0.02*
Age	0.12(0.25)	0.21	1.12	0.69-1.84	0.64
Age at first self-injury	−0.22(0.27)	0.67	0.80	0.47-1.36	0.41
Single-child	2.58(1.25)	4.24	13.20	1.13-3.99	0.04*
Type of household	0.94(1.17)	0.66	2.57	0.26-5.23	0.42
Parents' marital status	2.66(1.32)	4.07	14.34	1.08-9.39	0.24
PSS	0.05(0.10)	0.29	1.05	0.87-1.28	0.59
BSMAS	0.10(0.08)	1.56	1.10	0.95-1.28	0.21
VDG-S	0.16(0.05)	10.56	1.18	1.07-1.30	0.001*
PSSS					
Total score	0.01(0.05)	0.04	1.01	0.91-1.12	0.02
Support within the family	−0.01(0.14)	0.01	0.99	0.75-1.30	0.03*
Support outside the family	0.12(0.09)	0.03	1.22	0.95-1.41	0.69
EMBU					
Father's rearing style score					
Emotional warmth	0.03(0.06)	0.33	1.03	0.92-1.16	0.57
Punishment	0.01(0.08)	0.03	1.01	0.87-1.18	0.86
Excessive interference	0.24(0.11)	4.79	1.27	1.03-1.57	0.03*
Partialism	−0.23(0.19)	1.48	0.79	0.55-1.15	0.22
Rejection	0.07(0.05)	2.37	1.07	0.98-1.17	0.12
Overprotection	0.25(0.34)	0.53	1.28	0.66-2.49	0.47
Mother's rearing style score					
Emotional warmth	−0.05(0.06)	0.88	0.95	0.85-1.06	0.35
Punishment	0.89(0.42)	4.38	2.43	1.06-5.58	0.04*
Excessive interference	0.12(0.05)	5.18	1.12	1.02-1.24	0.02*
Partialism	−0.85(0.43)	3.95	0.43	0.19-0.99	0.05
Rejection	−0.00(0.19)	0.00	1.00	0.69-	0.99

SE, standard error; EMBU, egna minnen barndoms uppfostran; PSSS, perceived social support scale; PSS, perceived stress scale; BSMAS, bergen social media addiction scale; VDG-S, video game dependence scale, *$p < 0.05$.

previously reported that only children were more likely to have NSSI behavior than adolescents with siblings, because of a lack of social support from society and family (40, 41). Probably the proportion of non-only children was higher in our sample due to the insufficient sample size. However, our analysis shows that the only child is a risk factor for NSSI behavior addiction, confirming the findings of the previous two studies that the only child is more vulnerable to NSSI behavior. Furthermore, we also found that IGD has a predisposing effect on the formation of NSSI behavioral addiction characteristics, confirming that internet "addition" appears to be associated with NSSI (23). More profoundly, we found that internal emotion regulation was higher on the three functional scales of OSIC in the clinical subgroup of NSSI with addiction characteristics. That is, there are reasonable grounds to believe that the addictive characteristics of NSSI function through internal emotion regulation. Excessive interference in the father's approach, punishment, and undue interference in the mother's approach all show poor parental styles. Ying et al. reported the relationship between experience of negative parenting practices and NSSI in Chinese adolescents and found a significant positive correlation between negative parenting practices and NSSI (30), which is an important affirmation of our findings. Thus, we conclude that negative parenting styles also negatively contribute to NSSI behavioral addiction traits.

We need additional clarification that NSSI behavior in adolescent is likely to remain an "undifferentiated" form of mental disorder or simply one of the accompanying symptoms of other psychiatric disorders. The available reports also confirm that studies with adolescents with NSSI often correspond to more than a dozen diagnostic names (25, 42). It is the variability and uncertainty of the diagnostic names that has created some obstacles to our study. Therefore, we used monthly and semiannual NSSI frequency as inclusion criteria rather than specific diagnostic names.

There are limitations to this study. The inclusion of too many regression factors in the binary logistic regression model with a relatively small sample size may not be conducive to

statistical validity and generalization of the findings. In addition, this study only analyzed the NSSI cross-sectionally and did not give a longitudinal follow-up, making it difficult to draw any causal conclusions.

In conclusion, female, only child, internet addiction, and negative parenting styles were predictors of NSSI behavioral addiction characteristics in adolescents.

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 Ethics Committee of the Wuhan Mental Health Center reviewed and approved this study. All participants or their accompanying family members signed informed consent forms to participate.

Author contributions

JM and XL made substantial contributions to conception and design of the study. JZ drafted the manuscript. RQ and HZ had polished and re-edited the language and logic of the manuscript. YL was responsible for setting up and complement and modify the contents of the manuscript. JM gave final approval of the version to be published. 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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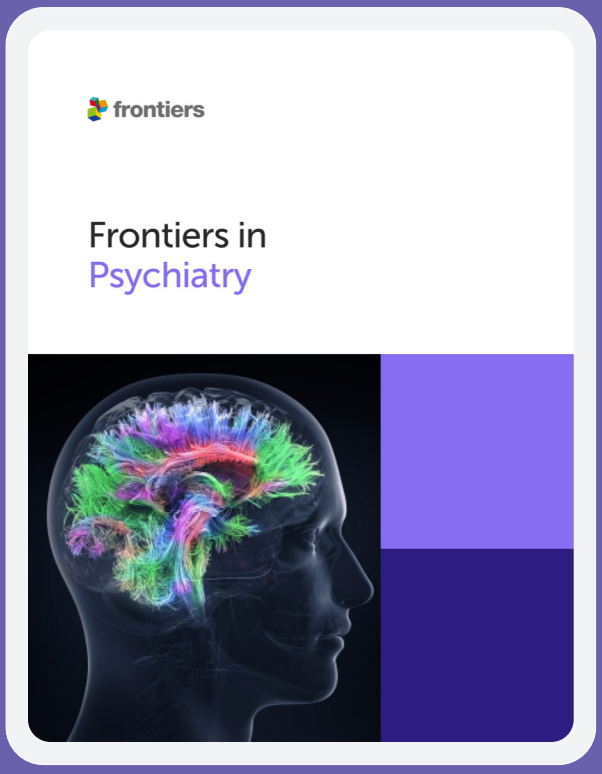

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