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REVIEW ARTICLE

Longitudinal modifiable risk and protective factors of internet gaming disorder: A systematic review and meta-analysis

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ABSTRACT

Background and aims: The study aims to thoroughly understand the causal and precedent modifiable risk or protective factors for Internet Gaming Disorder (IGD), a newly defined and prevalent mental disorder. *Methods:* We performed a systematic review on quality-designed longitudinal studies based on five online databases: MEDLINE, PsycINFO, Embase, PubMed, and Web of Science. Studies were included in the meta-analysis if they addressed IGD, adopted longitudinal, prospective, or cohort study designs, presented modifiable factors of IGD, and reported the effect sizes for correlations. Pooled Pearson's correlations were calculated using the random effects model. *Results:* Thirty-nine studies with 37,042 subjects were included. We identified 34 modifiable factors, including 23 intrapersonal factors (e.g., gaming time, loneliness, etc.), 10 interpersonal factors (e.g., peer relationship, social support, etc.), and 1 environmental factor (i.e., school engagement). Age, the male ratio, study region, and study years were significant moderators. *Discussion and conclusions:* Intrapersonal factors were stronger predictors than interpersonal and environmental factors. It may imply that individual-based theories are more powerful to explain the development of IGD. Longitudinal research on the environmental factors of IGD was lacking; more studies are warranted. The identified modifiable factors would help to guide effective interventions for IGD reduction and prevention.

KEYWORDS

meta-analysis, modifiable factors, internet gaming disorder, behavioural addiction, longitudinal studies

INTRODUCTION

Internet gaming activities play a major role in our social and leisure time today. Although there are social and physical benefits from normal engagement in gaming, excessive gaming and Internet gaming disorder (IGD) can lead to severe interpersonal and health problems (Brand, 2022; Yang, Yip, Lee, Zhang, & Wong, 2021). The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) proposes IGD as a potential psychiatric condition (American Psychiatric Association, 2013). Recently, gaming disorder (GD) is defined as a mental disorder, which is characterized by the inability to control, prioritisation of gaming over other activities, and persistent or exacerbated gaming behaviour despite

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negative life consequences in the International Classification of Diseases (ICD-11) (World Health Organization, 2018). The prevalence of IGD ranges from 0.2% to −57.5% in the general population and shows a growing trend over years (Darvesh et al., 2020).

Early detection and early intervention are efficient strategies to prevent mental disorders and severe consequences and reduce costs and burdens for health service systems (Carney & Myers, 2012). Meta-analyses (Horowitz & Garber, 2006) demonstrated that selective (secondary) prevention targeting a high-risk subgroup of a disorder is more effective and cost-effective for mental disorders than primary or tertiary prevention. However, there is a dearth of such selective programs for IGD (Rumpf et al., 2018). To develop effective selective preventions and to identify the high-risk groups of IGD, understanding its modifiable risk and protective predictors at various socio-ecological levels is warranted. An appropriate framework for exploring the multiple factors influencing behaviour health is the Social Ecological Model (SEM), which proposes that human development takes place through constant interchange between the individual and his or her environment (Bronfenbrenner & Ceci, 1994; Glanz & Bishop, 2010). Based on the SEM, risk and protective factors of IGD can be identified from intrapersonal, interpersonal and broader social-environmental and policy levels (Glanz et al., 2010). Many systematic review studies on risk and protective factors of certain health outcomes adopted SEM to frame the results and findings (O'Donoghue et al., 2016; Raynor, 2013).

We only identified one systematic review and one meta-analysis on correlates of IGD. Mihara and Higuchi's (2017) systematic review identified 37 cross-sectional and 13 longitudinal studies. Significant correlates included gaming-related factors (e.g., gaming time), demographic and familial factors (e.g., being male, familial difficulties), interpersonal relations and school/social functions (e.g., being bullied), personality, psychiatric comorbidity, and physical health (Mihara & Higuchi, 2017). However, meta-analysis was not performed in this study, and most of the identified correlates were based on cross-sectional studies. Only gaming time, male sex, impulsivity and conduct problems were identified in longitudinal studies (Mihara & Higuchi, 2017). Ji, Yin, Zhang, and Wong (2022) conducted a meta-analysis of 153 studies among Chinese people. They identified 56 risk and 28 protective correlates of IGD, including psychopathological characteristics, personality traits, cognition, emotion regulation style, gaming-related variables, peer-related variables, family-related variables, and community environment. This study only targeted Chinese populations; the results cannot be generalised to the non-Chinese population. Also, it did not differentiate cross-sectional studies and longitudinal studies in synthesizing effect sizes. The over-representation of cross-sectional studies might have overestimated the strength of the associations, and mixed up their roles as causes and consequences (Ji et al., 2022; Mihara & Higuchi, 2017). For example, some significant psychological correlates of IGD (e.g., parental constraint) identified in cross-sectional studies were not significant in longitudinal studies (Koning, Peeters, Finkenauer, & Van Den Eijnden, 2018; Su et al., 2018). To our knowledge, no meta-analysis examined the risk and protective factors (predictors) of IGD.

THE CURRENT STUDY

Our systematic review and meta-analysis included longitudinal studies that have examined modifiable risk or protective factors of IGD. Effect sizes of the identified modifiable risk and protective factors were synthesized to compare the magnitude of the associations. Specifically, first, our outcome was the onset of IGD or IGD symptoms as classified in the DSM-5 (American Psychiatric Association, 2013) or ICD-11 (World Health Organization, 2018). Second, we only included longitudinal studies as they can assess the extent to which a variable may be considered a predictor, temporally preceding the outcome of interest (Kraemer et al., 1997). Cross-sectional studies and retrospective studies were excluded as they are not able to rule out the concomitants or epiphenomena of the outcome due to a lack of evidence of temporal precedence. Third, our focus was on identifying factors that can be modified or controlled through personal effort and intervention, which, if prevented, can result in a lower risk of IGD. In contrast, non-modifiable factors such as age, sex, or genetic factors cannot be intervened (Bundhun, Wu, & Chen, 2015). These modifiable risk and protective factors at each socio-ecological level can serve as a guide for developing prevention programs aimed at promoting the health of populations, particularly those who are at high-risk. While reviews have identified modifiable risk factors of depression (Cairns, Yap, Pilkington, & Jorm, 2014) and anxiety (Zimmermann, Chong, Vechiu, & Papa, 2020), no such studies were conducted for IGD.

Furthermore, we examined potential moderators that may explain the heterogeneity of the study findings. Consistent with previous meta-analyses (Darvesh et al., 2020; Penney et al., 2022), moderators may include gender, age, study quality, study year, and study region. For example, being male is a well-documented risk factor for IGD (Su, Han, Yu, Wu, & Potenza, 2020). While females tend to use games to alleviate negative emotions and psychological distress, males are more sensation- and reward-seeking (Dong & Potenza, 2022). Age-related changes in parental factors may occur because parental involvement in children's recreational and physical activities may decrease as children get older (Gilic, Ostojic, Corluka, Volaric, & Sekulic, 2020). Moreover, the prevalence and antecedents of IGD may differ across study regions due to the inequality of the regional gaming market development and cultural diversity (Chen, 2022).

METHOD

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Liberati et al., 2009)

guidelines throughout this review. This review has been registered at PROSPERO. The registration number is CRD42021266264.

Search strategy

A systematic search was performed through the following five online databases: MEDLINE, PsycINFO, Embase, PubMed, and Web of Science. We also searched Google Scholar to find possible gray literature. English language publications before August 2022 were considered for inclusion. We then repeated the search procedure in September to identify the newly published studies before the final analyses. Broad search terms were used, including "Internet gam* disorder", "longitudinal", "perspective" and "cohort", in order to include the most comprehensive possible collection of the relevant literature. We also excluded "gamb*". The articles were included if their title, subject headings or abstracts matched these phrases.

Inclusion/exclusion criteria

The following inclusion criteria were applied: (1) original research; (2) the target disorder was IGD or a similar condition, including pathological or problematic gaming, gaming disorder, or gaming addiction; (3) validated psychological assessments were used to assess IGD symptoms; (4) modifiable predictive factors of IGD were identified; (5) longitudinal, prospective or cohort study designs were used.

We excluded studies that meet the following criteria: (1) non-original research (such as review studies); (2) an evaluation of an IGD intervention or prevention program, or an identification of predictors of treatment outcome; (3) gaming engagement (e.g., frequency, duration, number of activities, expenditure) instead of problem/pathological gaming was assessed; (4) provided insufficient details on the assessment of IGD; (5) provided insufficient methodological or statistical information to allow for classification into a thematic factor and/or synthesis of findings.

Validity assessment

Study quality was assessed with the Newcastle-Ottawa scale (NOS) for longitudinal studies (Wells et al., 2020). This scale evaluates the risk of bias of longitudinal studies according to eight items, divided into three sections: four items involving the selection of subjects (representativeness, equal derivation source between exposed and non-exposed subjects, ascertainment of the exposure, the outcome of interest was not present at the start of the study), one item involving comparability of cohorts), and three items involving outcomes (adequacy of outcome assessment, adequacy of the length of follow-up, and whether losses to follow-up occurred). A study can be awarded a maximum of one star for each numbered item within the selection and outcome categories, and a maximum of two stars for comparability. The maximum score of the NOS is 9. Two authors (XZ and XY) independently assigned the scores, and the inter-rater reliability was calculated using Cohen's kappa (Cohen & J., 1960). Disagreements between the two author's judgments were resolved by discussion.

Data extraction and coding

For each study, two authors (XZ and XY) independently extracted the data. The following information was collected from each study: study title and the author, study year, publication year, region of the sample, sample size, age range, percentage of male subjects, sampling and survey method, scales for assessment, psychosocial factors, and effect sizes. Disagreements between authors' judgements were resolved through discussion. For the included longitudinal studies, their baseline data were extracted. If the baseline data was unavailable, the follow-up data were extracted.

We also classified each factor according to its psychosocial dimension through discussion. All factors were further classified into the levels of the SEM (e.g., intrapersonal-level factors, interpersonal-level factors and environmental-level factors), based on the conceptualization and operationalization of the studied factors.

In this study, Pearson's correlation coefficient (r) was used as the effect size measure, because Pearson's r was the most commonly reported effect size in the majority of the studies, and it was easy to understand and interpret (Rosenthal, 1991). The effect size was extracted if zero-order correlation coefficients were provided without adjusting for any covariates. We followed the guidelines proposed by Hemphill (2003) for psychological literature. Weak, moderate and strong correlation coefficients are defined as $r < 0.2$, $0.2 \leq r \leq 0.3$, and $r > 0.3$, respectively.

Meta-analytic procedures

Since studies in each factor included in the meta-analysis have substantial heterogeneity, a random-effects model was more appropriate to combine the effect size (Borenstein, Hedges, Higgins, & Rothstein, 2009). All the correlation coefficients were converted by Fisher's r-to-z transformation to obtain normally distributed z values and further calculate 95% confidence intervals (CIs) (Hedges & Olkin, 1985). The I^2 statistic was chosen as an indicator of heterogeneity. I^2 values of 25%, 50%, and 75% are generally interpreted as mild, moderate, and high degrees of heterogeneity, respectively. An I^2 less than 50% is considered to be acceptable (Higgins, Thompson, Deeks, & Altman, 2003). Moderation analyses were used to identify the difference in mean effect size across variables. For categorical moderators (e.g., study region, study quality), subgroup analyses were performed using Q-test scores. Given the limited number of included studies, it was difficult to synthesise separate effect sizes at different time points. Therefore, all the multiple effect sizes obtained from one single study were combined according to the formula provided by Borenstein et al. (2009). The effect size of multiple time points was calculated according to the equation below:

$$\overline{Y} = \frac{1}{m}\left(\sum_{j}^{m} Y_j\right)$$

and the corresponding variance of the composite effect size is:

$$V_{\overline{Y}} = \left(\frac{1}{m}\right)^2 var\left(\sum_{j=1}^{m} Y_j\right) = \left(\frac{1}{m}\right)^2 \left(\sum_{j=1}^{m} V_j + \sum_{j\neq k} \left(r_{jk}\sqrt{V_j}\sqrt{V_k}\right)\right)$$

where m refers to the number of time points, Y refers to the effect sizes from different time points, V means the variances of the effect sizes, r refers to the correlation between Ys, j and k represent the jth and kth time points.

Meta-regressions were used for continuous moderators (e.g., sample size, percentage of male subjects). Publication bias was assessed using Egger's tests (Egger, Smith, Schneider, & Minder, 1997). For the statistical analyses, we used Comprehensive Meta-Analysis (V3.0, Biostat, Englewood, NJ, USA) to combine the effect size.

RESULTS

Characteristics of studies

Figure 1 depicts the flow diagram of the selection process. The literature search found a total of 4,552 references. Among these, 2,143 were excluded due to duplicate records and 2,199 were further excluded after screening titles and abstracts. The search done in the Google scholar revealed 100 pages of records. After a careful review of all the records, no extra gray literature fulfilled the inclusion criteria, and none was included in the meta-analysis. Then a total of 183 full texts were retrieved and assessed for eligibility. Finally, 39 articles met the inclusion criteria and were included in the meta-analysis.

The characteristics of the included studies are presented in Table 1. A total of 37,042 subjects were included, with sample sizes ranging from 61 to 2,974 and an average number of 950. These studies were mainly conducted in nine countries spanning four geographic regions, including East Asia (China, South Korea, and Singapore), Western/Northern Europe (Germany, Spain, the Netherlands, and Norway), North America (USA), and Oceania (Australia). The studies were all published after 2011. The mean age of the subjects ranged from 9 to 49 years old at the time of the first assessment and the percentage of males was between 22% and 77%. The quality of most studies (n = 28) was moderate (i.e., between 6 and 7), seven studies were rated as relatively low but acceptable quality (i.e., a score of 5), and only four had high quality (i.e., above 8). The longitudinal periods of the studies ranged from three months to five years. The mean period of followed-up was 18.54 months (standard deviation (SD) = 14.42).

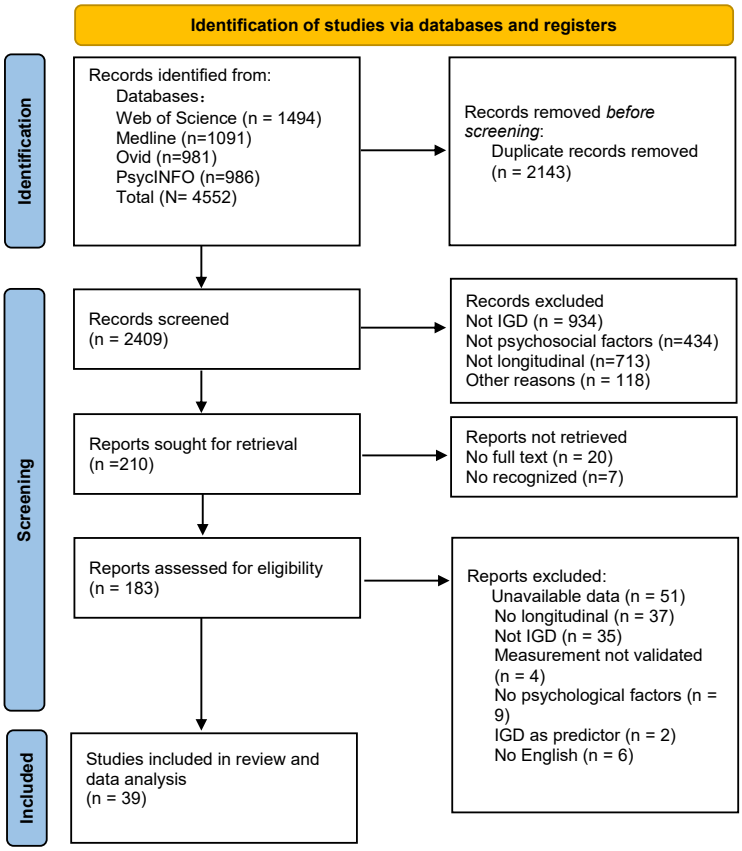

Fig. 1. PRISMA flowchart of study selection

Table 1. Characteristics of included studies in the meta-analysis

Study	Published year	Country	Follow-up period	Sample size	Outcome	Measurement	Predictors	Quality scores	Age	Female ratio
1. Lin et al.	2020	China	2 years	1,089 at baseline 1,024 at 1st year 908 at 2nd year	Internet gaming disorder	11-item Internet Gaming Disorder questionnaire	Parental psychological control, Deviant peer affiliation	7	Seventh-grade students aged between 9 and 14	47.1% at baseline 47.3% at 1st year 47.1% at 2nd year
2. Liu et al.	2017	China	18 months	520 at baseline 468 at 6 month 440 at 1 year 420 at 1.5 year	Internet gaming addiction	11-item Internet Gaming Disorder questionnaire	Autistic trait, emotion regulation, school connectedness, sensation seeking, age, gender	6	Fourth grade students, mean age = 9.74 SD = 0.45	46.2% at baseline 46.4% at T1 46.6% at T2 47.6% at T3
3. Koning et al.	2018	The Netherlands	1 year	554 at baseline 354 at 1 year	Internet gaming disorder	Nine-item Internet Gaming Disorder Scale	Internet-specific rules, reactive restriction, frequency of communication quality of communication	7	Mean age = 13.90, SD = 0.74, range: 11–15	51.1%
4. Hygen et al.	2020	Norway	4 years	703 at baseline 666 at 2nd year 636 at 4th year	Internet gaming disorder	Internet Gaming Disorder Interview	Depression, anxiety, ADHD, ODD/CD	9	Mean age = 10.51, SD = 0.17 at baseline, Mean age = 12.49 years, SD = 0.15 at T1 Mean age = 14.33 years, SD = 0.59 at T2.	52.2%
5. Burleigh et al.	2018	Australia	3 months	61 at baseline	Internet gaming disorder	Internet Gaming Disorder Scale-Short Form 9 (IGDS-SF9)	Depression, Gamer-avatar relationship, age, gender	5	Mean age = 23.02, SD = 3.43, range = 18–29.	Female: 23.0% Male: 77.0%
6. Lemmens et al.	2011a	The Netherland	6 months	1,024 at baseline 851 at 6- month	Pathological gaming	Seven-item game addiction scale	Physical aggression, gender	6	Mean age = 14.3, SD = 1.4 at wave 2.	Female: 49% Male: 51%
7. Lemmens, et al.	2011b	The Netherlands	6 months	1,024 at T1, 941 at T2	Pathological gaming	Seven-item game addiction scale	Loneliness, life satisfaction, social competence, self-esteem, gaming time	6	Mean age = 13.9, SD = 1.4 at T1. Mean age 14.3, SD = 1.4 at T2.	51% boys
8. Ok	2021	South Korea	4 years	600 at baseline 529 at 4th year	Problematic game use	Modified Young's Internet Addiction Test	Big five personality: extraversion, openness, consciousness, agreeableness, neuroticism, loneliness, gender, age	6	The age (as baseline) ranged spanned 11 (35.3%), 14 (36.5%), and 17 (28.2%).	Female: 51.20% Male: 48.8%
9. Rehbein and Baier	2013	Germany	5 years	1,217 at T1 1,070 at T2	Video GA	The Video Game Addiction scale	Family-, Media-, and School-related risk factors	6	Mean age = 9.7, SD = 0.63 in T1, Mean age = 15.0, SD = 0.58 in T2.	Female: 54.7% Male: 45.3%

(continued)

Table 1. Continued

Study	Published year	Country	Follow-up period	Sample size	Outcome	Measurement	Predictors	Quality scores	Age	Female ratio
10. Su et al.	2018	China	1 year	1,830 at T1 1,680 at T2 1,490 at T3	Internet Gaming Disorder	The modified eight-item Internet Addiction Scale	Parental monitoring, parent-child relationship	7	Mean age = 12.03, SD = 1.59, range: 9–15 years in the final sample.	Female: 45.40% Male: 54.6%
11. van den Eijnden et al.	2018	The Netherland	3 years	543 at T1 538 at T3	Internet gaming disorder	The Nine-item IGD scale	Social Media disorder symptoms Level of education Gaming time	7	Mean age = 12.9, SD = 0.73, range = 12–15	Female: 51.10% Male: 48.9%
12. Yuan et al.	2021	China	1 year	1,809 at baseline 981 at T2 341 at T3	Internet gaming disorder	The Chinese version of the internet Gaming Disorder Questionnaire	Depression, fear of missing out,	7	Mean age = 19.90, SD = 2.57 at baseline, Mean age = 20.85, SD = 2.80 at T2, Mean age = 21.24, SD = 2.72 at T3.	T1: 66.1% female; T2: 70.4% female; T3: 75.7% female;
13. Teng et al.	2020a	China	1 year	1,054 at baseline 924 at T2 931 at T3	Internet gaming disorder	Internet gaming disorder scale-short form (IGDS9-SF)	Social support, life satisfaction, self-esteem	6	Mean age: 18.25 Age range: 17–21	Female: 58.80% Male: 41.2%
14. Teng et al.	2020b	China	1 year	1,054 at T1 924 at T2 931 at T3	Internet gaming disorder	Nine-item Internet Gaming Disorder Scale-Short Form (IGDS-SF9)	Mother attachment, father attachment, peer attachment	7	Mean age: 18.25 Age range: 17–21	Female: 58.8%:620 63.1%:583 62%: 577 Male: 41.2% 36.9% 38%
15. Teng et al.	2021	China	6 months	2,111 at T1 1,778 at T2	Internet gaming disorder	Nine-item Internet Gaming Disorder Scale-Short Form (IGDS-SF9)	Videogame use, depressive symptoms, anxiety symptoms	6	Children and adolescents in two primary schools and middle schools	Female: 49.3% Male: 50.7%
16. Adams et al.	2019	Australia	1 year	61	Internet gaming disorder	Internet Gaming Disorder Scale–Short Form 9 (IGDS-SF9)	Anxiety, family cohesion	5	Mean age = 23.02, SD = 3.43, range = 18–29	Female: 19.7% Male: 80.3%
17. Li, Lo et al.	2018	China (Hong Kong)	1 year	241	Video gaming addition	15-item, 5-point Likert-type Korean Internet Addiction Scale for Adolescents (K-scale).	Parent-child interactions: negative affectivity, positive affectivity, cohesiveness, coerciveness Emotional support Child-report exposure to game violence, parent report exposure to game violence	6	Mean age = 12.09, SD = 1.41 at completion	Female: 43% 78% Male: 57% 22%

(continued)

Table 1. Continued

Study	Published year	Country	Follow-up period	Sample size	Outcome	Measurement	Predictors	Quality scores	Age	Female ratio
18. Wartberg et al.	2019	Germany	1 year	1,095 at baseline 985 at year 2	Internet gaming disorder	The 9-item dichotomized Internet Gaming Disorder Scale	Hyperactivity/ inattention, parental depression/anxiety, antisocial behaviour, anger control, self-esteem problem, emotional distress, gender, age	6	Mean age = 12.99, SD = 0.82 at baseline and 13.89, SD = 0.89 at T2.	Female: 49.2% 49.3% Male: 50.8% 50.7%
19. Choo et al.	2015	Singapore	1 year	2,974 at baseline, 2,601 at T2	The number of pathological symptoms of video-gaming	A 10-item screening instrument derived from the pathological gambling items of the DSM-IV	Parent-child closeness, impulsivity, gaming hour per week, parental restriction of child video-gaming behaviour	6	Mean age = 11.2, SD = 2.05	Female: 27.4% Male: 72.6%
20. Jeong et al.	2020a	South Korea	1 year	294 at baseline, 268 at T2	Internet gaming disorder features	Internet Game Use-Elicited Symptoms Screen (IGUESS)	Parental marital conflict, parent-child attachment, self-esteem	6	Range = 9–10	Female: 46.6% Male: 53.4%
21. Jeong et al.	2020b	South Korea	2 years	1,914 at baseline, 1,834 at T2 1,732 at T3	Internet gaming disorder features	Internet Game Use-Elicited Symptoms Screen (IGUESS)	Inattention/hyperactivity problems, low self-control, aggression, family type, low academic achievement, socioeconomic status	7	Male: Mean age = 12.9, SD = 0.2. Female: Mean age = 12.8, SD = 0.2.	57.0% were male.
22. Jeong et al.	2019	South Korea	1 year	399 at baseline, 366 at T2	Internet gaming disorder	The Internet Game Use-Elicited Symptom Screen (IGUESS)	Depression	7	Median age = 10, range: 9–12	48.6% were female
23. Jeong Jun Eui et al.	2019	South Korea	4 years	968 at four waves	Pathological gaming	20 items of the scale of Young's Internet Game Addiction	Parents' excessive interference Communication with parents Friends' support Academic stress Gaming hours Self-control	6	345 (35.6%) were elementary school students, 333 (34.4%) were middle school students, and 290 (29.9%) were high school students.	477 (49.3%) were males and 491 (50.7%) were females
24. Yu et al.	2015	China	2 years	431 at baseline, 407 at T2, 356 at T3	Problematic online game use	11 items adapted from Gentile's Pathological Video-Game Use Questionnaire.	Teacher autonomy support, basic psychological needs satisfaction, school engagement	6	Mean age = 14.83, SD = 0.49	Female: 58.99% Male: 41.01%

(continued)

Table 1. Continued

Study	Published year	Country	Follow-up period	Sample size	Outcome	Measurement	Predictors	Quality scores	Age	Female ratio
25. Peeters et al.	2018	The Netherlands	1 year	544 at baseline, 354 at T2	Internet gaming disorder symptoms	Nine dichotomous (no, yes) items of the Internet Gaming Disorder Scale	Social vulnerability, life satisfaction, attention problems (ADHD)	6	At T1, Mean age = 13.90, SD = 0.74, range 11–15	48.9% boys
26. Dang et al.	2019	China	1 year	496 at T1 282 at T2	Internet gaming disorder	Nine diagnostic criteria listed in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders	Emotional Intelligence, coping flexibility, depression, age, gender	6	Mean age = 19.29, SD = 1.10 at T1, Mean age = 20.47, SD = 1.15 at T2	Female: 58% 60% Male: 42% 40%
27. Mößle and Rehbein	2013	Germany	4 years	943 at baseline, 842 at T2, 935 at T3, 827 at T4, 806 at T5	Problematic video game behaviour	Video Game Addiction Scale CSAS Based on IGD-10, 20-item	Academic self-concept, depression, peer problems, family violence, parental care, gaming motivation	9	Mean age = 11.5 years at T4 and 12.5 years at T5	Female: 49.40% Male: 50.60%
28. Zhang, et al.	2019	China	1 year	469 at baseline, 283 at T2	Internet gaming disorder	Nine items dichotomized measurement validated and has cut-off score	Purpose in life, social support, gender, age, GPA	6	Range = 18–27, Mean age = 19.29, SD = 1.10	41.6% male
29. Zhu & Chen	2021	China	1 year	1,987 at baseline, 1,818 at w2, 1,829 at w3	Internet gaming disorder	Chinese-language version of the Internet Gaming Disorder Scale – Short Form (IGDS9-SF; Pontes & Griffiths, 2015).	Parental rejection, Anxiety	7	Baseline: Mean age = 12.32, SD = 0.53	Female: 44.02% Male: 55.98%
30. Weinstein et al.	2017	USA	6 months	2,316	Internet gaming disorder	nine-item criteria checklist	Health Psychological needs, Physical and social activity	8	Mean age = 49.21	Female: 61.8% Male: 38.2%
31. Rothmund et al.	2016	Germany	1 year	756 at T1 574 at T2	Excessive Gaming	A German translation of the 11-item scale for pathological gaming based on DSM criteria	Gaming frequency, Gaming duration	6	Baseline: Mean age = 14.08 SD = 1.07,12–17	47% boys, 46% girls, 8% who did not indicate their gender
32. Brunborg et al.	2014	Norway	2 years	1928	video game addiction	The seven-item version of the "Game Addiction Scale for Adolescents"	Video game use, depression, heavy episodic drinking, academic achievement, and conduct problems	6	Range: 13–17 years old	Female: 55.5% Male: 44.5%
33. Xiang et al.	2022	China	6 months	1,023	Internet gaming disorder symptoms	11-item Internet Gaming Disorder Questionnaire (IGDQ) (Yu et al., 2015)	Developmental assets, self-control	6	Baseline: Mean age = 13.16 SD = 0.86	Male: 49.4% Female:50.6%

(continued)

Table 1. Continued

Study	Published year	Country	Follow-up period	Sample size	Outcome	Measurement	Predictors	Quality scores	Age	Female ratio
34. Chang et al.	2022	Hong Kong, Taiwan, China	9 months	649	Problematic gaming	Nine-item gaming Disorder Scale-Short Form	Social media addiction, depression, anxiety	5	Baseline: Mean age = 20.95 SD = 5.63	Male: 41.0% Female: 59.0%
35. Wang Likun et al.	2022	China	18 months	660	Internet gaming addiction	11-item Chinese version of the Problematic Online Game Use Questionnaire	Perceived discrimination, deviant peer affiliation, maladaptive cognitions, self-esteem	5	Baseline: Mean age = 13.43 SD = 0.48	Male: 55.6% Female: 44.4%
36. Wang Peng et al.	2022	China	1 year	1,047	Internet gaming disorder symptoms	Ten-item Internet gaming disorder test (IGDT-10)	Shyness, depression	5	Baseline: Mean age = 12.45 SD = 0.898 Range: 10–15 years old	Male: 48.1% Female: 51.9%
37. Wang Rong et al.	2021	China	Three years	316	Internet gaming disorder	Ten-Item Internet Gaming Disorder Test (IGDT-10)	Depression	5	Baseline: Mean age = 11.63 SD = 0.64	Male: 47.5% Female: 52.5%
38. Marrero et al.	2021	Spain	9 months	550	Problematic videogame playing	Nine-item Problematic Videogame Playing (PVP)	Extraversion, agreeableness, conscientiousness, emotional stability, openness, depression, anxiety, hostility, family functioning, impulsivity	5	Baseline: Mean age = 13.4 SD = 1.2 Range: 11–18 years old	Male: 51.1% Female: 48.9%
39. Gan Xiong et al.	2021	China	1 year	1,041 T1 9,51 T2 9,03 T3	Problematic online game use	Chinese version of Problematic online game use questionnaire	Depression Parental control Parental care	6	Baseline: Mean age = 12.9 SD = 1.32 Completion: M = 14.02 SD = 2.50	Male: 45.4% Female: 54.6%

Effect size estimates

The main results of the meta-analysis for each factor are shown in Table 2 and Fig. 2. Amount to thirty-four modifiable factors were extracted and they can be broadly grouped into three categories: Intrapersonal, interpersonal, and environmental factors according to the SEM framework. For each factor, the number of studies (n), sample size, pooled effect size (r), 95% confidence intervals, degree of heterogeneity (I^2), and publication bias (p using Egger's test) were reported.

First, the majority (i.e., 23 factors) of the identified modifiable factors belonged to the intrapersonal category (e.g., factors such as knowledge, attitude, skills, and psychological attributes) (Glanz & Bishop, 2010). Regarding identified risk factors, the strongest predictor is gaming time (r = 0.33, 95% CI = [0.21, 0.44]), followed by loneliness (r = 0.29, 95% CI = [0.12, 0.44]), Social Media Disorder (r = 0.24, 95% CI = [0.03, 0.43]), aggression (r = 0.23, 95% CI = [0.19, 0.27]), anxiety (r = 0.21, 95% CI = [0.14, 0.27]), attention hyperactivity (r = 0.20, 95% CI = [0.06, 0.32]), depression (r = 0.18, 95% CI = [0.13,0.23]), sensation seeking (r = 0.13, 95% CI = [0.06, 0.20]), social vulnerability (r = 0.12, 95% CI = [0.05, 0.20]), and impulsivity (r = 0.11, 95% CI = [0.06, 0.16]). The identified protective factors include self-control (r = −0.27, 95% CI = [−0.38, −0.16]), conscientiousness (r = −0.25, 95% CI = [−0.30, −0.20]), agreeableness (r = −0.20, 95% CI = [−0.35, −0.05]), self-esteem (r = −0.19, 95% CI = [−0.25, −0.12]), autonomy needs (r = −0.15, 95% CI = [−0.23, −0.07]), relatedness needs (r = −0.15, 95% CI = [−0.22, −0.08]), grade point average (GPA) (r = −0.15, 95% CI = [−0.25, −0.06]), competence needs (r = −0.14, 95% CI = [−0.17, −0.10]), extraversion (r = −0.12, 95% CI = [−0.23, −0.01]), openness (r = −0.12, 95% CI = [−0.23, −0.01]), and life satisfaction (r = −0.11, 95% CI = [−0.14, −0.07]). However, the effect sizes for neuroticism (r = −0.15, 95% CI = [−0.31, 0.006]) and low education level (r = 0.03, 95% CI = [−0.03, 0.10]) were not statistically significant, which may be because of the small number of included studies in the meta-analysis. The magnitudes of most effects were at the moderate level, except that the gaming time reached a large effect size level of 0.30.

Table 2. The pooled effect size estimates, heterogeneity, and publication bias

Modifiable factors	N of studies	Sample size	Effect size r [95% CI]	I^2 (%)	Egger's test, p
Gaming time	7	8,444	0.33 [0.21, 0.44]	97.07	0.80
Loneliness	2	1,470	0.29 [0.12, 0.44]	90.71	NA
Social media disorder	3	1,541	0.24 [0.03, 0.43]	94.73	0.26
Aggression	2	2,583	0.23 [0.19, 0.27]	5.40	NA
Anxiety	6	5,892	0.21 [0.14, 0.27]	86.23	0.53
Attention/hyperactivity	4	6,308	0.20 [0.06,0.32]	94.13	0.97
Depression	12	9,113	0.18 [0.13,0.23]	89.32	0.58
Sensation seeking	2	827	0.13 [0.06, 0.20]	0.00	NA
Social vulnerability	3	1,625	0.12 [0.05, 0.20]	57.25	0.26
Impulsivity	2	3,151	0.11 [0.06, 0.16]	42.39	NA
Low education level	2	892	0.03 [−0.03, 0.10]	0.00	NA
Self-control	2	4,706	−0.27 [−0.38, −0.16]	94.67	NA
Conscientiousness	2	1,479	−0.25 [−0.30, −0.20]	0.73	NA
Agreeableness	2	1,479	−0.20 [−0.35, −0.05]	88.16	NA
Self-esteem	6	3,191	−0.19 [−0.25, −0.12]	81.30	0.15
GPA	5	5,819	−0.15 [−0.25, −0.06]	92.46	0.47
Autonomy	2	2,672	−0.15 [−0.23, −0.07]	57.37	NA
Relatedness	2	2,672	−0.15 [−0.22, −0.08]	49.136	NA
Neuroticism	2	1,479	−0.15 [−0.31, 0.006]	89.02	NA
Competence	2	2,672	−0.14 [−0.17, −0.10]	0.00	NA
Extraversion	2	1,479	−0.12 [−0.23, −0.01]	77.22	NA
Openness	2	1,479	−0.12 [−0.23, −0.01]	78.03	NA
Life satisfaction	3	2,136	−0.11 [−0.14, −0.07]	69.91	0.97
Deviant peer affiliation	2	1,508	0.20 [0.07, 0.33]	87.57	NA
Abuse by family	3	3,694	0.15 [0.04, 0.25]	90.98	0.38
Parental behavioural control/restriction	3	3,858	0.06 [−0.02, 0.14]	82.25	0.85
Parental conflict	2	1,285	0.17 [−0.04, 0.04]	88.87	NA
Peer relationship	3	2,705	−0.23 [−0.27, −0.18]	49.83	0.45
Parent-child relationship	10	9,364	−0.15 [−0.18, −0.11]	62.54	0.34
Social support	4	1,962	−0.14 [−0.18, −0.10]	0.00	0.25
Father-child relationship	4	3,906	−0.13 [−0.15, −0.10]	62.96	0.36
Mother-child relationship	4	3,960	−0.13 [−0.18, −0.08]	66.07	0.39
Parental supervision	2	2,560	−0.09 [−0.16, −0.03]	67.67	NA
School engagement	3	1,846	−0.18 [−0.22, −0.14]	80.80	0.01

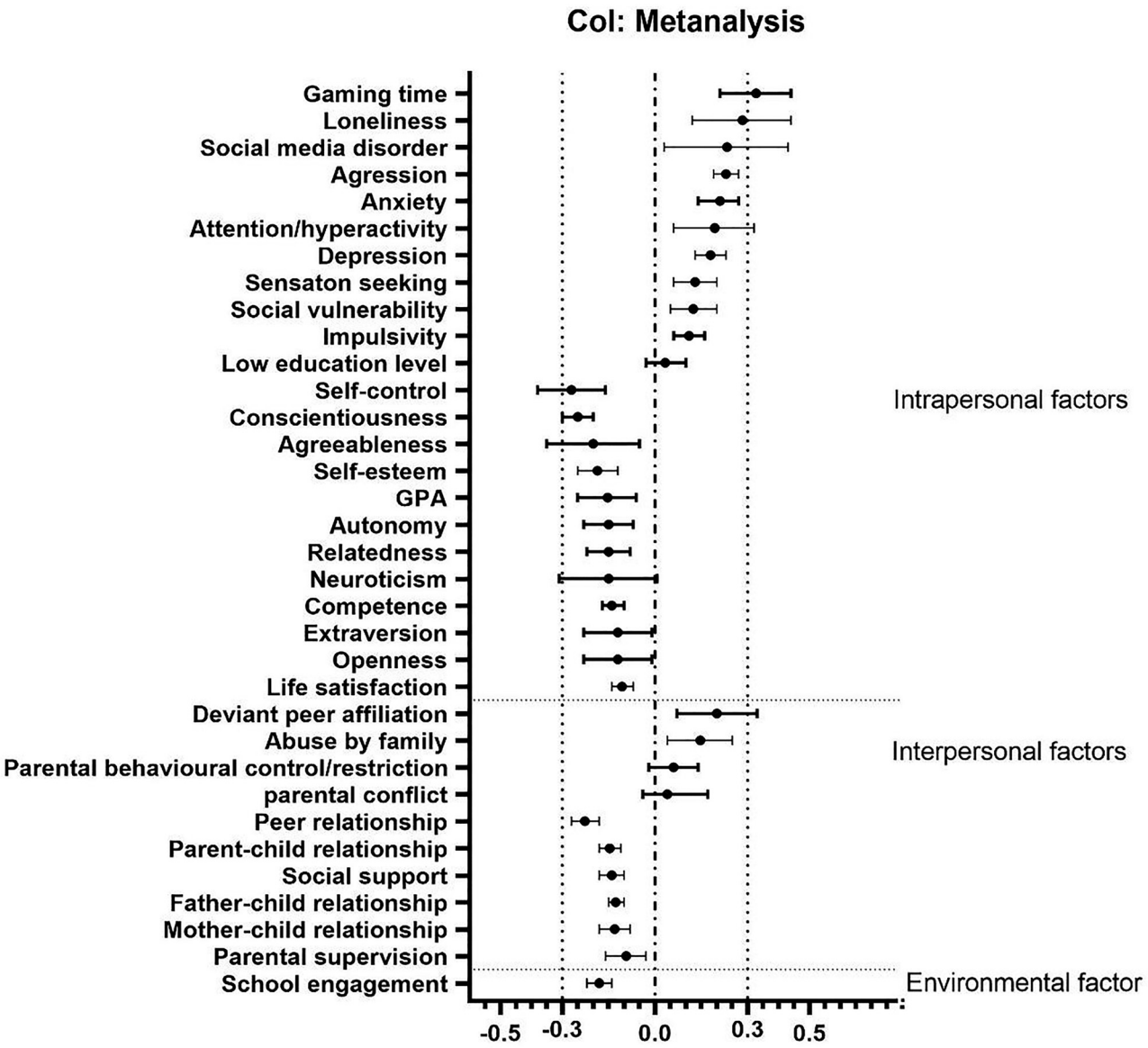

Fig. 2. The pooled effect size estimates

Second, ten identified modifiable factors can be categorized into the interpersonal group (e.g., factors such as family, friends and social networks) (Glanz & Bishop, 2010). The strongest interpersonal modifiable factor was peer relationship (r = −0.23, 95% CI = [−0.27, −0.18]), followed by deviant peer affiliation (r = 0.20, 95% CI = [0.07, 0.33]), social support (r = −0.14, 95% CI = [−0.18, −0.10]), parent-child relationship (r = −0.15, 95% CI = [−0.18, −0.11]), abuse by family (r = 0.15, 95% CI = [0.04, 0.25]), father-child relationship (r = −0.13, 95% CI = [−0.15, −0.10]) and mother-child relationship (r = −0.13, 95% CI = [−0.18, −0.08]), and parental supervision (r = −0.09, 95% CI = [−0.16, −0.03]). Risk factors in this category were deviant peer affiliation and abuse by family, while protective factors were peer relationship, social support, parent-child relationship and parental supervision. However, the effect sizes for parental conflict (r = 0.17, 95% CI = [−0.04, 0.04]), and parental behavioural control/restriction (r = 0.06, 95% CI = [−0.02, 0.14]) were not statistically significant.

Last but not the least, only one modifiable factor, namely, school engagement (r = −0.18, 95% CI = [−0.22, −0.14]) can be categorized into the environmental factor category. The relationships with and support received from instructors, classmates, and the school environment are regarded as "school engagement" in the three studies that are included. Connections, relationships, rules and regulations within the school context has been conceptualized as organizational and environmental factors in the SEM (Glanz & Bishop, 2010; Hu, Zhou, Crowley-McHattan, & Liu, 2021). As shown in the meta-analysis, school engagement modestly predicted the development of IGD.

Sixteen factors had a low or moderate heterogeneity (I^2 = 0%–69.9%), and 18 factors had a high heterogeneity (I^2 = 78%–95%). Publication bias was assessed using Egger's p. The findings showed that school engagement had

significant publication bias (Egger's $p = 0.01$). Since factors such as aggression and loneliness were investigated in only two included articles, their publication bias of Egger's p could not be calculated.

Moderation analysis

We tested the effect of various moderators on two of the modifiable factors, namely "parent-child relationship" and "depression", since there were sufficient studies for the analysis (12 and 10 included studies for the two variables, respectively). The moderators included study region (Asian versus non-Asian), age, study quality, study year (i.e., the year when the study was conducted), and gender (i.e., the male ratio). Four significant (or marginally significant) moderation effects were identified, including age, study region, gender, and study year. Age was found to marginally influence the magnitude of the effect sizes of the parent-child relationship on IGD ($\beta = 0.01$, $p = 0.09$). The correlation coefficients reduced with age. Besides, we also found that the predictive relationship between depression and IGD was stronger among Asian subjects ($r = 0.233$, 95% CI = [0.179, 0.286]) than that among non-Asian subjects ($r = 0.081$, 95% CI = [0.049, 0.133]). The inclusion of the moderator decreased the heterogeneity of the study findings ($Q = 21.97$, $p < 0.001$, $I^2_{\text{non-Asian}} = 13.55$, $I^2_{\text{Asian}} = 83.02$). The male ratio in the studied sample was found to significantly moderate the relationship between depression and IGD, with studies that had lower male ratios reporting stronger associations between depression and IGD ($\beta = -0.004$, $p = 0.03$). Moreover, study year was a significant moderator according to the meta-regression analysis; stronger relationships between depression and IGD were found among recent-year studies ($\beta = 0.013$, $p = 0.03$).

DISCUSSION

The present meta-analysis included 39 longitudinal studies. Thirty-four significant modifiable factors were identified, including twenty-three intrapersonal factors, ten interpersonal factors, and one environmental factor. Consistent with the pattern presented in Ji et al. (2022)'s meta-analysis among Chinese people, intrapersonal factors such as gaming time, mood disturbance (anxiety and depression), and self-control were more influential than interpersonal factors such as family abuse/violence and parent-child relationship. The results support the argument of Ji et al. (2022) that despite that intrapersonal/environmental factors play roles in IGD development, individual styles of processing information and coping responses might be more proximal factors of a behaviour or health status. It can be envisaged that family, school and social factors contribute to IGD because they can facilitate a person's development of affective, cognitive, and behavioural responses related to IGD. In other words, these intrapersonal factors may play as mediators or underlying mechanisms in explaining the relationships from higher socio-ecological level factors to individual IGD. For example, environmental and interpersonal stress and a lack of social support may cause maladaptive coping which in turn can increase the risk of IGD (Cao et al., 2022).

Regarding the intrapersonal category of modifiable factors, only gaming time achieved a strong effect size of 0.33 (Hemphill, 2003). Self-control, loneliness, social media disorder, aggression, anxiety, attention problems/hyperactivity, agreeableness, self-esteem and depression were found to have significantly modest levels of effect sizes. It is not surprising that gaming time was the strongest predictor, corroborating with the recent meta-analysis among Chinese people (Ji et al., 2022). It has been argued that players are no longer able to regulate their gaming behaviour when their ongoing behavioural engagement turns into profound cognitive immersion, which hinders or interferes with executive function (Cheng, Cheung, & Wang, 2018). Reduced executive function and behavioural inhibition are central ingredients of the developmental course of IGD (Brand, Young, & Laier, 2014). IGD may in turn enhance impulsive decision-making (Kräplin et al., 2021). This supports Ji et al. (2022) and our findings that self-control was the most reliable protective intrapersonal factor of IGD. Self-control, which is connected to behavioural inhibition, is the capacity to withstand an urge, drive, or temptation to act (Kim et al., 2016). Thus, people with high self-control may be good at withstanding the impulse to play Internet games immoderately or less likely to experience the urge or craving to Internet gaming.

Extending previous meta-analysis studies (Ji et al., 2022; Mihara & Higuchi, 2017), we found that negative emotions, such as feelings of loneliness, anxiety and depression, could be significant antecedents of IGD symptoms. As argued by Li and Wang (2013), searching for socialization through Internet games can be interpreted as an attempt to reduce loneliness. Moreover, a meta-analysis study revealed a comorbid rate of around 30% of depression and IGD (Ostinelli et al., 2021). Our results provided preliminary support to the escapist perspective of IGD where people engaged in excessive usage of gaming to escape from real-life stress to a virtual world and gain temporal comfort (Cho, Sung, Shin, Lim, & Shin, 2013; Ji et al., 2022).

Three significant moderators for the relationship between depression and IGD were identified. First, depression functioned as a stronger predictor for IGD among Asian countries, including China and Korea, than non-Asian countries, such as Norway and Germany. It may be due to the rise of the gaming industry and cultural values in the local contexts. As reported, in 2018, the Asia-Pacific region accounted for 62% of all app game revenues worldwide, among which China, Japan and South Korea were the main force that drove the growth (Newzoo, 2019). It may have constituted a social environment where people grew up with games and use them to cope with stress (Ha, 2017). In addition, Eastern Asia cultures emphasizing achievement and personal (academic) success might exacerbate the relationship between psychological distress and excessive gaming behaviour (Snodgrass, Dengah, Polzer, & Else, 2019). People may easily feel psychologically drained

(Snodgrass et al., 2019), and thus turn to excessive gaming for immediate gratification. Second, we found that studies with more female respondents revealed a stronger relationship between depression and IGD. It is consistent with previous studies on gender differences in gaming motivations. As argued by Dong and Potenza (2022), negative emotions may constitute a risk factor for females, as females are more likely to use gaming to alleviate psychological distress. Third, our positive association between study year and effect sizes suggests that the positive relationship between depression and IGD became stronger these years than before. It is possible that people become more dependent on the Internet and excessive gaming to dilute their negative emotions. Indeed, evidence shows that prevalence of IGD has been rising annually (Darvesh et al., 2020). Health behaviour promotions are warranted to enhance awareness of healthy gaming and encourage adaptive emotion regulation strategies (e.g., physical activity).

The most influential interpersonal factor identified was peer relationship, followed by other peer and family factors. Our results showed that though not as strong as intrapersonal level factors, interpersonal factors still played important roles in contributing to the development of IGD symptoms. This contention is consistent with the interpersonal impairment hypothesis that conceptualizes IGD as a maladaptive response to interpersonal stress rather than as pathology per se (Cheng et al., 2018). As the studied population is predominantly composed of youth, the influences of peer and family relationships are particularly relevant. Peer relationships have been well-documented as a factor related to deviant behaviours (Plaisier & Konijn, 2013). Youth with poor peer relationships offline may seek interpersonal connections online (Zhou, Zhang, Liu, & Wang, 2017). Similarly, when families function well, children have access to sufficient social support, positive parent-child relationships, and coping resources, which can prevent excessive Internet gaming (Choo, Sim, Liau, Gentile, & Khoo, 2015).

Our analysis revealed that participants' age was a significant moderator in the relationship between parent-child relationship quality and IGD. This finding aligns with the fact that younger children tend to rely more on their parents for support than older children or adults. As people move into adolescence and adulthood, they become more independent and develop more connections with peers and non-family members. Future research should track the trajectory of IGD and the changes in weight of its associated factors across childhood, adolescence, and adulthood.

Another intriguing finding is that we found differential effects of parental behavioural control/restriction and parental supervision/monitoring on IGD. While parental behavioural control/restriction exerted no significant effect on IGD, parental supervision/monitoring revealed a significantly negative effect although the effect size was small. Literature has shown mixed evidence on the role of these parenting practices in children's gaming problems (Schneider, King, & Delfabbro, 2017). As Schneider et al. (2017) argued, the mixed results may suggest that parental control of gaming devices may not be effective on their own, but broader parental supervision and involvement are required. On one hand, behavioural control or restriction involves behavioural-specific limitations and regulations for Internet gaming, such as setting rules for gaming hours or prohibiting certain games. Since IGD is not merely a repetitive behaviour but also entails addictive symptoms, parental behavioural control may be insufficient to reduce IGD. On the other hand, parental supervision or monitoring involves practices and knowledge related to their children's activities, whereabouts, and peers (Stattin & Kerr, 2000). This type of supervision can foster a sense of relatedness and connection with children by showing interest, knowledge, and understanding about their daily activities and meeting their psychosocial needs, effectively reducing the risk of IGD (Schneider et al., 2017).

Our meta-analysis only identified and included one environmental modifiable factor-school engagement, which showed a modest prediction effect on IGD. Consistent with social control theory, youth with feelings of safety and belonging in school may experience strong emotional connections with school teachers and peers in daily life, which can protect them from engaging in problematic behaviours or over-relying on the Internet. In addition, a good school climate with high levels of organisation and cohesion can reduce deviant peer affiliation, and strengthen the awareness of school discipline of students, which may reduce their problematic behaviours and IGD (Li et al., 2016). It is worth noting that only three studies were included in our review, and thus the effects of school-related environmental factors on IGD have yet to be consolidated. Moreover, no longitudinal study examined other environmental factors, such as neighbourhood, Internet gaming-related policy/regulation, and cultural norms. Such longitudinal studies are warranted.

Theoretical implication

The identified three-level risk and protective factors correspond with the social ecological model of behavioural and mental health. Intrapersonal, interpersonal, and environmental systems affect and interact with each other and can conjunctively contribute to IGD. The relatively larger effect sizes of intrapersonal-level factors may suggest that individual-based theories are more powerful and provide more proximal factors to explain the development of IGD. Such theories may include but not limited to the cognitive behavioural theory (CBT) and the interaction of person-affect-cognition-execution (I-PACE) model which highlight the importance of personal motivation, beliefs, emotions, and coping styles in the development of IGD (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015; Brand et al., 2019; Brand, 2022; Dang et al., 2019). Based on these individual-level theories, IGD can be considered as a negative consequence of a person's maladaptive cognitive, affective, and behavioural processes. Our results do not necessarily suggest that interpersonal and environmental theories or factors have less influence on IGD than intrapersonal factors. The fact is that they have received relatively less attention in previous longitudinal studies, and these factors may need a longer study period to observe their temporal changes and effects. More longitudinal studies with a longer follow-up

duration on these higher-level factors are needed to better understand the whole picture of the development of IGD.

Practical implication

Future intervention programmes may emphasize gaming time management and self-regulation skills as their primary objectives. A meta-analysis showed promise for curriculum-based and mindfulness-based training programmes to enhance self-regulation and reduce behavioural problems among young people (Pandey et al., 2018). These programmes adopt strategies of role play, cognitive modeling, and educational workshops to enhance self-control, goal setting and behavioural monitoring (Pandey et al., 2018). Peer-based programmes that identify influential peers based on social network analyses and develop conducive hobbies (e.g., physical activity) and leisure activities among peers are also promising to reduce gaming time (Pandey et al., 2018). Family-based interventions that improve parental mediation skills and parent-child relationships may be more effective for younger children's IGD (Choo et al., 2015).

Mood disturbances should be well tackled to prevent IGD. Education and training workshops to teach adaptive emotional regulation and stress-coping skills may be helpful. Existing IGD interventions mainly target behavioural dysfunction and motivations (Zajac, Ginley, Chang, & Petry, 2017), and few aim to address the psychiatric conditions of people with IGD. Transdiagnostic interventions that target not only IGD but also comorbid psychiatric conditions may be cost-effective and efficient. For example, mindfulness-based therapy and acceptance and commitment therapy represent promising approaches to address heterogeneous needs and various mental and behavioural problems.

Limitations

First, most studies in our meta-analysis included samples of adolescents or young adults; thus, the conclusions may not be generalised to older age groups. Second, we only examined the three-level variables as individually independent factors of IGD. However, the causes and development of IGD may be complex and reciprocal. A single factor may not fully explain the onset and persistence of IGD. Multiple factors (e.g., genetic, environmental, social, psychological) might interact together to cause IGD. Structure equation modeling and cross-lagged modeling analyses may help to illustrate their interrelationships and provide robust evidence on the causal relationships. Third, many of the included studies predated the DSM-5 IGD classification, and thus inconsistency in assessing IGD should be expected. Inconsistent assessments might influence our pooled effect sizes for each factor. Forth, although we have used a random-effects model to combine effect sizes and account for the high heterogeneity of included factors, there are still some factors (e.g., gaming time, depression, self-control) for which large heterogeneity remains unexplained. Additionally, due to the limited number of studies included for most of the variables, moderation analyses could not be performed. Therefore, caution should be exercised when interpreting the results. Future studies could employ moderation analyses to explore factors that can explain the high heterogeneity observed in this study.

CONCLUSION

The study is the first attempt to comprehensively review and meta-analyse the modifiable risk and protective predictors of IGD. Our systematic review identified three categories of modifiable risk and protective factors, including intrapersonal factors (e.g., gaming time, self-control, negative emotions), interpersonal factors (e.g., peer attachment, parent-child relationship) and environmental factors (i.e., school engagement). Only the intrapersonal risk factor, gaming time, achieved a strong pooled effect size, indicating strong predictive power for consequent IGD. Intrapersonal factors also exerted stronger impacts on IGD than interpersonal or environmental factors, suggesting that individual-based theories may have more proximal roles in explaining IGD and interventions modifying the identified intrapersonal factors may be more efficient. Although environmental predictors of IGD were under-examined, we identified several moderators related to cultures and groups (e.g., Asian versus non-Asian samples). These moderators may also play a role in explaining the differences in the prevalence of IGD and should be explored in future cross-cultural studies.

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