



# Associations Between Problematic Internet Use and Mental Health Outcomes of Students: A Meta-analytic Review

Zhihui Cai<sup>1</sup> · Peipei Mao<sup>1</sup> · Zhikeng Wang<sup>1</sup> · Dandan Wang<sup>1</sup> · Jinbo He<sup>2</sup> · Xitao Fan<sup>3</sup>

Received: 12 October 2022 / Accepted: 22 December 2022 / Published online: 28 January 2023  
© The Author(s), under exclusive licence to Springer Nature Switzerland AG 2023

## Abstract

The increasing prevalence of problematic internet use has heightened concerns about its adverse impact on internet users' mental health. Despite reviews investigating the associations between problematic internet use and mental health outcomes, there is a lack of understanding of various aspects of students' mental health. This study aimed to bridge this gap by providing a more comprehensive overall picture of this issue through a quantitative synthesis based on three-level random-effects meta-analytic models. In total, 223 studies with a cumulative total of 498,167 participants and 512 effect sizes were included in this synthesis. The results showed that problematic internet use was moderately and positively associated with depressive symptoms, anxiety, loneliness, and other mental health outcomes, and negatively related to subjective well-being. Moderator analyses revealed that several study features (i.e., school grade, region, measure of problematic internet use, publication year, and gender) could explain the variations in the findings across individual studies. These research results provide solid evidence for the link between problematic internet use and different mental health outcomes and have implications for future research and interventions on students' problematic internet use.

**Keywords** Problematic internet use · Depressive symptoms · Anxiety · Loneliness · Mental health outcomes · Meta-analysis

## Introduction

Over the past decades, internet use has grown exponentially among all age groups, with more than 4 billion internet users worldwide as of 2021 (Internet World Stats, 2021). Along with the popularity of internet use is the increasing number of people with problematic internet use. Recent evidence shows that the estimated prevalence of problematic internet use (PIU) ranged from 20.0 to 44.6% in different regions

(Chia et al., 2020; Endomba et al., 2022), and this phenomenon was found to be more prominent during the COVID-19 pandemic (Masaeli & Farhadi, 2021). Such findings have heightened concerns about the potential adverse impact of problematic internet use on various aspects of mental health, such as depressive symptoms, anxiety, loneliness, and subjective well-being (Peng et al., 2021; Shan et al., 2021; Yang et al., 2022). Given the accessibility to the internet, the lack of self-control and immaturity of physical and psychological development of students, it is imperative that researchers pay special attention to the issue as related to student population (Dong et al., 2020; Hwang et al., 2020). Thus, this study examines the overall relationship between problematic internet use and students' mental health outcomes.

Although some meta-analytic reviews have focused on the relationship between problematic internet use and one or more aspects of mental health (e.g., Lei et al., 2020; Saadati et al., 2021, See Table 1), there are obvious deficiencies in existing meta-analytic reviews, such as a small number of primary studies included in these reviews, inconsistent inclusion criteria (e.g., sample, region), and lack of moderator analyses to explore possible factors contributing to

✉ Zhihui Cai  
caizhihui922@ccnu.edu.cn

✉ Jinbo He  
hejinbo@cuhk.edu.cn

Xitao Fan  
xtfan@cuhk.edu.hk

<sup>1</sup> School of Psychology, Central China Normal University, Wuhan, Hubei, China

<sup>2</sup> School of Humanities and Social Science, The Chinese University of Hong Kong, Shenzhen, Guangdong, China

<sup>3</sup> Faculty of Education, The Chinese University of Hong Kong, Hong Kong, China

**Table 1** Meta-analyses on the relationships between problematic internet use and mental health

Study	Study count	Years included	Demographics	Outcome	Results
Tokunaga (2017)	247	Before 2015	All age groups	Depressive symptoms, loneliness	$r=0.53$ $r=0.29$
Lei et al. (2020)	70	2004–2018	Chinese students	Subjective well-being	$r=-0.313$ $r=-0.21$ $r=-0.183$
Lozano-Blasco and Cortes-Pascual (2020)	13	2013–2019	12–18 years	Depressive symptoms	$r=0.3$
Saadati et al. (2021)	16	2009–2018	All age groups	Loneliness	$r=0.26$

the inconsistent findings across studies. As a result, these reviews provided us with a relatively limited and fragmented understanding about the issue. To address such research gaps, this study synthesized empirical studies examining the relationships between problematic internet use and the major mental health outcomes of students. Specifically, the present study conducted five meta-analyses, with each focusing on one of five different mental health outcomes (i.e., depressive symptoms, anxiety, loneliness, subjective well-being, and other mental health outcomes) as discussed in Tang et al. (2021), such that this study could provide a more comprehensive and robust review of this issue among students.

Problematic internet use is characterized by excessive use of the internet, which may lead to significant impairment or distress (Laconi et al., 2014; Shaw & Black, 2008). Mental health, on the other hand, involves both negative (e.g., depressive symptoms, anxiety, loneliness, etc.) and positive indicators (e.g., life satisfaction, subjective well-being, etc.). Two theories about the associations between problematic internet use and mental health outcomes were discussed. According to the internet use displacement hypothesis (Nie et al., 2002), the amount of time available to an individual is more or less fixed. Time spent on the internet replaces face-to-face interaction, which could be detrimental to interpersonal relationships with friends and family in real life, thus leading to a sense of alienation. This sense of alienation, in turn, could have a negative impact on the mental health of the individual. On the other hand, however, drawing on the uses and gratification theory of Parker and Plank (2000), some researchers posited that the convenience, entertainment, anonymity, and other characteristics of the internet can satisfy the cognitive and emotional needs of students, which could effectively reduce their sense of loneliness and improve their life satisfaction (Boylu & Günay, 2019; Serin, 2011).

In general, problematic internet use was shown to have positive relationship with negative mental health indicators, and negative relationship with positive mental health indicators. But the empirical findings from many individual studies have been far from being consistent. With regard to problematic internet use's association with negative mental

health indicators (e.g., depressive symptoms, anxiety, loneliness), while relatively strong positive associations were reported in many studies (e.g., Bousono et al., 2017; Przepiorka et al., 2021; Sultana & Uddin, 2019), very weak or even non-significant associations were revealed by some other studies (e.g., Javaeed et al., 2019; Shen et al., 2021; Turan et al., 2020). With respect to problematic internet use's relationship with positive mental health indicators (e.g., subjective well-being), similar inconsistencies were observed, with some studies reporting strong negative correlations between problematic internet use and subjective well-being (e.g., Agbaria & Bdier, 2021; Dalton & Cassidy, 2020), while there are other studies reporting close to zero or even positive associations between problematic internet use and subjective well-being (e.g., Serin, 2011; Turan et al., 2020; Zeng et al., 2021). Taken together, the empirical findings on the strengths and directions of the relationships between problematic internet use and mental health outcomes are largely inconsistent. Thus, a systematic and comprehensive meta-analytic review is warranted to further enhance our understanding of this issue.

From the individual studies, little insight can be gained about why the findings in one study differed from those in another. The research literature related to quantitative synthesis of individual studies, however, suggests that the characteristics associated with different studies (e.g., methodological and contextual variations across the studies) may often have played a role in contributing to the inconsistencies of findings across the individual studies. As a result, in a meta-analysis study, the study characteristics of the individual studies may often be considered as potential "moderators" that may partially explain the inconsistencies observed across the studies. Based on some previous meta-analytic studies and on the consideration for information availability from the empirical studies in this area, a few variables of study characteristics were selected as potential moderators that could have contributed to the inconsistency in prior findings regarding the associations between problematic internet use and mental health outcomes, as detailed below (i.e., school grade, region, measure of problematic internet use, measure of mental health, publication year, and gender).

## School Grade

The associations between problematic internet use and mental health outcomes showed some variations across school grade levels. Some studies reported statistically significant, positive, and strong associations between problematic internet use and depressive symptoms for undergraduate students (e.g.,  $r=0.64$ ; Dong & Li, 2020). Yet other studies show statistically non-significant associations between problematic internet use and mental health outcomes for secondary students (e.g., Cerruti et al., 2017). Similar phenomenon was observed from other empirical studies (e.g., Awasthi et al., 2020; Ha & Hwang, 2014; Yadav et al., 2013). Thus, “school grade” was proposed as a potential moderator variable in our moderator analyses. More specifically, “school grade” was coded as “secondary” for an included study with its sample consisting of students from middle or high schools, “undergraduate” if the sample consisted of college students, and “others” if the sample consisted of students from primary schools or mixed groups (i.e., both primary and secondary schools, both secondary schools and universities).

## Region

Research on the relationship between problematic internet use and mental health has been carried out globally (e.g., U.S.A., China, Turkey, Korea). There has been some evidence that the prevalence rate of problematic internet use varied across different nations. For example, a meta-analysis was conducted to estimate the prevalence of problematic internet use in 31 nations and revealed that problematic internet use rates were the highest in the Middle East (10.9%) and the lowest in Northern and Western Europe (2.6%) (Cheng & Li, 2014). Past empirical studies also implied that there were regional differences in the associations of problematic internet use with mental health outcomes, such as anxiety and loneliness (Akhter et al., 2020; Vigna-Taglianti et al., 2017; Zhang et al., 2013). Thus, it would be meaningful to include region as a potential moderator. In this meta-analysis, depending on where the study was conducted, “region” was coded into five categories: Eastern Asia (e.g., China, Japan, Korea), Western Asia (e.g., Turkey, Iran, Israel), Southern Asia (e.g., India, Bangladesh), Europe (e.g., Spanish, Finland, the UK), and others (e.g., America, Chile).

## Measure of Problematic Internet Use

A variety of measures has been used to assess problematic internet use. These measures were based on diverse theoretical models and differed in the dimension or diagnostic criteria (Laconi et al., 2014), which might lead to different findings across studies that used different measurement

tools. In Schoenfeld and Zheng (2012), two measures (Young’s Internet Addiction Test and Caplan’s Generalized Problematic Internet Use Scale) were used to estimate the prevalence rate of problematic internet use among undergraduate students, and the study revealed that the proportion of students identified at risk for problematic internet use varied considerably between the two instruments (18.3% vs 50.4%). Similarly, a meta-analysis also showed that the prevalence of problematic internet use differed by assessment tools (Li et al., 2018). As a result, the measure of problematic internet use could be a potential moderator that might have resulted in the heterogeneity of the findings across previous studies. In this synthesis, for the included primary studies, “measure of problematic internet use” was coded as five categories to reflect the most widely used measures for problematic internet use: Internet Addiction Test, Chen Internet Addiction Scale, Young’s Diagnostic Questionnaire, Online Cognition Scale, and others.

## Measures of Mental Health

Depending on the mental health outcomes of interest (e.g., depressive symptoms, anxiety), various measures could be used for evaluating the mental health outcomes. There has been some evidence that the measures for mental health outcomes used in a study could affect the associations between problematic internet use and mental health indicators in empirical studies (e.g., Cai et al., 2021; Shen et al., 2021; Zhang et al., 2021). For example, Zafar et al. (2018) indicated that there was a significant and strong positive correlation between mental health assessed by the Mental Health Inventory and problematic internet use ( $r=0.73$ ), while Mamun et al. (2020) showed a statistically significant weak relationship between psychological health evaluated by the General Health Questionnaire and problematic internet use ( $r=0.14$ ). Therefore, the measure for mental health was proposed and included as a potential moderator in the present meta-analysis study. In this regard, we coded this study feature only in the studies that assessed depressive symptoms or anxiety as the mental health outcomes, due to the limited categories of measures for other mental health outcomes. More specifically, for studies that focused on depressive symptoms and anxiety, “measure of mental health” was coded as these categories: Beck Depression Inventory, Children’s Depression Inventory, Centre for Epidemiologic Studies Depression Scale, Depression Anxiety Stress Scale, Symptom Checklist-90, Self-Rating Depression scale, Patient Health Questionnaire, Beck Anxiety Inventory, Liebowitz Social Anxiety Scale, Self-Rating Anxiety Scale, and others.

## Publication Year

With the increasing popularity and rapid development of the internet, the number of internet users has been growing rapidly. In many societies, the internet has become an indispensable part of people's daily life. The research has suggested that the prevalence rate of problematic internet use is also increasing (Modara et al., 2017; Shao et al., 2018). Moreover, research suggested that, with the society's more dependence on the internet, the connection between internet habits and mental health, such as depressive symptoms, could be stronger than before (Tokunaga, 2017). Consequently, the research findings on the issue of problematic internet use and mental health could change over time, thus publication year of a study was considered as a potential moderator variable in the present study, and this potential moderator was coded as a continuous variable (i.e., year in which a study was published).

## Gender

There is growing amount of evidence that differences can be found in internet use and the prevalence rate of problematic internet use between males and females, which may contribute to distinct psychological problems (Ha & Hwang, 2014; Lozano-Blasco & Cortes-Pascual, 2020; Ostovar et al., 2016). Some studies showed that the relationships of problematic internet use with depressive symptoms, anxiety, and subjective well-being were stronger for females than males (Baloglu et al., 2018; Ha & Hwang, 2014; Lei et al., 2020), but findings to the opposite (Lozano-Blasco & Cortes-Pascual, 2020), as well as findings of no difference between gender groups (Tokunaga, 2017), also existed. With regard to these inconsistent findings, it is prudent to consider the potential moderating effect of gender in the relationship between problematic internet use and mental health outcomes in this study. Operationally, the proportion of females in the study sample was used in the moderator analysis in this meta-analysis.

## Current Study

Many studies have been conducted to investigate the relationship between problematic internet use and mental health, and considerable inconsistencies in the findings have emerged across the individual studies. Such a situation calls for a comprehensive synthesis of the relevant individual studies for the purpose of developing a better understanding of the overall relationship between problematic internet use and mental health outcomes, as well as a better understanding of how and why the findings of the individual studies varied. This meta-analysis aimed to estimate the overall

relationships between problematic internet use and different mental health outcomes (i.e., depressive symptoms, anxiety, loneliness, subjective well-being, and other mental health outcomes) of students. Then, moderator analyses were conducted to explore whether some study characteristics (i.e., school grade, region, measure of problematic internet use, measure of mental health, publication year, and gender) could have contributed to the observed inconsistent findings across the individual studies.

## Methods

### Literature Search

This study used five online databases, namely Web of Science, PubMed, PsycINFO, ProQuest and Scopus, and systematically searched for the research literature related to the relationship between PIU and mental health outcomes. The terms used were: (“internet addiction” OR “pathological internet use” OR “problematic internet use” OR “internet dependency” OR “internet disorder” OR “compulsive internet use” OR “excessive internet use” OR “internet overuse”) AND (“mental health” OR “anxiety” OR “loneliness” OR “depression” OR “subjective well-being” OR “life satisfaction” OR “stress” OR “psychopathology” OR “suicide” OR “aggression” OR “unhappiness” OR “positive affect” OR “negative affect”). Furthermore, relevant studies were also identified by using Google Scholar, and those from the reference lists in the included studies, from previous reviews or meta-analyses. The search covered the research literature up to February 2022.

### Inclusion and Exclusion Criteria

To be included in this meta-analysis, a study met the following criteria:

- (1) The study examined the association between PIU and mental health outcomes (e.g., depressive symptoms, anxiety, loneliness, subjective well-being, suicide, aggression, hostility, stress, etc.).
- (2) The PIU measurement used in a primary study assessed generalized PIU rather than specific subtype of PIU (e.g., internet gaming disorder, smartphone addiction, etc.). For measuring generalized PIU, the items focus on the overall internet use (e.g., “How often do you choose to spend your time online rather than going out with others?” and “How often do you spend time online when you'd rather sleep?”), rather than a specific aspect of the network use (e.g., “I have slept less than 4 h more than one time due to using smartphone.” and “I

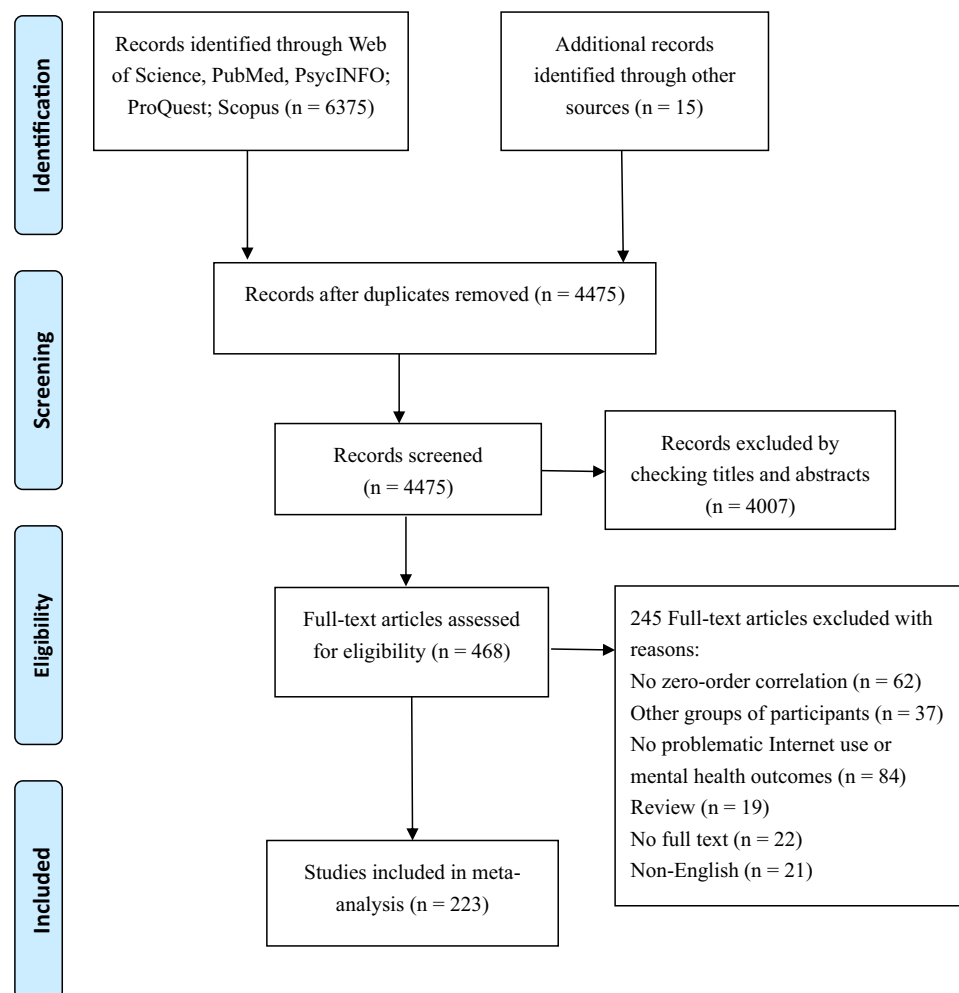
- find that I am becoming more and more dependent on smartphone longer and longer.”).
- (3) The study sample consisted of students from elementary, middle, high schools, and colleges.
  - (4) The study reported zero-order correlation  $r$  between PIU and mental health outcome, or provided other statistical information (e.g.,  $t$ ,  $\chi^2$ ,  $F$  values), to allow us to derive the correlation between PIU and mental health outcome.
  - (5) This meta-analysis focused on the studies involving normal population. Studies involving clinical populations were excluded. For example, the study by Alpaslan et al. (2016) involved adolescents with major depressive disorders, and such or similar studies were not included in this meta-analysis.
  - (6) If a study used a longitudinal design to record the data at different time points, we only used the information of the first measurement. For instance, in the longitudinal study by Ciarrochi et al. (2016), the relationship between compulsive internet use and mental health was measured four times at Grade 8, 9, 10 and 11, respec-

- tively. Only the results measured at Grade 8 were used in our meta-analysis.
- (7) The study was published in an English academic journal.

## Study Selection

The selection procedure was described graphically in Fig. 1. More specifically, in the initial search, 4475 non-duplicate studies were obtained. After screening all titles and abstracts, 468 studies were identified as being relevant for further consideration. Two authors of this study read these articles carefully based on the aforementioned inclusion criteria, and 245 studies were excluded due to various reasons (e.g., no sufficient data, no PIU or mental health outcomes, reviews). Then, the authors of 68 studies that did not report the zero-order correlation between PIU and mental health in their articles were contacted to request this information, and only six responses were received to provide us with the data. Eventually, a total of 223 studies published from 2002 to 2022 were included in the present meta-analysis. The

**Fig. 1** PRISMA flow chart of the selection of studies for the meta-analysis



characteristics and citations of all studies were presented in Online Appendix A and Online Appendix C respectively.

### Coding Process

Two authors of this study coded the primary studies. They first independently coded 30% of the 223 studies, and verified the coding information together. The inter-rater reliability was assessed by intraclass correlation coefficients (ICC) for continuous variables and Cohen's Kappa ( $\kappa$ ) for categorical variables. Specifically, the internal consistency values of moderator variables were: school grade ( $\kappa=0.974$ ), region ( $\kappa=1.000$ ), measure of PIU ( $\kappa=1.000$ ), measure of mental health ( $\kappa=0.948$ ), publication year (ICC=0.999), and gender (ICC=0.998). These results showed high inter-rater reliability among the coders.

### Quality Appraisal

Davids et al. (2017) presented the Methodological Quality Appraisal Tool for evaluating the quality of non-randomized, cross-sectional studies in psychology or other social sciences. This measure was adapted in recent meta-analytic reviews for the purpose of assessing the quality of included studies in a systematic review (e.g. He et al., 2020a, 2020b). In this study, the same approach for quality appraisal of the included studies was used. Specifically, this tool includes 6 items, reflecting five domains of study quality (sampling methods, measurement tool, the data sources used, whether PIU or mental health outcomes were examined, and whether the relationship between PIU and mental health was discussed). Each of the six items was rated as either “yes” or “no” and assigned a score of “1” or “0”, respectively. The quality appraisal score was then obtained by dividing the total score by total number of items multiplied by 100 (expressed as a percentage). As discussed previously (e.g., Davids et al., 2017; Roman & Frantz, 2013), appraisal scores of 0–33%, 34–66%, and 67–100% indicate bad, satisfactory, and good methodological quality, respectively. The quality assessment was conducted by two authors independently and discrepancies were resolved through discussion between the two evaluators.

### Data Analysis

As mentioned earlier, mental health is multi-faceted, and different studies covered different aspects of mental health. In the current meta-analysis, studies that covered negative (depressive symptoms, anxiety, loneliness, suicide, aggression, hostility, stress, etc.) and positive (subjective well-being) indicators of mental health were included. These five categories of mental health outcomes (i.e., depressive symptoms, anxiety, loneliness, subjective well-being, and other

mental health outcomes) were treated as different outcomes, and a meta-analysis was conducted for each of these five mental health outcomes. So essentially, the current synthesis study consists of five meta-analyses.

In our meta-analysis, the zero-order correlation coefficient  $r_s$  from the included studies between PIU and a specific mental health outcome were treated as effect sizes. When studies reported other types of statistical results, those were transformed into correlation coefficients based on well-documented statistical conversion formulas (Yap & Jorm, 2014). For a negative mental health outcome (e.g., depressive symptoms), a positive  $r$  indicated that the higher level of PIU was associated with more serious mental health problems. For the positive mental health outcome (i.e., subjective well-being), a negative  $r$  indicated that the higher level of PIU was associated with lower level of subjective well-being, thus more serious mental health issue. Since correlation coefficients were not normally distributed, all effect sizes were initially converted to Fisher's z-scores for computations. After all the computations, the Fisher's z-scores were transformed back to correlation coefficients for easier interpretation.

The traditional approach to meta-analysis assumes that the effect sizes are independent of each other. However, some studies included in our meta-analysis reported multiple effect sizes based on the same sample and these effect sizes were related. Therefore, a three-level meta-analysis was performed to deal with interdependency of effect sizes (Assink & Wibbelink, 2016). In the current meta-analysis, three different sources of variances were distinguished in the three-level meta-analytic model: sampling variance at level 1; variance across effect sizes within the same study at level 2; variance across effect sizes between studies at level 3 (Cheung, 2014). The appropriateness and the advantages of using this meta-analytic model over traditional approach for such data have been discussed and supported in the literature (Assink & Wibbelink, 2016). All statistical analyses were conducted by using Viechtbauer's (2010) metafor package in the R statistical platform.

### Assessment for Publication Bias

Analysis for potential publication bias was conducted as preliminary analysis prior to meta-analysis. In meta-analysis research literature, publication bias was assumed that studies reporting statistically significant results were easier to get published than those with statistically non-significant findings, and this is also called “file-drawer problem” (Rosenthal, 1979). This assumption, if correct, may lead to estimation error for the true effect size. With this consideration, several widely accepted methods in meta-analysis research literature were used to assess the likelihood that such a problem existed in our data in the current

meta-analysis. First, the funnel plot was applied to estimate the presence or absence of publication bias. If effect sizes of studies were symmetrically distributed on both sides of the mean effect sizes, the absence of publication bias would be supported (Borenstein et al., 2009). Moreover, the trim-and-fill method was also used to assess this problem (Duval & Tweedie, 2000), as proposed by Fernández-Castilla et al. (2021), to detect the potential publication bias.

## Results

### Characteristics of Included Studies

In total, 223 studies involving 498,167 participants met the inclusion criteria and 512 effect sizes were obtained in the present meta-analysis. More specifically, for depressive symptoms, there were 131 studies with 159 effect sizes that involved a cumulative total of 336,642 participants. For anxiety, there were 67 studies with 91 effect sizes that involved a cumulative total of 92,205 participants. For loneliness, there were 56 studies with 69 effect sizes that involved a cumulative total of 79,921 participants. For subjective well-being, there were 29 studies with 38 effect sizes that involved a cumulative total of 208,968 participants. Finally, for other mental health outcomes, there were 76 studies with 155 effect sizes that involved a cumulative total of 217,028 participants.

### Quality Appraisal

The methodological appraisal scores of the included studies ranged from 50 to 100%, indicating overall adequate quality for the included studies. The details of the quality evaluation of each study were presented in Online Appendix B.

### Overall Analysis

The overall analysis results for the relationships between PIU and mental health outcomes are shown in Table 2. More concretely, overall, the four negative mental health outcomes (depressive symptoms, anxiety, loneliness, and other mental health outcomes) were all positively associated with PIU ( $r=0.313, p<0.001$ ;  $r=0.277, p<0.001$ ;  $r=0.252, p<0.001$ ;  $r=0.289, p<0.001$ , respectively). The positive mental health outcome, subjective well-being, was negatively associated to PIU with similar magnitude ( $r=-0.213, p<0.001$ ). These summary findings indicated that higher levels of PIU were associated with more serious mental health issues (depressive symptoms, anxiety, loneliness, and other mental health outcomes), and with lower level of subjective well-being. According to Cohen’s (1992) guidelines that the  $r$  value of 0.1, 0.3, and 0.5 refer to small,

**Table 2** Results for the overall analysis of the relation between problematic internet use and mental health outcomes

Type of outcomes	No. studies	No. ES	Mean $r$	95% CI	$r$ value (sig)	% Var. at level 1	Level 2 variance	% Var. at level 2	Level 3 variance	% Var. at level 3
Depressive symptoms	131	159	0.313	(0.299, 0.348)	26.155***	2.449	0.003***	15.088	0.016***	82.463
Anxiety	67	91	0.277	(0.252, 0.316)	17.676***	4.851	0.001*	5.806	0.015***	89.343
Loneliness	56	69	0.252	(0.218, 0.298)	12.899***	4.133	0.004*	16.700	0.017*	78.867
Subjective well-being	29	38	-0.213	(-0.270, -0.163)	-8.203***	0.833	0.025***	99.167	0.000	0.000
Other mental health outcomes	76	155	0.289	(0.262, 0.331)	16.895***	1.959	0.003***	13.252	0.021***	84.789

\* $p<0.05$ ; \*\* $p<0.01$ ; \*\*\* $p<0.001$

medium, and large effects respectively, these overall meta-analysis findings indicated moderate relationships between PIU and mental health outcomes across many individual studies.

The results of the likelihood-ratio tests for heterogeneity across the effect sizes revealed that there was statistically significant within-study effect size heterogeneity (i.e., statistically significant level-2 variances) or statistically significant between-study effect size heterogeneity (i.e., statistically significant level-3 variances) for the five mental health outcomes (i.e., depressive symptoms, anxiety, loneliness, subjective well-being, and other mental health outcomes). Thus, we conducted moderator analyses to explore whether some study characteristics could have moderated the association between PIU and mental health outcomes for these five domains (i.e., depressive symptoms, anxiety, loneliness, subjective well-being, and other mental health outcomes).

## Moderator Analyses

### Depressive Symptoms

As shown in Table 3, across the studies that examined the relationship between depressive symptoms and PIU, three study characteristics appeared to be moderators for the heterogeneity of the effect sizes: school grade ( $F_{(2, 156)} = 5.054$ ,  $p = 0.007$ ), region ( $F_{(4, 154)} = 2.668$ ,  $p = 0.034$ ), and publication year ( $F_{(1, 157)} = 5.482$ ,  $p = 0.020$ ). More specifically, this association was stronger in the studies involving samples of undergraduate students ( $r = 0.353$ ) than in those involving samples of secondary school students ( $r = 0.281$ ). For region as a moderator, this relationship appeared to be weaker in the studies involving samples in East Asia ( $r = 0.282$ ) than those in other regions. Additionally, the moderation analysis result of publication year showed that the magnitude of the

**Table 3** Results for the moderator analysis of the relation between problematic internet use and depressive symptoms

Moderator variables	No. studies	No. ES	Mean $r$	95% CI	$t$ value (sig)	$F$ (df1, df2)	Level 2 variance	Level 3 variance
<i>School grade</i>	131	159				$F(2, 156) = 5.054^{**}$	0.003	0.015
Secondary	72	89	0.281	(0.257, 0.321)	17.849***			
Undergraduate	50	59	0.353	(0.330, 0.408)	18.705***			
Others	10	11	0.331	(0.262, 0.426)	8.314***			
<i>Region</i>	131	159				$F(4, 154) = 2.668^*$	0.003	0.015
East Asia	66	74	0.282	(0.257, 0.323)	17.476***			
West Asia	30	37	0.335	(0.296, 0.399)	13.355***			
South Asia	10	10	0.327	(0.248, 0.433)	7.257***			
Europe	20	27	0.377	(0.335, 0.457)	12.839***			
Others	5	11	0.322	(0.212, 0.456)	5.422***			
<i>Measure of PIU</i>	131	159				$F(3, 155) = 2.382$	0.003	0.016
IAT	64	74	0.330	(0.308, 0.378)	19.380***			
CIAS	14	15	0.230	(0.162, 0.307)	6.414***			
YDQ	12	13	0.315	(0.247, 0.406)	8.109***			
Others	41	57	0.314	(0.283, 0.367)	15.235***			
<i>Measure of depressive symptoms</i>	131	159				$F(7, 151) = 1.075$	0.003	0.016
BDI	27	35	0.316	(0.272, 0.382)	11.739***			
CDI	5	6	0.246	(0.135, 0.367)	4.271***			
CES-D	28	28	0.342	(0.303, 0.409)	13.270***			
DASS-21	16	18	0.335	(0.277, 0.420)	9.622***			
SCL-90	6	6	0.333	(0.226, 0.467)	5.677***			
SDS	5	6	0.264	(0.150, 0.391)	4.442***			
PHQ	9	9	0.359	(0.281, 0.471)	7.841***			
Others	35	51	0.283	(0.246, 0.337)	12.719***			
<i>Publication year</i>	131	159	0.007	(0.001, 0.012)	2.341*	$F(1, 157) = 5.482^*$	0.003	0.016
<i>Female</i>	123	150	-0.017	(-0.167, 0.133)	-0.230	$F(1, 148) = 0.053$	0.003	0.017

IAT Internet Addiction Test; CIAS Chen Internet Addiction Scale; YDQ Young's Diagnostic Questionnaire; BDI Beck Depression Inventory; CDI Children's Depression Inventory; CES-D Centre for Epidemiologic Studies Depression Scale; DASS-21 Depression Anxiety Stress Scale; SCL-90 Symptom Checklist-90; SDS Self-Rating Depression scale; PHQ Patient Health Questionnaire

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$



“PIU-depressive symptoms” association became stronger over time. No moderating effects were found for other coded moderator variables (measure of PIU, measure of depressive symptoms, and gender).

**Anxiety**

Table 4 showed the moderator analysis results for anxiety, and only measure of PIU appeared to be a moderator for the heterogeneity of the effect sizes ( $F_{(3, 87)}=2.904, p=0.039$ ). More precisely, the association between PIU and anxiety was the strongest when PIU was assessed with YDQ ( $r=0.377$ ). Other moderators (school grade, region, measure of anxiety, publication year, gender) appeared not to have accounted for any statistically significant amount of between-study effect-size heterogeneity.

**Loneliness**

The results of the moderator analyses of the connection between PIU and loneliness were shown in Table 5. Two

study features turned out to be statistical moderators for the effect size heterogeneity across the studies that examined the relationship between PIU and loneliness: region ( $F_{(4, 64)}=2.807, p=0.033$ ) and gender ( $F_{(1, 64)}=5.180, p=0.026$ ). The averaged effect size ( $r=0.174$ ) from the studies involving samples in West Asia, and that ( $r=0.409$ ) from studies involving samples in South Asia were the smallest and the largest respectively, with the effect sizes conducted in other regions being somewhere in-between. For gender (operationalized as the proportion of females in a study sample) as a moderator, the studies with larger proportions of females showed weaker association between PIU and loneliness, and this observation is to be discussed later. Other coded moderator variables (school grade, measure of PIU, publication year) showed no statistical moderation effects.

**Subjective Well-Being**

The results of the moderator analyses for subjective well-being were presented in Table 6, and only publication year

**Table 4** Results for the moderator analysis of the relation between problematic internet use and anxiety

Moderator variables	No. Studies	No. ES	Mean <i>r</i>	95% CI	<i>t</i> value (sig)	<i>F</i> (df1, df2)	Level 2 variance	Level 3 variance
<i>School grade</i>	67	91				<i>F</i> (2, 88)=0.432	0.001	0.016
Secondary	41	56	0.276	(0.241, 0.324)	13.494***			
Undergraduate	23	32	0.272	(0.226, 0.332)	10.405***			
Others	3	3	0.344	(0.194, 0.525)	4.322***			
<i>Region</i>	67	91				<i>F</i> (4, 86)=0.516	0.001	0.016
East Asia	27	41	0.259	(0.215, 0.314)	10.654***			
West Asia	15	22	0.304	(0.247, 0.381)	9.259***			
South Asia	6	6	0.250	(0.137, 0.372)	4.313***			
Europe	15	18	0.283	(0.219, 0.362)	8.116***			
Others	4	4	0.316	(0.192, 0.462)	4.820***			
<i>Measure of PIU</i>	67	91				<i>F</i> (3, 87)=2.904*	0.001	0.014
IAT	31	36	0.282	(0.244, 0.337)	12.375***			
CIAS	10	19	0.205	(0.136, 0.280)	5.739***			
YDQ	6	8	0.377	(0.287, 0.504)	7.232***			
Others	20	28	0.282	(0.235, 0.346)	10.341***			
<i>Measure of anxiety</i>	66	90				<i>F</i> (5, 84)=0.893	0.001	0.015
BAI	6	6	0.261	(0.166, 0.368)	5.252***			
DASS-21	15	17	0.319	(0.260, 0.401)	9.346***			
LSAS	5	8	0.300	(0.206, 0.415)	5.907***			
SCL-90	6	10	0.305	(0.207, 0.424)	5.778***			
SAS	5	5	0.200	(0.081, 0.326)	3.293**			
Others	32	44	0.266	(0.227, 0.320)	11.724***			
<i>Publication year</i>	67	91	0.001	(-0.007, 0.009)	0.344	<i>F</i> (1, 89)=0.119	0.001	0.015
<i>Female</i>	66	90	-0.112	(-0.287, 0.063)	-1.277	<i>F</i> (1, 88)=1.629	0.001	0.016

IAT Internet Addiction Test; CIAS Chen Internet Addiction Scale; YDQ Young’s Diagnostic Questionnaire; BAI Beck Anxiety Inventory; DASS-21 Depression Anxiety Stress Scale; LSAS Liebowitz Social Anxiety Scale; SCL-90 Symptom Checklist-90; SAS Self-Rating Anxiety Scale

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

**Table 5** Results for the moderator analysis of the relation between problematic internet use and loneliness

Moderator variables	No. Studies	No. ES	Mean <i>r</i>	95% CI	<i>t</i> value (sig)	<i>F</i> (df1, df2)	Level 2 variance	Level 3 variance
<i>School grade</i>	56	69				<i>F</i> (2, 66)=0.548	0.004	0.017
Secondary	24	25	0.234	(0.176, 0.300)	7.701***			
Undergraduate	28	40	0.262	(0.211, 0.325)	9.383***			
Others	4	4	0.304	(0.165, 0.463)	4.219***			
<i>Region</i>	56	69				<i>F</i> (4, 64)=2.807*	0.004	0.015
East Asia	14	14	0.290	(0.224, 0.373)	7.989***			
West Asia	15	19	0.174	(0.102, 0.250)	4.748***			
South Asia	4	4	0.409	(0.274, 0.594)	5.415***			
Europe	13	16	0.243	(0.171, 0.325)	6.415***			
Others	10	16	0.273	(0.190, 0.370)	6.228***			
<i>Measure of PIU</i>	56	69				<i>F</i> (2, 66)=0.399	0.004	0.017
IAT	21	22	0.268	(0.209, 0.342)	8.278***			
OCS	5	5	0.204	(0.065, 0.349)	2.912**			
Others	30	42	0.250	(0.200, 0.309)	9.337***			
<i>Publication year</i>	56	69	0.001	(- 0.007, 0.010)	0.258	<i>F</i> (1, 67)=0.067	0.004	0.017
<i>Female</i>	53	66	- 0.375	(- 0.740, -0.048)	- 2.276	<i>F</i> (1, 64)=5.180*	0.004	0.015

IAT Internet Addiction Test; OCS Online Cognition Scale

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

**Table 6** Results for the moderator analysis of the relation between problematic internet use and subjective well-being

Moderator variables	No. studies	No. ES	Mean <i>r</i>	95% CI	<i>t</i> value (sig)	<i>F</i> (df1, df2)	Level 2 variance	Level 3 variance
<i>School grade</i>	29	38				<i>F</i> (2, 35)=0.201	0.026	0.000
Secondary	16	21	- 0.204	(- 0.279, - 0.134)	- 5.785***			
Undergraduate	11	15	- 0.233	(- 0.327, - 0.147)	- 5.357***			
Others	2	2	- 0.177	(- 0.411, 0.053)	- 1.568			
<i>Region</i>	29	38				<i>F</i> (3, 34)=0.462	0.025	0.001
East Asia	10	12	- 0.176	(- 0.274, - 0.081)	- 3.751***			
West Asia	11	15	- 0.217	(- 0.311, - 0.130)	- 4.953***			
Europe	3	3	- 0.280	(- 0.480, - 0.096)	- 3.048**			
Others	5	8	- 0.235	(- 0.362, - 0.116)	- 3.936***			
<i>Measure of PIU</i>	29	38				<i>F</i> (2, 35)=2.116	0.023	0.000
IAT	10	13	- 0.266	(- 0.364, - 0.182)	- 6.074***			
OCS	3	5	- 0.101	(- 0.246, 0.044)	- 1.409			
Others	16	20	- 0.207	(- 0.280, - 0.139)	- 6.033***			
<i>Publication year</i>	29	38	- 0.020	(- 0.033, - 0.007)	- 3.218**	<i>F</i> (1, 36)=10.355**	0.019	0.000
<i>Female</i>	27	36	- 0.081	(- 0.367, 0.205)	- 0.576	<i>F</i> (1, 34)=0.332	0.026	0.000

IAT Internet Addiction Test; OCS Online Cognition Scale

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

was found to be a significant moderator ( $F_{(1, 36)} = 10.355$ ,  $p = 0.003$ ). The correlation between PIU and subjective well-being became smaller over time. No moderating effects were found for other coded moderator variables (school grade, region, measure of PIU, gender).

### Other Mental Health Outcomes

As shown in Table 7, region ( $F_{(4, 150)} = 4.321$ ,  $p = 0.002$ ) and publication year ( $F_{(1, 153)} = 5.385$ ,  $p = 0.022$ ) showed statistically significant moderating effects on the heterogeneity

**Table 7** Results for the moderator analysis of the relation between problematic internet use and other mental health outcomes

Moderator variables	No. Studies	No. ES	Mean <i>r</i>	95% CI	<i>t</i> value (sig)	<i>F</i> (df1, df2)	Level 2 variance	Level 3 variance
<i>School grade</i>	76	155				<i>F</i> (2, 152)=0.466	0.003	0.021
Secondary	40	89	0.275	(0.235, 0.329)	11.832***			
Undergraduate	30	58	0.303	(0.256, 0.370)	10.898***			
Others	6	8	0.316	(0.197, 0.458)	4.951***			
<i>Region</i>	76	155				<i>F</i> (4, 150)=4.321**	0.003	0.017
East Asia	28	71	0.217	(0.170, 0.272)	8.629***			
West Asia	21	40	0.344	(0.297, 0.422)	11.343***			
South Asia	9	9	0.352	(0.268, 0.468)	7.297***			
Europe	9	17	0.356	(0.276, 0.468)	7.670***			
Others	9	18	0.270	(0.191, 0.362)	6.387***			
<i>Measure of PIU</i>	76	155				<i>F</i> (4, 150)=2.315	0.003	0.019
IAT	34	57	0.293	(0.251, 0.353)	11.755***			
YDQ	3	8	0.449	(0.309, 0.658)	5.470***			
CIAS	11	22	0.227	(0.145, 0.316)	5.330***			
OCS	3	6	0.404	(0.255, 0.602)	4.875***			
Others	25	62	0.277	(0.226, 0.342)	9.698***			
<i>Publication year</i>	76	155	0.009	(0.001, 0.017)	2.321*	<i>F</i> (1, 153)=5.385*	0.003	0.019
<i>Female</i>	70	149	-0.007	(-0.221, 0.207)	-0.063	<i>F</i> (1, 147)=0.004	0.003	0.018

IAT Internet Addiction Test; YDQ Young's Diagnostic Questionnaire; CIAS Chen Internet Addiction Scale; OCS Online Cognition Scale

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

of the effect sizes from the studies that examined the relationship between PIU and other mental health outcomes. More specifically, larger effect sizes were found in the studies involving samples from Europe ( $r=0.356$ ), South Asia ( $r=0.352$ ), and West Asia ( $r=0.344$ ) than in the studies involving samples from East Asia ( $r=0.217$ ) and “Others” ( $r=0.270$ ). The moderating effect of publication year indicated that the relationship between PIU and other mental health outcomes was stronger in more recent studies. Other coded study features (school grade, measure of PIU, gender) did not show statistical effect on the heterogeneity of the effect sizes across the studies.

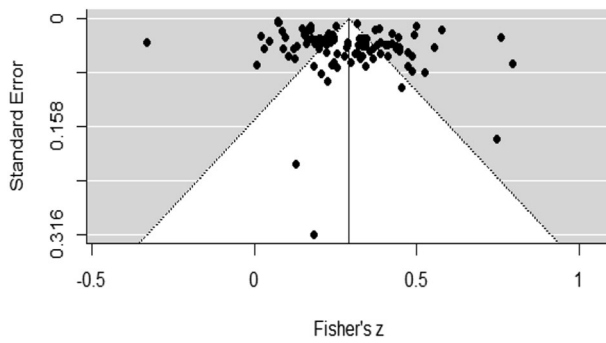
### Publication Bias

As can be seen in Figs. 2, 3, 4, 5 and 6, the funnel plots of the five mental health outcomes (i.e., depressive symptoms, anxiety, loneliness, subjective well-being, other mental health outcomes) were basically symmetrically distributed, suggesting little evidence for publication bias. Furthermore, as suggested by Fernández-Castilla et al. (2021) for trim-and-fill method, the optimal values for indicating publication bias would vary based on the magnitude of effect sizes ( $r=0.213$  to  $0.313$  in this review) and the number of effect sizes (38 to 159 in this review) included in an analysis. Under our data conditions, for “depressive symptoms” and “other mental health outcomes”, the publication bias would

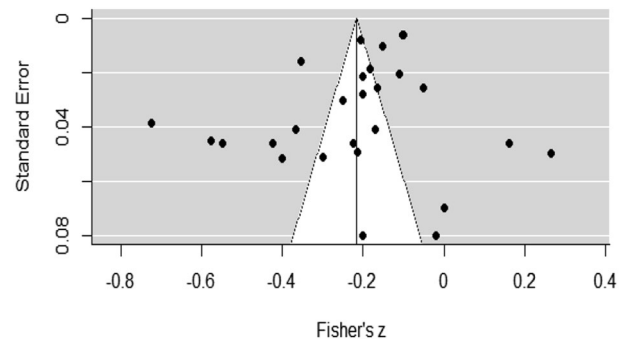
be suggested if  $L_0^+$  is greater than 3. For “anxiety”, “loneliness”, and “subjective well-being”, the publication bias would be suggested if  $L_0^+$  is greater than 2. Our results of the trim-and-fill method for depressive symptoms ( $L_0^+ = 0$ ), anxiety ( $L_0^+ = 0$ ), loneliness ( $L_0^+ = 0$ ), subjective well-being ( $L_0^+ = 0.347$ ) and other mental health outcomes ( $L_0^+ = 0$ ) indicated a lack of evidence for publication bias.

### Discussion

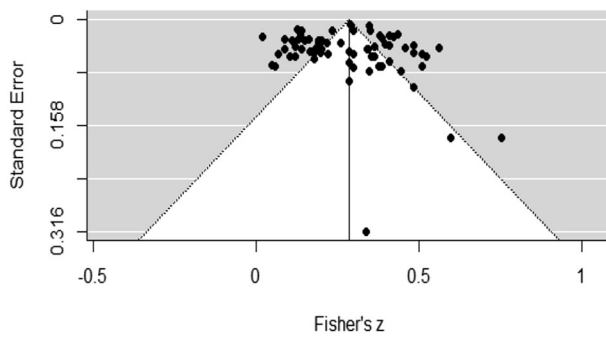
Despite a growing body of research suggesting that problematic internet use is associated with various mental health problems, there has been a lack of understanding about the similarities and differences between problematic internet use and different mental health indicators. Therefore, this study conducted five meta-analyses to estimate the overall associations between problematic internet use and each of five mental health outcomes for students of different grades; and it also sought to examine whether certain study characteristics could have contributed to the heterogeneity of the findings across previous individual studies. The results indicated that higher levels of problematic internet use were related to higher levels of depressive symptoms, anxiety, loneliness, and other negative mental health outcomes, but to lower levels of subjective well-being. The strength of such relationships between problematic internet use and mental health outcomes were moderated by school grade, region,



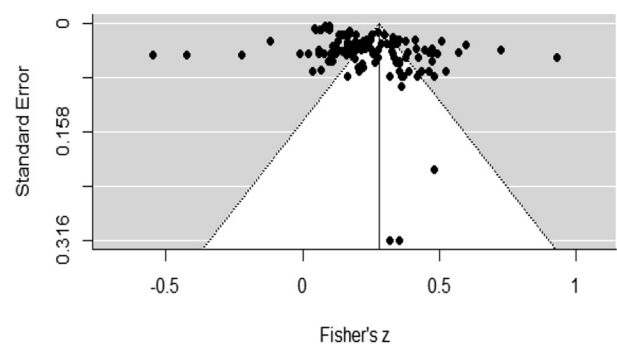
**Fig. 2** Funnel plot for the association between problematic internet use and depressive symptoms



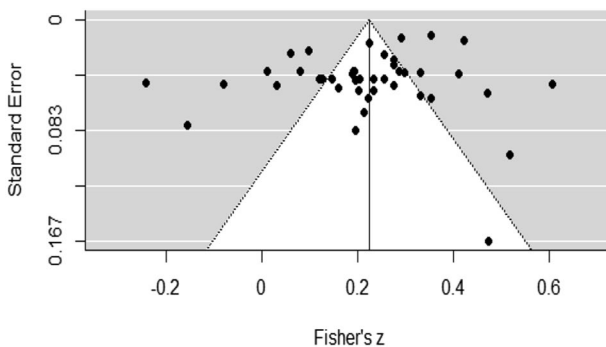
**Fig. 5** Funnel plot for the association between problematic internet use and subjective well-being



**Fig. 3** Funnel plot for the association between problematic internet use and anxiety



**Fig. 6** Funnel plot for the association between problematic internet use and other mental health outcomes



**Fig. 4** Funnel plot for the association between problematic internet use and loneliness

measure of problematic internet use, publication year, and gender.

### Overall Associations Between Problematic Internet Use and Mental Health Outcomes

The results of three-level meta-analysis showed moderate positive correlations between problematic internet use

and depressive symptoms ( $r = 0.313$ ), anxiety ( $r = 0.277$ ), loneliness ( $r = 0.252$ ), other mental health outcomes ( $r = 0.289$ ) and a moderate negative relation with subjective well-being ( $r = -0.213$ ). In other words, despite the considerable variations in the findings across the many studies included in this meta-analysis, overall, individuals who reported higher levels of problematic internet use were more likely to have reported higher levels of negative mental health problems, and to have reported lower levels of subjective well-being, a positive indicator of mental health. These findings were generally consistent with previous studies in this area and provided evidence for the internet use displacement hypothesis (e.g., Cikrikci, 2016; Lei et al., 2020; Lozano-Blasco & Cortes-Pascual, 2020; Tokunaga, 2017). At the same time, some studies pointed out that the negative mental health problems might be potential risk factors for problematic internet use (Cikrikci, 2019; Liang et al., 2016; Lu et al., 2017). Individuals suffering from mental health issues are more inclined to use the internet to alleviate their negative emotions. The psychological dependence on the Internet and maladaptive cognition of the virtual world led them to spend more time on the internet. Additionally,

similar to the findings in some previous studies (Carli et al., 2013; Cheung et al., 2018; Erceg et al., 2018; Li et al., 2019), the association between problematic internet use and depressive symptoms appeared to be relatively strong and robust. This result has important implications for future practice.

## Potential Implications of Moderators

### School Grade

Regarding school grade, our results suggested that, in the reported association between problematic internet use and depressive symptoms, there was significant difference between the studies involving secondary school students and those involving undergraduates, but no significant differences were found for other mental health outcomes (anxiety, loneliness, subjective well-being, and other mental health outcomes). It could be likely that, compared with secondary school students, college students could be more likely to experience the symptom of problematic internet use because they have abundant time to surf the Internet without the supervision of parents and teachers, which might be prone to trigger depressive symptoms (Tian et al., 2017). Furthermore, in addition to facing the same academic pressure as secondary school students, college students are exposed to more stressors, such as interpersonal pressure, parental expectations, and work pressure, which could contribute to higher levels of problematic internet use and mental health problems (Buizza et al., 2022).

### Region

The study feature region turned out to be a statistical moderator for the observed heterogeneity in the correlations of problematic internet use with depressive symptoms, loneliness, and other mental health outcomes across the studies. More specifically, these associations were stronger in the studies conducted in South Asia and Europe than those conducted in other regions coded in this meta-analysis (Europe, West Asia, and East Asia). There could be two relevant factors in play for this finding. On one hand, there was some indication that the prevalence rate of problematic internet use was higher in some South Asia nations (e.g., Nepal and India; Balhara et al., 2019) than in some other countries. On the other hand, some policy and prevention approaches for problematic internet use prevention adopted in some other areas (e.g., China, Japan, South Korea, Germany, Australia, USA, UK; King et al., 2018) could also have made some difference for the association between problematic internet use

and mental health outcomes. Nevertheless, this finding is not in line with some previous studies reporting that the prevalence of problematic internet use was relatively low in European countries (Balhara et al., 2019; Cheng & Li, 2014). This issue should receive more attention in future studies.

### Measure of Problematic Internet Use

No statistically significant amount of the effect-size heterogeneity across the studies was explained by the different measuring instruments for problematic internet use used in the primary studies for four mental health outcomes (depressive symptoms, anxiety, loneliness, subjective well-being, and other mental health outcomes), indicating that this connection between problematic internet use and these mental health outcomes was robust with regard to different problematic internet use measures. However, the measure of problematic internet use could affect the relationship between problematic internet use and anxiety, with this association being the strongest when problematic internet use was assessed with YDQ. Compared with IAT and OCS, YDQ was less used to measure problematic internet use in the studies included in the meta-analysis. Due to the limited number of effect sizes, this result should be interpreted with caution.

### Measure of Mental Health

In addition to the findings related to problematic internet use measures described above, the findings also indicated that different measures for depressive symptoms and anxiety used in different primary studies played no “moderating” role in the relationships between problematic internet use and depressive symptoms; nor did they play a role between problematic internet use and anxiety. Although there were differences in measures for depressive symptoms and anxiety, these tools had good internal consistency reliability to accurately evaluate the degree of depressive symptoms and anxiety of participants. This lack of “moderating” effect of mental health measures provides support for the robustness of the problematic internet use’s respective relationships with depressive symptoms and anxiety.

### Publication Year

The time when different primary studies were published showed no moderating effect on problematic internet use’s respective relationships with two mental health outcomes examined in this synthesis (anxiety and loneliness), indicating that these associations were robust regarding when the studies were conducted. However, the strength of the association between problematic internet use and depressive

symptoms, and the association between problematic internet use and other mental health outcomes (e.g., aggression, hostility, suicide, etc.), was stronger in more recent studies. In line with the stronger relationship of problematic internet use with negative mental health indicators in more recent studies described above, the association between problematic internet use and the positive mental health indicator, i.e., subjective well-being, was weaker in more recent studies. A possible explanation for this might be that, as mentioned earlier, the prevalence of problematic internet use has significantly increased in recent years, and the internet is often used to cope with life stress or difficulties, which makes internet users more likely to escape from reality and suffer from mental health problems. Additionally, the coronavirus 2019 (COVID-19) has a significant impact on life style and the mental health of students (Aranda & Rodriguez-Cuevas, 2021; Cui et al., 2022), which might also contribute to this trend.

### Gender

The moderator analysis results revealed that the relationship between problematic internet use and loneliness was weaker in samples with a higher percentages of females; in other words, the strength of this association tended to be stronger for males than for females. One possible reason for this finding could be related to gender difference in internet usage: more females tended to use the internet for social communication, leading to lower level of loneliness feeling; whereas more males tended to spend more time on online gaming, or even as escape from the real life, further increasing their loneliness (Dufour et al., 2016). With regard to the relationships of problematic internet use with the other four mental health outcomes (depressive symptoms, anxiety, subjective well-being, and other mental health outcomes), gender was not shown to have any “moderating” role in those relationships, which was consistent with some previous research findings (e.g., Huang, 2010; Tokunaga, 2017). Some studies, however, reported that gender played a role in problematic internet use’s respective relationships with depressive symptoms and subjective well-being (Lei et al., 2020; Lozano-Blasco & Cortes-Pascual, 2020), suggesting that more research may be warranted with regard to this issue.

### Limitations and Future Directions

The present study has some limitations. First, almost all the studies included in this meta-analysis had cross-sectional design, which limited the possibility of making inferences about possible causal relationship between problematic internet use and mental health outcomes. Future studies would benefit from longitudinal design to examine

problematic internet use and mental health outcomes for shedding light on the nature of relationships between problematic internet use and a range of mental health indicators.

Second, the current meta-analysis examined the direct connection between problematic internet use and mental health outcomes, but could not address the issues of any possible mediating or moderating mechanisms of this association (e.g., social support, self-control, and personality), due to the very limited number of primary studies that considered mediating/moderating mechanisms (Floros et al., 2014; He et al., 2014; Song & Park, 2019) for such associations. Future studies in this area may need to consider potential mediating/moderating mechanisms for better understanding of the link between problematic internet use and mental health outcomes.

Third, with regard to problematic internet use and mental health outcomes, the majority of the studies included in this meta-analysis involved samples of secondary school students or college students, and too few studies had samples of elementary school students. However, with the substantial infiltration of internet in the society, internet users are becoming younger, and even very young students have ready access to the internet. As a result, it is becoming more likely that very young students may develop problematic internet use (Wang & Cheng, 2019). Consequently, in future research, it is important that samples of elementary school students should be included, with the hope that problematic internet use problem could be prevented at earlier age.

Finally, this study generally examined the associations between problematic internet use and different mental health problems (i.e., depressive symptoms, anxiety, loneliness, subjective well-being, and other mental health outcomes). However, due to the small number of primary studies, some mental health indicators (e.g., suicide, aggression, and hostility) were aggregated into “other mental health outcomes”, and the present study is unable to investigate the relationship between problematic internet use and each of these specific mental health outcomes. Future research is needed to involve these more specific mental health problems.

### Conclusion

Several studies have focused on the relationship between problematic internet use and mental health; however, there has been little discussion about various mental health issues. The current meta-analysis quantitatively synthesized the empirical studies on the relationships between problematic internet use and different mental health outcomes for students. The findings from this synthesis showed that problematic internet use was positively related to depressive symptoms, anxiety, loneliness, and other mental health outcomes, while negatively related to subjective well-being. In

addition, the association between problematic internet use and depressive symptoms appeared to be relatively robust. Furthermore, several study features (i.e., school grade, region, measure of problematic internet use, publication year, and gender) were shown to account for the variations in the relationships between problematic internet use and mental health outcomes across the individual studies. More specifically, the results showed that (1) undergraduates with high levels of problematic internet use reported more depressive symptoms than secondary school students; (2) the strength of the associations between problematic internet use and depressive symptoms, loneliness, and other mental health outcomes were stronger in the studies conducted in South Asia and Europe; (3) the links of problematic internet use with depressive symptoms, subjective well-being, and other mental health outcomes were stronger in more recent studies; and (4) males with higher levels of problematic internet use reported more loneliness than females. This study's findings shed light on more nuanced relationships between problematic internet use and different aspects of mental health, which contributes to our better understanding about how problematic internet use and different mental health outcomes were related. Such understanding could have useful implications in helping researchers design intervention mechanisms for problematic internet use for improving the mental health of adolescents. Researchers are encouraged to explore the causal relationships between problematic internet use and mental health outcomes by using longitudinal designs.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s40894-022-00201-9>.

**Acknowledgements** The authors would like to thank Dr. Xin Hao for her help revising manuscript.

**Authors' Contributions** Z.C. conceived of the study, participated in its design, data collection, statistical analysis and drafted the manuscript; P.M. participated in the data collection and statistical analysis and helped to draft the manuscript; Z.W. participated in the data collection; D.W. participated in the data collection; J.H. participated in the design of the study and helped to draft the manuscript; X.F. helped to draft the manuscript. All authors read and approved the final manuscript.

**Funding** This research was supported by the National Natural Science Foundation of China (No. 62107018) the Fundamental Research Funds for the Central Universities (No. CCNU22QN013, CCNU22QN020).

**Data Availability** Data is available from the corresponding author upon reasonable request.

## Declarations

**Conflict of interest** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## References

- Agbaria, Q., & Bdier, D. (2021). The role of social support and subjective well-being as predictors of internet addiction among Israeli–Palestinian college students in Israel. *International Journal of Mental Health & Addiction*, *19*(5), 1889–1902. <https://doi.org/10.1007/s11469-020-00282-4>
- Akhter, M. S., Islam, M. H., & Momen, M. N. (2020). Problematic Internet Use among university students of Bangladesh: The predictive role of age, gender, and loneliness. *Journal of Human Behavior in the Social Environment*, *30*(8), 1082–1093. <https://doi.org/10.1080/10911359.2020.1784346>
- Alpaslan, A. H., Soylu, N., Kocak, U., & Guzel, H. I. (2016). Problematic Internet use was more common in Turkish adolescents with major depressive disorders than controls. *Acta Paediatrica*, *105*(6), 695–700. <https://doi.org/10.1111/apa.13355>
- Aranda, Z., & Gabriela Rodriguez-Cuevas, F. (2021). COVID-19 and global mental health. *The Lancet Psychiatry*, *8*(6), 457–457.
- Assink, M., & Wibbelink, C. J. (2016). Fitting three-level meta-analytic models in R: A step-by-step tutorial. *The Quantitative Methods for Psychology*, *12*(3), 154–174. <https://doi.org/10.20982/tqmp.12.3.p154>
- Awasthi, A. A., Taneja, N., Maheshwari, S., & GuptaBhavika, T. (2020). Prevalence of internet addiction, poor sleep quality, and depressive symptoms among medical students: A cross-sectional study. *Osong Public Health and Research Perspectives*, *11*(5), 303–308. <https://doi.org/10.24171/j.phrp.2020.11.5.06>
- Baloglu, M., Kozan, H. I. O., & Kesici, S. (2018). Gender differences in and the relationships between social anxiety and problematic internet use: Canonical analysis. *Journal of Medical Internet Research*. <https://doi.org/10.2196/jmir.8947>
- Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. Wiley.
- Bousono, M., Al-Halabi, S., Buron, P., Garrido, M., Ma Diaz-Mesa, E., Galvan, G., & Bobes, J. (2017). Substance use or abuse, Internet use, psychopathology and suicidal ideation in adolescents? *Adicciones*, *29*(2), 97–104. <https://doi.org/10.20882/adicciones.811>
- Boylu, A. A., & Günay, G. (2019). Loneliness and internet addiction among university students. In Information Resources Management Association (Ed.), *Psychological, social, and cultural aspects of internet addiction* (pp. 109–125). IGI Global.
- Buizza, C., Bazzoli, L., & Ghilardi, A. (2022). Changes in college students mental health and lifestyle during the COVID-19 pandemic: A systematic review of longitudinal studies. *Adolescent Research Review*, *7*(4), 537–550. <https://doi.org/10.1007/s40894-022-00192-7>
- Cai, H., Xi, H. T., Zhu, Q., Wang, Z., Han, L., Liu, S., & Xiang, Y. T. (2021). Prevalence of problematic Internet use and its association with quality of life among undergraduate nursing students in the later stage of COVID-19 pandemic era in China. *The American Journal on Addictions*, *30*(6), 585–592. <https://doi.org/10.1111/ajad.13216>
- Carli, V., Durkee, T., Wasserman, D., Hadlaczky, G., Despalins, R., Kramarz, E., & Kaess, M. (2013). The association between pathological internet use and comorbid psychopathology: A systematic review. *Psychopathology*, *46*(1), 1–13. <https://doi.org/10.1159/000337971>
- Cerruti, R., Spensieri, V., Presaghi, F., Valastro, C., Fontana, A., & Guidetti, V. (2017). An exploratory study on Internet addiction, somatic symptoms and emotional and behavioral functioning in school-aged adolescents. *Clinical Neuropsychiatry*, *14*(6), 374–383.
- Cheng, C., & Li, A. Y. (2014). Internet addiction prevalence and quality of (real) life: A meta-analysis of 31 nations across seven

- world regions. *Cyberpsychology, Behavior and Social Networking*, 17(12), 755–760. <https://doi.org/10.1089/cyber.2014.0317>
- Cheung, J.C.-S., Chan, K.H.-W., Lui, Y.-W., Tsui, M.-S., & Chan, C. (2018). Psychological well-being and adolescents' internet addiction: A school-based cross-sectional study in Hong Kong. *Child and Adolescent Social Work Journal*, 35(5), 477–487. <https://doi.org/10.1007/s10560-018-0543-7>
- Cheung, M.W.-L. (2014). Modeling dependent effect sizes with three-level meta-analyses: A structural equation modeling approach. *Psychological Methods*, 19(2), 211–229. <https://doi.org/10.1037/a0032968>
- Chia, D., Ng, C., Kandasami, G., Seow, M., Choo, C. C., Chew, P., Lee, C., & Zhang, M. (2020). Prevalence of internet addiction and gaming disorders in Southeast Asia: A meta-analysis. *International Journal of Environmental Research and Public Health*, 17(7), 2582. <https://doi.org/10.3390/ijerph17072582>
- Ciarrochi, J., Parker, P., Sahdra, B., Marshall, S., Jackson, C., Gloster, A. T., & Heaven, P. (2016). The development of compulsive Internet use and mental health: A four-year study of adolescence. *Developmental Psychology*, 52(2), 272–283. <https://doi.org/10.1037/dev0000070>
- Cikrikci, O. (2016). The effect of Internet use on well-being: Meta-analysis. *Computers in Human Behavior*, 65, 560–566. <https://doi.org/10.1016/j.chb.2016.09.021>
- Cikrikci, O. (2019). An exploration of the associations among positivity, general distress and Internet addiction: The mediating effect of general distress. *Psychiatry Research*, 272, 628–637. <https://doi.org/10.1016/j.psychres.2018.12.147>
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155–159. <https://doi.org/10.1037/0033-2909.112.1.155>
- Cui, J., Lu, J., Weng, Y., Yi, G. Y., & He, W. (2022). COVID-19 impact on mental health. *BMC Medical Research Methodology*. <https://doi.org/10.1186/s12874-021-01411-w>
- Dalton, F., & Cassidy, T. (2020). Problematic Internet usage, personality, loneliness, and psychological well-being in emerging adulthood. *Analyses of Social Issues and Public Policy (ASAP)*. <https://doi.org/10.1111/asap.12224>
- Davids, E. L., Roman, N. V., & Leach, L. (2017). The link between parenting approaches and health behavior: A systematic review. *Journal of Human Behavior in the Social Environment*, 27(6), 589–608. <https://doi.org/10.1080/10911359.2017.1311816>
- Dong, H., Yang, F., Lu, X., & Hao, W. (2020). Internet addiction and related psychological factors among children and adolescents in China during the coronavirus disease 2019 (COVID-19) epidemic. *Frontiers in Psychiatry*, 11, 00751. <https://doi.org/10.3389/fpsy.2020.00751>
- Dong, Y., & Li, H. (2020). The relationship between social support and depressive symptoms among the college students of Liaoning, China: A moderated mediated analysis. *Psychology Health & Medicine*, 25(3), 368–378. <https://doi.org/10.1080/13548506.2019.1679844>
- Dufour, M., Brunelle, N., Tremblay, J., Leclerc, D., Cousineau, M.-M., Khazaal, Y., & Berbiche, D. (2016). Gender difference in internet use and internet problems among Quebec high school students. *Canadian Journal of Psychiatry-Revue Canadienne De Psychiatrie*, 61(10), 663–668. <https://doi.org/10.1177/0706743716640755>
- Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, 56(2), 455–463. <https://doi.org/10.1111/j.0006-341X.2000.00455.x>
- Endomba, F. T., Demina, A., Meille, V., Ndoadoumgué, A. L., Danwang, C., Petit, B., & Trojak, B. (2022). Prevalence of internet addiction in Africa: A systematic review and meta-analysis. *Journal of Behavioral Addictions*, 11(3), 739–753. <https://doi.org/10.1556/2006.2022.00052>
- Erceg, T., Flander, G. B., & Brezinscak, T. (2018). The relationship between compulsive internet use and symptoms of depression and anxiety in adolescence. *Alcoholism and Psychiatry Research*, 54(2), 101–112. <https://doi.org/10.20471/dec.2018.54.02.02>
- Fernández-Castilla, B., Declercq, L., Jamshidi, L., Beretvas, S. N., Onghena, P., & Van den Noortgate, W. (2021). Detecting selection bias in meta-analyses with multiple outcomes: A simulation study. *Journal of Experimental Education*, 89(1), 125–144. <https://doi.org/10.1080/00220973.2019.1582470>
- Floros, G., Siomos, K., Stogiannidou, A., Giouzevas, I., & Garyfallos, G. (2014). The relationship between personality, defense styles, internet addiction disorder, and psychopathology in college students. *Cyberpsychology Behavior and Social Networking*, 17(10), 672–676. <https://doi.org/10.1089/cyber.2014.0182>
- Ha, Y.-M., & Hwang, W. J. (2014). Gender differences in internet addiction associated with psychological health indicators among adolescents using a National Web-based Survey. *International Journal of Mental Health and Addiction*, 12(5), 660–669. <https://doi.org/10.1007/s11469-014-9500-7>
- He, F., Zhou, Q., Li, J., Cao, R., & Guan, H. (2014). Effect of social support on depression of Internet addicts and the mediating role of loneliness. *International Journal of Mental Health Systems*, 8, 5. <https://doi.org/10.1186/1752-4458-8-34>
- He, J., Sun, S., Lin, Z., & Fan, X. (2020b). Body dissatisfaction and sexual orientations: A quantitative synthesis of 30 years research findings. *Clinical Psychology Review*, 81, 101896. <https://doi.org/10.1016/j.cpr.2020.101896>
- He, J., Sun, S., Zickgraf, H., Lin, Z., & Fan, X. (2020a). Meta-analysis of gender differences in body appreciation. *Body Image*, 33, 90–100. <https://doi.org/10.1016/j.bodyim.2020.02.011>
- Huang, C. (2010). Internet use and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior, and Social Networking*, 13(3), 241–249. <https://doi.org/10.1089/cyber.2009.0217>
- Hwang, T. J., Rabheru, K., Peisah, C., Reichman, W., & Ikeda, M. J. (2020). Loneliness and social isolation during the COVID-19 pandemic. *International Psychogeriatrics*, 32, 1217–1220. <https://doi.org/10.31234/osf.io/3dwxq>
- Internet World Stats. World Internet Users Statistics and 2021 World Population Stats. <https://www.internetworldstats.com/stats.htm>
- Javaeed, A., Zafar, M. B., Iqbal, M., & Ghauri, S. K. (2019). Correlation between Internet addiction, depression, anxiety and stress among undergraduate medical students in Azad Kashmir. *Pakistan Journal of Medical Sciences*, 35(2), 506–509. <https://doi.org/10.12669/pjms.35.2.169>
- King, D. L., Delfabbro, P. H., Doh, Y. Y., Wu, A. M. S., Kuss, D. J., Pallesen, S., & Sakuma, H. (2018). Policy and prevention approaches for disordered and hazardous gaming and internet use: An international perspective. *Prevention Science*, 19(2), 233–249. <https://doi.org/10.1007/s11121-017-0813-1>
- Laconi, S., Rodgers, R. F., & Chabrol, H. (2014). The measurement of Internet addiction: A critical review of existing scales and their psychometric properties. *Computers in Human Behavior*, 41, 190–202. <https://doi.org/10.1016/j.chb.2014.09.026>
- Lei, H., Chiu, M. M., & Li, S. (2020). Subjective well-being and Internet overuse: A meta-analysis of mainland Chinese students. *Current Psychology*, 39(3), 843–853. <https://doi.org/10.1007/s12144-019-00313-x>
- Li, L., Xu, D. D., Chai, J. X., Wang, D., Li, L., Zhang, L., & Xiang, Y. T. (2018). Prevalence of Internet addiction disorder in Chinese university students: A comprehensive meta-analysis of observational studies. *Journal of Behavioral Addictions*, 7(3), 610–623. <https://doi.org/10.1556/2006.7.2018.53>
- Li, X., Luo, X., Zheng, R., Jin, X., Mei, L., Xie, X., & Song, R. (2019). The role of depressive symptoms, anxiety symptoms, and school functioning in the association between peer victimization and Internet addiction: A moderated mediation model.



- Journal of Affective Disorders*, 256, 125–131. <https://doi.org/10.1016/j.jad.2019.05.080>
- Liang, L., Zhou, D., Yuan, C., Shao, A., & Bian, Y. (2016). Gender differences in the relationship between Internet addiction and depression: A cross-lagged study in Chinese adolescents. *Computers in Human Behavior*, 63, 463–470. <https://doi.org/10.1016/j.chb.2016.04.043>
- Lozano-Blasco, R., & Cortes-Pascual, A. (2020). Problematic Internet uses and depression in adolescents: A meta-analysis. *Comunicar*, 28(63), 109–120. <https://doi.org/10.3916/c63-2020-10>
- Lu, W.-H., Lee, K.-H., Ko, C.-H., Hsiao, R. C., Hu, H.-F., & Yen, C.-F. (2017). Relationship between borderline personality symptoms and Internet addiction: The mediating effects of mental health problems. *Journal of Behavioral Addictions*, 6(3), 434–441. <https://doi.org/10.1556/2006.6.2017.053>
- Mamun, M. A., Hossain, M. S., Moonajilin, M. S., Masud, M. T., Misti, J. M., & Griffiths, M. D. (2020). Does loneliness, self-esteem and psychological distress correlate with problematic Internet use? A Bangladeshi survey study. *Asia-Pacific Psychiatry*, 12(4), e12386. <https://doi.org/10.1111/appy.12426>
- Masaeli, N., & Farhadi, H. (2021). Prevalence of Internet-based addictive behaviors during COVID-19 pandemic: A systematic review. *Journal of Addictive Diseases*, 39(4), 468–488. <https://doi.org/10.1080/10550887.2021.1895962>
- Modara, F., Rezaee-Nour, J., Sayehmiri, N., Maleki, F., Aghakhani, N., Sayehmiri, K., & Rezaei-Tavirani, M. (2017). Prevalence of internet addiction in Iran: A systematic review and meta-analysis. *Addiction & Health*, 9(4), 243–252.
- Nie, N. H., Hillygus, D. S., & Erbring, L. (2002). Internet use, interpersonal relations, and sociability. In B. Wellman & C. Haythornthwaite (Eds.), *The Internet in everyday life* (pp. 215–243). Wiley.
- Ostovar, S., Allahyar, N., Aminpoor, H., Moafian, F., Nor, M. B. M., & Griffiths, M. D. (2016). Internet addiction and its psychosocial risks (depression, anxiety, stress and loneliness) among Iranian adolescents and young adults: A structural equation model in a cross-sectional study. *International Journal of Mental Health and Addiction*, 14(3), 257–267. <https://doi.org/10.1007/s11469-015-9628-0>
- Pal Singh Balhara, Y., Doric, A., Stevanovic, D., Knez, R., Singh, S., Roy Chowdhury, M. R., & Le Thi Cam Hong Le, H. (2019). Correlates of problematic internet use among college and university students in eight countries: An international cross-sectional study. *Asian Journal of Psychiatry*, 45, 113–120. <https://doi.org/10.1016/j.ajp.2019.09.004>
- Parker, B. J., & Plank, R. E. (2000). A uses and gratifications perspective on the internet as a new information source. *American Business Review*, 18(2), 43–49.
- Peng, C., Wang, M., Cheng, J., Tan, Y., Huang, Y., Rong, F., & Yu, Y. (2021). Association between internet addiction and suicidal ideation, suicide plans, and suicide attempts among Chinese adolescents with and without parental migration. *Computers in Human Behavior*, 125, 106949. <https://doi.org/10.1016/j.chb.2021.106949>
- Przepiorka, A., Blachnio, A., & Cudo, A. (2021). Relationships between morningness, Big Five personality traits, and problematic Internet use in young adult university students: Mediating role of depression. *Chronobiology International*, 38(2), 248–259. <https://doi.org/10.1080/07420528.2020.1851703>
- Roman, N. V., & Frantz, J. M. (2013). The prevalence of intimate partner violence in the family: A systematic review of the implications for adolescents in Africa. *Family Practice*, 30(3), 256–266. <https://doi.org/10.1093/fampra/cms084>
- Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin*, 86(3), 638–641. <https://doi.org/10.1037/0033-2909.86.3.638>
- Saadati, H. M., Mirzaei, H., Okhovat, B., & Khodamoradi, F. (2021). Association between Internet addiction and loneliness across the world: A meta-analysis and systematic review. *SSM-Population Health*, 16, 100948. <https://doi.org/10.1016/j.ssmph.2021.100948>
- Schoenfeld, D., & Zheng, Y. (2012). Prevalence and correlates of Internet addiction in undergraduate students: Assessing with two major measures. *International Journal of Cyber Behavior, Psychology and Learning*, 2(2), 16–34. <https://doi.org/10.4018/ijcbpl.2012040102>
- Serin, N. B. (2011). An examination of predictor variables for problematic Internet use. *Turkish Online Journal of Educational Technology*, 10(3), 54–62.
- Shan, X., Ou, Y., Ding, Y., Yan, H., Chen, J., Zhao, J., & Guo, W. (2021). Associations between internet addiction and gender, anxiety, coping styles and acceptance in university freshmen in South China. *Frontiers in Psychiatry*, 12, 558080. <https://doi.org/10.3389/fpsy.2021.558080>
- Shao, Y.-J., Zheng, T., Wang, Y.-Q., Liu, L., Chen, Y., & Yao, Y.-S. (2018). Internet addiction detection rate among college students in the People's Republic of China: a meta-analysis. *Child and Adolescent Psychiatry and Mental Health*. <https://doi.org/10.1186/s13034-018-0231-6>
- Shaw, M., & Black, D. (2008). Internet addiction: Definition, assessment, epidemiology and clinical management. *CNS Drugs*, 22, 353–365. <https://doi.org/10.2165/00023210-200822050-00001>
- Shen, Y., Wang, L., Huang, C., Guo, J., De Leon, S. A., Lu, J., & Zhang, X. Y. (2021). Sex differences in prevalence, risk factors and clinical correlates of Internet addiction among Chinese college students. *Journal of Affective Disorders*, 279, 680–686. <https://doi.org/10.1016/j.jad.2020.10.054>
- Song, W. J., & Park, J. W. (2019). The influence of stress on internet addiction: Mediating effects of self-control and mindfulness. *International Journal of Mental Health and Addiction*, 17(4), 1063–1075. <https://doi.org/10.1007/s11469-019-0051-9>
- Sultana, M., & Uddin, M. K. (2019). Parental rejection, depression, and Internet addiction among young adults. *Pakistan Journal of Psychological Research*, 34(2), 419–432. <https://doi.org/10.33824/PJPR.2019.34.2.23>
- Tang, S., Werner-Seidler, A., Torok, M., Mackinnon, A. J., & Christensen, H. (2021). The relationship between screen time and mental health in young people: A systematic review of longitudinal studies. *Clinical Psychology Review*, 86, 102021. <https://doi.org/10.1016/j.cpr.2021.102021>
- Tian, Y., Bian, Y., Han, P., Gao, F., & Wang, P. (2017). Associations between psychosocial factors and generalized pathological Internet use in Chinese university students: A longitudinal cross-lagged analysis. *Computers in Human Behavior*, 72, 178–188. <https://doi.org/10.1016/j.chb.2017.02.048>
- Tokunaga, R. S. (2017). A meta-analysis of the relationships between psychosocial problems and Internet habits: Synthesizing Internet addiction, problematic Internet use, and deficient self-regulation research. *Communication Monographs*, 84(4), 423–446. <https://doi.org/10.1080/03637751.2017.1332419>
- Turan, N., Durgun, H., Kaya, H., Asti, T., Yilmaz, Y., Gunduz, G., & Ertas, G. (2020). Relationship between nursing students' levels of Internet addiction, loneliness, and life satisfaction. *Perspectives in Psychiatric Care*, 56(3), 598–604. <https://doi.org/10.1111/ppc.12474>
- Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, 36(3), 1–48. <https://doi.org/10.18637/jss.v036.i03>
- Vigna-Taglianti, F., Brambilla, R., Priotto, B., Angelino, R., Cuomo, G., & Diecidue, R. (2017). Problematic Internet use among high school students: Prevalence, associated factors and gender differences. *Psychiatry Research*, 257, 163–171. <https://doi.org/10.1016/j.psychres.2017.07.039>
- Wang, T.-H., & Cheng, H.-Y. (2019). Problematic Internet use among elementary school students: Prevalence and risk factors.

- Information Communication & Society*. <https://doi.org/10.1080/1369118x.2019.1645192>
- Yadav, P., Banwari, G., Parmar, C., & Maniar, R. (2013). Internet addiction and its correlates among high school students: A preliminary study from Ahmedabad, India. *Asian Journal of Psychiatry*, 6(6), 500–505. <https://doi.org/10.1016/j.ajp.2013.06.004>
- Yang, X., Guo, W. J., Tao, Y. J., Meng, Y. J., Wang, H. Y., Li, X. J., & Li, T. (2022). A bidirectional association between internet addiction and depression: A large-sample longitudinal study among Chinese university students. *Journal of Affective Disorders*, 299, 416–424. <https://doi.org/10.1016/j.jad.2021.12.013>
- Yap, M. B. H., Pilkington, P. D., Ryan, S. M., & Jorm, A. F. (2014). Parental factors associated with depression and anxiety in young people: A systematic review and meta-analysis. *Journal of Affective Disorders*, 156, 8–23. <https://doi.org/10.1016/j.jad.2013.11.007>
- Zafar, N., Kausar, R., & Pallesen, S. (2018). Internet addiction, insomnia and mental health problems in university students in Pakistan. *Pakistan Journal of Social and Clinical Psychology*, 16(2), 10–16.
- Zeng, G., Zhang, L., Fung, S.-F., Li, J., Liu, Y.-M., Xiong, Z.-K., & Huang, Q. (2021). Problematic internet usage and self-esteem in Chinese undergraduate students: The mediation effects of individual affect and relationship satisfaction. *International Journal of Environmental Research and Public Health*, 18(13), 6949. <https://doi.org/10.3390/ijerph18136949>
- Zhang, H.-X., Jiang, W.-Q., Lin, Z.-G., Du, Y.-S., & Vance, A. (2013). Comparison of psychological symptoms and serum levels of neurotransmitters in shanghai adolescents with and without internet addiction disorder: A case–control study. *PLoS ONE*. <https://doi.org/10.1371/journal.pone.0063089>
- Zhang, Y., Liu, Z., & Zhao, Y. (2021). Impulsivity, social support and depression are associated with latent profiles of internet addiction among male college freshmen. *Frontiers in Psychiatry*, 12, 642914. <https://doi.org/10.3389/fpsy.2021.642914>

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.