Negative Consequences Experienced by Individuals with Gaming Disorder Symptoms: A Systematic Review of Available Longitudinal Studies

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Abstract

Purpose of Review Gaming disorder (GD) is a growing concern for health policies worldwide. The aim of the research presented here was to review systematically negative consequences of symptoms of GD by focusing on longitudinal studies that considered the temporal order of the effects.

Recent Findings A total of 48 longitudinal studies met the inclusion criteria. The analysis indicated that so far negative consequences of symptoms of GD pertaining to mental health, behavioural problems, social and interpersonal factors, psychological factors, and physical health have been investigated.

Summary The most consistent finding is an association between symptoms of GD and depression. In addition, symptoms of GD are an important predictor for symptoms of GD in the future. For other domains, there are few studies and findings are mixed with several studies reporting no association with negative consequences. Future studies should further investigate negative consequences of gaming as well as moderating factors. Regarding prevention and intervention strategies, negative consequences can be addressed in motivational interventions to drive behaviour change.

Keywords Gaming disorder · Problematic gaming · Negative consequences · Change motives · Motivational interventions

Introduction

According to the WHO, gaming disorder (GD) is defined as a pattern of persistent or recurrent gaming behaviour, characterized by impaired control over gaming, priority of gaming over other life interests or daily activities, and continuation of gaming despite negative consequences [1]. In 2018, the *International Classification of Diseases* (11th edition; ICD-11) introduced GD as a new mental disorder recognizing its status as a functionally impairing condition [2]. However, including GD in ICD-11 has also been criticized as premature and bearing the risk for false-positive diagnosis as mental health disorder [3–5]. Nevertheless, it is important to acknowledge that while gaming may be a leisure time activity for many individuals that should not be overpathologized [6], there are also a number of individuals that develop problematic use pattern resulting in marked distress and substantial impairments in important areas of functioning (e.g. personal, family, social, educational) [7]. Two recent meta-analyses found prevalence rates of GD of 4.6% in adolescents [8] and 2.5% in the general population [9]. Especially in recent years, the number of studies investigating negative consequences of gaming has increased drastically. Previous cross-sectional studies reported a correlation of symptoms of GD and a deterioration in various domains of functioning, including mental health, psychological factors, behavioural problems, interpersonal and social factors, and physical health. Typical findings include depression [10–12], attention deficit hyperactivity disorder (ADHD [11]), anxiety [11, 12], lower life satisfaction [12, 13], aggression [14], poorer occupational and academic performance [14, 15], poorer social health [13–15] and physical health problems, like fatigue, sleep problems, and higher body mass index [13, 16, 17]. However, it cannot be excluded that some of these correlates are antecedes, rather than negative consequences,

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of gaming. Therefore, researchers have called for longitudinal studies [4, 18, 19]. However, no systematic assessment of these studies and their results is available yet.

Negative psychosocial consequences from a behaviour may be a reason for individuals to change this behaviour. Thus, psychotherapeutic approaches to addictive behaviour usually use techniques of motivational interviewing [20] and contrast negative consequences that the individual experiences to important subjective values and goals. Ultimately, the perception of this dissonance is expected to ignite behaviour change [21, 22•]. While studies investigating the reasons and motives underlying the change of gaming primarily investigated game-related factors like lack of enjoyment (e.g. [23]) and shortcomings in the game mechanics (e.g. [24]), there are also studies that found that reasons to change are closely related to negative consequences from gaming. For example deterioration in several domains, like school, work, and social life, as well as missing out on alternative activities, emerged as important change motives [23, 25, 26]. Therefore, the identification of negative consequences of gaming presents a major anchor point for behavioural interventions.

Against this background, the aim of the current research was to systematically review longitudinal studies to provide an up-to-date review of the negative consequences linked to symptoms of GD that can inform the conceptualization of prevention and intervention strategies.

Methods

The methodology of this review adheres to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [27]. For a study to meet the inclusion criteria, it had to comply with the following: 1) published until end of June, 2023; (2) written in English or German or contain an English translation; (3) measured GD with a standardized instrument or proposed criteria (for studies published before inclusion of GD in the ICD-11 and DSM-5); (4) assessed psychosocial or physical effects of gaming; (5) collected empirical data; (6) Implemented a longitudinal or prospective study design. PsycInfo (APA) and PsycArticles (APA) via EbscoHost, ScienceDirect, PubMed, and Web of Science were searched. The search string was determined by consensus of LD and SSL and was based on two subsections, which were combined with an AND condition: (1) internet gaming disorder (e.g. "Internet gaming disorder" OR "gaming disorder" OR "game addiction" OR "video game"); (2) longitudinal study (e.g. "longitudinal study" OR "longitudinal analysis" OR "prospective" OR "developmental trajectory" OR "cross-lagged"). Search strings were adjusted to the databases' individual search functions, see Table 1.

The initial screening of all search results was carried out by LD. Duplicates as well as studies that did not meet the inclusion criteria based on title and abstract were removed. The remaining literature was then submitted to a screening of the full text and subsequently included or excluded based on the predefined criteria. Search and screening were under the supervision of SSL. The study selection process is graphically displayed in Fig. 1. For the narrative synthesis of the information, the study characteristics, sample characteristics, and the main findings regarding the negative psychosocial consequences of symptoms of GD were extracted.

Results

Study Characteristics

A total of 48 studies could be identified for the systematic review. Table 2 provides an overview of the included studies. The majority of studies was conducted in Asia ($n = 21$ in China, Hong Kong, Japan, Singapore, South Korea) and Europe ($n = 15$ in the Netherlands, Norway, Germany, Sweden, Switzerland). Seven studies were conducted in the USA. Two studies comprised samples from Mexico and one study a sample from Australia. Finally, one study gathered data from samples comprising participants from different countries [28] and one study did not specify any country [29].

To assess GD, 23 different measurement tools were used. The Game Addiction Scale (GAS) [76] and the Internet Gaming Disorder Scale-Short Form (IGDS9-SF) [77] were the two mostly used tools to assess the severity of GD, followed by the Pathological Gaming Scale [78]. In all studies, the scores derived from the questionnaires or the interview served as predictor variable in the subsequent analysis.

The longitudinal analysis was carried out using different statistical methods. Structural equation modelling (SEM) was the most widely used technique to analyse the data. As a second main statistical method, regression analysis was used.

Sample Characteristics

The majority of the 48 studies examined adolescents ($n = 15$), adolescents and children ($n = 11$), or adults ($n = 13$). Four studies examined children and two studies investigated adolescents and young adults. Three studies included students without specifying the age.

In 26 studies, males represented more than 50% of the sample and four studies assessed only male participants. In 20 studies, female participants made up the majority of the sample. Two studies did not provide information on gender distribution.

Table 1 Search strings

Database	Search string
EbscoHost (PsycInfo, PsycArticles)	TI ("Internet gaming disorder" OR "gaming disorder" OR "gaming addiction" OR "game addiction" OR "video game*" OR "video game use" OR "video game play*" OR "online gaming" OR "online game*" OR "MMORPG" OR (("pathological" OR "problematic" OR "excessive") AND ("gaming" OR "video gaming"))) OR AB ("Internet gaming disorder" OR "gaming disorder" OR "gaming addiction" OR "game addiction" OR "video game*" OR "video game use" OR "video game play*" OR "online gaming" OR "online game*" OR "MMORPG" OR (("pathological" OR "problematic" OR "excessive") AND ("gaming" OR "video gaming"))) AND TI ("Longitudinal" OR "longitudinal study" OR "longitudinal analysis" OR "prospective" OR "developmental trajectory" OR "cross-lagged" OR "autoregressive cross-lagged modelling" OR "long-term evaluation" OR "latent growth model") OR AB ("Longitudinal" OR "longitudinal study" OR "longitudinal analysis" OR "prospective" OR "developmental trajectory" OR "cross-lagged" OR "autoregressive cross-lagged modelling" OR "long-term evaluation" OR "latent growth model")
PubMed	(("Internet gaming disorder"[Title/Abstract] OR "gaming disorder"[Title/Abstract] OR "gaming addiction"[Title/Abstract] OR "game addiction"[Title/Abstract] OR "video game*"[Title/Abstract] OR "video game use"[Title/Abstract] OR "video game play*"[Title/Abstract] OR "online gaming"[Title/Abstract] OR "online game*"[Title/Abstract] OR "MMORPG"[Title/Abstract] OR (("pathological"[Title/Abstract] OR "problematic"[Title/Abstract] OR "excessive"[Title/Abstract]) AND ("gaming"[Title/Abstract] OR "video gaming"[Title/Abstract])))) AND (("Longitudinal"[Title/Abstract] OR "longitudinal study"[Title/Abstract] OR "longitudinal analysis"[Title/Abstract] OR "prospective"[Title/Abstract] OR "developmental trajectory"[Title/Abstract] OR "cross-lagged"[Title/Abstract] OR "autoregressive cross-lagged modelling"[Title/Abstract] OR "long-term evaluation"[Title/Abstract] OR "latent growth model"[Title/Abstract]))
Web of Science	(TI=("Internet gaming disorder" OR "gaming disorder" OR "gaming addiction" OR "game addiction" OR "video game*" OR "video game use" OR "video game play*" OR "online gaming" OR "online game*" OR "MMORPG" OR (("pathological" OR "problematic" OR "excessive") AND ("gaming" OR "video gaming"))) OR AB=("Internet gaming disorder" OR "gaming disorder" OR "gaming addiction" OR "game addiction" OR "video game*" OR "video game use" OR "video game play*" OR "online gaming" OR "online game*" OR "MMORPG" OR (("pathological" OR "problematic" OR "excessive") AND ("gaming" OR "video gaming")))) AND (TI=("Longitudinal" OR "longitudinal study" OR "longitudinal analysis" OR "prospective" OR "developmental trajectory" OR "cross-lagged" OR "autoregressive cross-lagged modelling" OR "long-term evaluation" OR "latent growth model") OR AB=("Longitudinal" OR "longitudinal study" OR "longitudinal analysis" OR "prospective" OR "developmental trajectory" OR "cross-lagged" OR "autoregressive cross-lagged modelling" OR "long-term evaluation" OR "latent growth model"))
ScienceDirect	("Internet gaming disorder" OR "gaming disorder" OR "gaming addiction" OR "pathological gaming" OR "problematic gaming" OR "video game") AND ("longitudinal" OR "prospective" OR "long-term evaluation")

The severity of GD as indicated by the mean scores of the different questionnaires was generally rather low across the studies, indicating that only a minority of participants displayed a problematic or pathological use. Only nine studies reported the percentage of participants of the sample with GD based on cut-off scores. These ranged from 2.2 [44] to 23.6% [68].

Negative Psychosocial Consequences of Symptoms of Gaming Disorder

Negative consequences from gaming were investigated across various domains, including mental and physiological health, psychological, behavioural, as well as social and interpersonal problems. However, results from different studies are often mixed. In the following, study results for the different domains are briefly summarized with a focus on the variables that were researched most.

Mental Health

Depression was the most researched variable ($n=21$). While a few studies ($n=7$) reported that symptoms of GD did not act as an antecedent of depression, other studies found that symptoms of GD consistently predicted depression at a later assessment ($n=6$). In addition, increases in GD were related to increases in depressive scores at a later time point ($n=3$). Five studies found a reciprocal association between the two measures.

Anxiety was shown to develop after symptoms of GD in five studies. Non-significant relations between symptoms of GD and anxiety were observed in two studies. One study found higher scores of GD at baseline to be related to a decrease of anxiety at follow-ups.

Psychological distress was examined in three studies. Two studies reported that symptoms of GD significantly predicted psychological distress in children, adolescents, and adults. Similarly, in another study, symptoms of GD acted
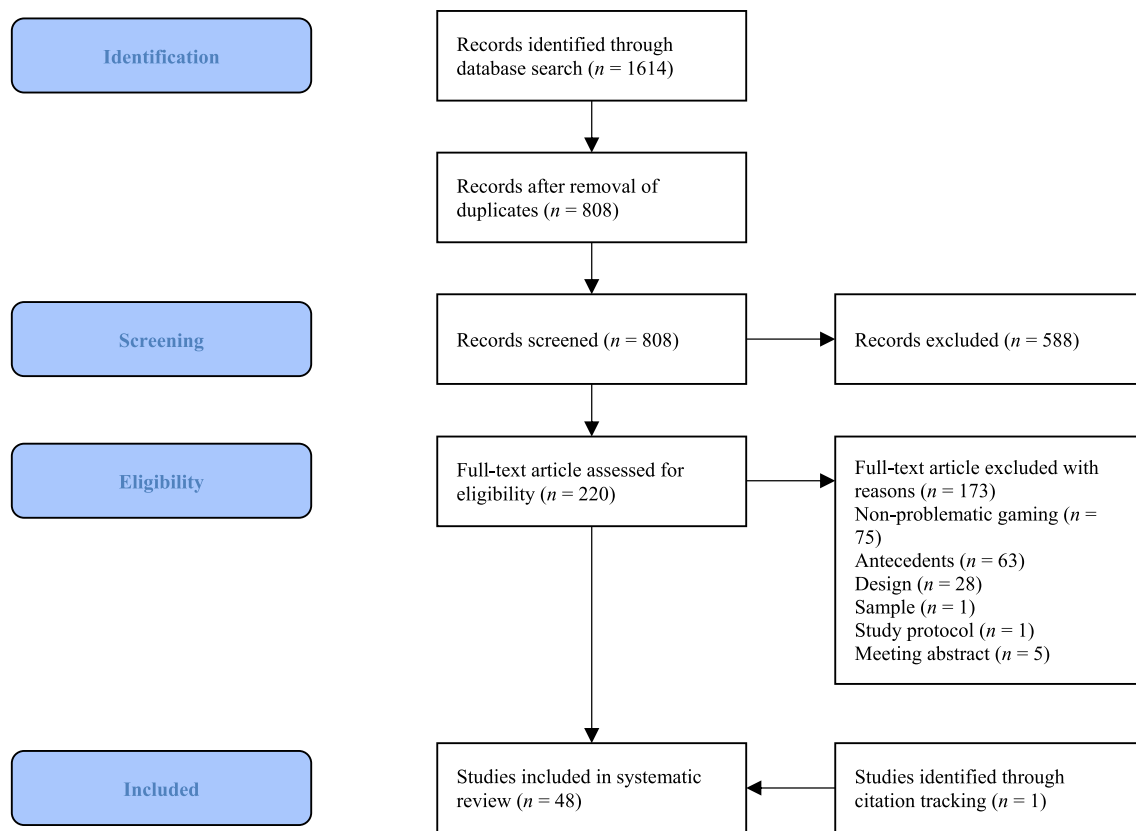
Fig. 1 Selection process

as significant covariate in the trajectory of psychological distress across six months.

Regarding ADHD, one study identified a significant reciprocal relationship with symptoms of GD. Two studies found that ADHD symptoms predict symptoms of GD. Non-significant relationships between symptoms of GD and ADHD among children were reported in one study.

Mental health was shown to be generally lower in participants that showed higher GD-scores at an earlier time point in two studies. In addition, quality of life (i.e. psychological health, physical health, and social relationships) was found to be negatively affected by GD symptoms. In another study, the relation between mental, physical, and social health, and symptoms of GD was not significant.

Psychological Factors

Life satisfaction was investigated in five studies. Lower life satisfaction was predicted by higher GD scores at an earlier assessment occasion in four studies. One study found that symptoms of GD were not related to life satisfaction.

Two studies found that symptoms of GD and loneliness were related reciprocally. One study found that the group of individuals with problematic gaming had significantly

higher loneliness scores compared to the groups with non-problematic use.

The effects of symptoms of GD on shyness were examined in two studies with one study reporting no significant association and the other finding that the group of participants with the highest GD scores had higher levels of shyness compared to the non-problematic group.

The findings regarding self-esteem show also no consistent pattern. Two studies did not find symptoms of GD to precede lower self-esteem, while two studies found symptoms of GD to be a consistent predictor of low self-esteem.

Behavioural Problems

The predictive power of symptoms of GD for symptoms of GD itself was reported in numerous studies ($n = 25$), while two studies that investigated symptoms of GD across three measurements did not find a similar consistent pattern.

The association of symptoms of GD with problematic gambling was investigated in two studies with one reporting a significant association and one not. One study found that symptoms of GD lead to higher levels of problematic cell phone use.

Table 2 Overview of longitudinal studies

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Baggio et al. (2016) [30]	Two-wave panel study	$N_0=5990$ $N_1=5223$ $N_{analysed}=4813$ $n_{male}=4813$ (100%) Mean age at $t_0=19.95$ years	Regression analysis	Game Addiction Scale Mean score at $t_0=1.67$ and $t_1=1.61$	Heavy use over time Physical health Mental health Depression	GD symptoms at t_0 significantly predicted higher depression scores, lower physical health and lower mental health at t_1
Benjet et al. (2022) [31]	Two-wave longitudinal study	$N_0=8122$ $N_1=1741$ $N_{analysed}=1526$ $n_{male}=$ n/a Mean age = n/a	Log-binomial models	DSM-5 IGD Scale Mean score = n/a	Academic/school achievement Social impairment Physical health Extracurricular activities Stress	GD symptoms at t_0 predicted severe school impairment and poor social life at t_1
Borges et al. (2023) [32]	Two-wave longitudinal study	$N_0=8122$ $N_1=1741$ $N_{analysed}=1741$ $n_{male}=$ n/a Mean age = n/a	Log-binomial models	DSM-5 IGD Scale Mean score = n/a	Mental disorders	Non-sig
Brunborg et al. (2014) [33]	Two-wave panel study	$N_0=8356$ $N_1=2450$ $N_{analysed}=1928$ $n_{male}=858$ (44.5%) Mean age = n/a Age range at $t_0=13$–17 years	Regression analysis First differencing	Game Addiction Scale Mean score at $t_0=1.47$ and $t_1=1.37$	Amount of gaming Depression Academic achievement Heavy episodic drinking Conduct problems	GD symptoms at t_0 associated with increase in depression and conduct problems and decrease in average grades at t_1; association with heavy episodic drinking not significant
Byeon et al. (2022) [34]	Prospective cohort study	$N_0=2319$ $N_1=1849$ $N_{analysed}=1838$ $n_{male}=1182$ (64.3%) Mean age = n/a	Regression analysis	Internet Game Use-Elicited Symptom Screen IGD risk group at $t_0=8.8\%$ and at $t_1=7.8\%$	Physical pain experiences Physical exercise Sleep hours	GD symptoms at t_0 significantly associated with physical pain experiences at t_1; no significant association between GD symptoms and weekend sleep duration and physical exercise

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Chang et al. (2022) [35]	Three-wave longitudinal study	$N_0 = 645$ $N_1 = 358$ $N_2 = 272$ $N_3 = 178$ n_{male} at $t_0 = 266$ (41%) Mean age at $t_0 = 20.95$ years	Random intercept cross-lagged model	Internet Gaming Disorder Scale Short Form Mean score = 16.92	Social media addiction Anxiety Depression	GD symptoms at t_1 associated with high levels of anxiety at t_2; GD symptoms at t_1 (t_2) did not lead to high levels of depression at t_2 (t_3); depression at t_2 led to higher levels of GD symptoms at t_3; GD symptoms did not consistently predict GD symptoms at a later assessment occasion
Chen, Chen et al. (2022) [36]	Two-wave longitudinal study	$N = 980$ $n_{male} = 168$ (17.1%) Mean age = 34.76	Cross-lagged panel model Hierarchical linear regression	Internet Gaming Disorder Scale Short Form Mean score at $t_0 = 12.92$ and $t_1 = 13.59$	Administrators´ support Psychological need thwarting of online teaching Problematic social media use Psychological distress	GD symptoms at t_0 associated with increased psychological distress at t_1 GD symptoms at t_0 were significantly associated with GD symptoms at t_1
Chen, Lin et al. (2022) [37]	Three-wave longitudinal study	$N_0 = 283$ $N_1 = 277$ $N_2 = 272$ n_{male} at $t_0 = 283$ (100%) Mean age $t_0 = 10.76$ years	Hierarchical linear modelling	Internet Gaming Disorder Scale Short Form Mean score at $t_0 = 1.48$, $t_1 = 1.44$, and $t_2 = 1.42$	Psychological distress Perceived weight stigma	GD symptoms as significant covariate for psychological distress
Coyne et al. (2020) [38]	Six year longitudinal study	$N = 385$ $n_{male} = 181$ (47%) Mean age = 15.01 years	Structural equation model	Pathological Gaming Scale Mean score at $t_0 = 1.54$, $t_1 = 1.44$, $t_2 = 2.49$, $t_3 = 1.98$, $t_4 = 1.22$, and $t_5 = 1.10$	Depression Anxiety Aggression Delinquency Empathy Prosocial behaviour Shyness Parental knowledge Financial stress Problematic cell phone use	Problematic group (i.e. highest levels of GD symptoms) had higher levels of aggression, depression, problematic cell phone use, anxiety, and shyness compared to the nonproblematic group

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Ferguson et al. (2022) [39]	Three-wave longitudinal study	$N_0=2998$ $N_1=2605$ $N_2=2532$ n_{male} at $t_0=2179$ (72.7%) Mean age $t_0=11.21$ years	OLS regression analysis	Pathological Gaming Scale Mean score at $t_0=2.27$, $t_1=2.05$, and $t_2=1.78$	Family environment Impulse control problems Intelligence Self-control Somatic complaints ADHD Depression Anxiety Social phobia	GD symptoms at t_0 did not predict somatic complaints, self-control, ADHD symptoms, depression, anxiety or social phobia at t_2; GD symptoms at t_2 predicted by GD symptoms, ADHD and depression at t_1; at t_2 only 12% continued to endorse high GD symptoms
Ferguson and Ceranoglu (2014) [40]	One year prospective analysis	$N=144$ $n_{male}=76$ (52.8%) Mean age = 12.7 years	OLS regression analysis Path analysis	Scale of Pathological Gaming (developed by the authors) Mean score at $t_1=0.87$	Attention problems Grade point average Family attachment Peer delinquency	GD symptoms at t_0 did not predict attention problems and lower GPA at t_1, but attention problems at t_0 predicted GD symptoms at t_1; GD symptoms at t_0 predicted GD symptoms at t_1
Gan et al. (2021) [41]	One year longitudinal study	$N_0=1041$ $N_1=951$ $N_2=903$ n_{male} at $t_2=410$ (45.40%) Mean age at $t_0=12.90$ years	Autoregressive cross-lagged model	Pathological Gaming Scale Mean score at $t_0=0.552$ (girls=0.329), $t_1=0.504$ (girls=0.328), and $t_2=0.433$ (girls=0.340)	Parenting style (parental care and parental control) Depression	GD symptoms negatively affected depressive symptoms and parenting style significantly but inconsistently over time The reverse relationship was consistent over time GD symptoms as consistent predictor of GD symptoms across all time points
Gan et al. (2022) [42]	Two-wave longitudinal study	$N_0=995$ $N_1=962$ $N_{analysed}=956$ n_{male} of $N_{analysed}=437$ (45.71%) Mean age of $N_{analysed}=16.03$	Hierarchical regression model	Internet Gaming Disorder Questionnaire Mean score at $t_0=1.37$ and $t_1=1.38$	Depression	Non-sig GD symptoms at t_0 predicted GD symptoms at t_1

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Gentile et al. (2011) [43]	Two year longitudinal study	$N_0 = 2998$ $N_1 = 2605$ $N_2 = 2532$ n_{male} at $t_0 = 2179$ (72..7%) Mean age = n/a	Latent mixture growth modelling	Pathological Gaming Scale Mean score at $t_0 = 2.28$ and $t_1 = 2.05$	Amount of gaming Social competence Impulsivity Social phobia Depression Anxiety Parent–child relationship quality School performance	GD symptoms at t_0 predicted depression, anxiety, social phobia, and poor school performance at t_2; 84% of those who were in the GD group at t_0 were still in the same group at t_2
Henchoz et al. (2016) [44]	Two-wave longitudinal study	$N_0 = 5990$ $N_1 = 5223$ $N_{analysed} = 4933$ n_{male} at $t_0 = 5990$ (100%) Mean age at $t_0 = 19.95$ years	Autoregressive cross-lagged model	Game Addiction Scale Mean score = n/a 2.2% identified as addicted gamers	Sport and exercise	GD symptoms at t_0 negatively predicted level of sport and exercise at t_1, the reverse relationship was also significant; GD symptoms at t_0 predicted GD symptoms at t_1
Huang et al. (2022) [45]	Six month longitudinal study	$N_0 = 974$ $N_2 = 452$ n_{male} at $t_0 = 396$ (40.7%) Mean age at $t_0 = 23.70$ years	Linear mixed effect models	Internet Gaming Disorder Scale Short Form Mean score at $t_0 = 19.53$, $t_1 = 21.06$, and $t_2 = 21.95$	Physical activity Problematic smartphone use Problematic social media use	Significant positive association between GD symptoms and physical activity at t_1 and t_2 GD symptoms were associated across all waves
Hygen et al. (2020) [46]	Three-wave longitudinal study	$N_0 = 703$ $N_1 = 666$ $N_2 = 636$ n_{male} at $t_0 = 336$ (47.8%) Mean age at $t_0 = 10.51$ years	Random intercept cross-lagged panel model	Internet Gaming Disorder Interview Mean score at $t_0 = 0.75$, $t_1 = 0.80$, and $t_2 = 0.86$	Symptoms of psychiatric disorders	GD symptoms at t_0 (t_1) predicted decreased symptoms of anxiety at t_1 (t_2), no association between GD symptoms and further psychopathology; GD symptoms at t_1 predicted GD symptoms at t_2
Jeong et al. (2019) [47]	Two-wave longitudinal study	$N_0 = 399$ $N_1 = 366$ n_{male} at $t_1 = 188$ (51.4%) Median age at $t_1 = 10$ years (range 9–12)	Cross-lagged panel model	Internet Game Use-Elicited Symptom Screen Median score = 2	Depression	GD symptoms at t_0 predicted level of depression at t_1 and vice versa; GD symptoms at t_0 predicted GD symptoms at t_1

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Kim et al. (2022) [48]	Three-wave longitudinal study	$N_0 = 6640$ $N_1 = 4968$ $N_2 = 4466$ n_{male} at $t_0 = 3453$ (52%) Mean age at $t_0 = 12.6$ years	Regression analysis	Internet Gaming Disorder Scale Mean score at $t_1 = 2.46$ and at $t_2 = 2.47$	Anxiety Gaming intensity	GD symptoms at t_1 predicted higher levels of anxiety at t_2 and vice versa
Kim et al. (2023) [49]	Five-wave longitudinal study	$N_0 = 1728$ $N_{analysed} = 801$ n_{male} of $N_{analysed} = 474$ (49%) Mean age at $t_0 = 13.37$ years	Autoregressive cross-lagged models	Internet Addiction Test modified to assess GD Mean score male gamers $= 49.30$ and female gamers $= 40.05$	Aggression Intrusive parenting	Across all waves and only among boys, GD symptoms led to higher levels of aggression at a later time point The relationship was partly reciprocal Among boys, GD symptoms at t_0, t_1, and t_3 predicted intrusive parenting at a later time point The reverse relationship was partly significant Among girls, only GD symptoms at t_0 predicted intrusive parenting at t_1 GD symptoms were associated across all waves
Koning et al. (2018) [50]	Two-wave prospective study	$N_0 = 544$ $N_1 = 354$ n_{male} at $t_1 = 173$ (48.9%) Mean age at $t_1 = 13.9$ years	Structural equation modelling	Internet Gaming Disorder Scale Mean score at $t_0 = 9.69$ and $t_1 = 10.11$	Social media disorder Internet-specific rules Reactive restrictions Frequency of communication Quality of communication Level of education	GD symptoms at t_0 predicted more reactive rules among boys and girls at t_1, a lower quality of communication among girls at t_1, and a higher frequency of communication among boys at t_1
Krossbakken et al. (2018) [51]	Three-wave longitudinal study	$N_0 = 2059$ $N_1 = 1334$ $N_2 = 1277$ n_{male} at $t_0 = 968$ (47%) Mean age at $t_0 = 17.5$ years	Cross lagged path model Satorra-Bentler test	Game Addiction Scale Mean score = n/a	Depression Anxiety Loneliness Aggression Alcohol use disorder	Depression and loneliness as antecedent and consequence of GD symptoms; anxiety as consequence of GD symptoms; physical aggression antecedent of GD symptoms; stability of the addicted gamer group was 35%

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Larrieu et al. (2023) [29]	Three-wave longitudinal study	$N_0 = 4772$ $N_1 = 2021$ $N_2 = 1128$ n_{male} at $t_0 = 4519$ (94.7%) Mean age at $t_0 = 21.38$ years	Random intercept cross-lagged panel model	4 criteria according to DSM-5/ICD-11 Presence of all 4 criteria at $t_0 = 4.33\%$, at $t_1 = 4.34\%$ and at $t_3 = 5.47\%$	Gaming motives Quality of life Personality traits Impulsivity traits Self-esteem Anxiety Depression Objective gaming behaviour	GD symptoms negatively associated with psychological health, physical health and social relationships GD symptoms at t_1 were significantly associated with GD symptoms at t_2
Lemmens et al. (2011a) [52]	Two-wave longitudinal panel study	$N_0 = 1024$ $N_1 = 941$ $N_{analysed} = 540$ n_{male} at $t_0 = 522$ (51%) Mean age at $t_0 = 13.9$ years	Autoregressive cross-lagged panel model	Game Addiction Scale Mean score for each participant ranged from 1 to 4.43 6% at t_0 and 4% at t_1 had a mean score of ≥ 3	Time spent on games Violent game play Physical aggression	Higher levels of GD symptoms at t_0 predicted self-reported physical aggression at t_1; the reverse relation was not significant; in boys, GD symptoms at t_0 predicted an increase in physical aggression at t_1; among girls, GD symptoms at t_0 predicted a decrease in physical aggression at t_1; GD symptoms at t_0 predicted GD symptoms at t_1
Lemmens et al. (2011b) [53]	Two-wave longitudinal panel study	$N_0 = 1024$ $N_1 = 941$ $N_{analysed} = 543$ n_{male} at $t_0 = 522$ (51%) Mean age at $t_0 = 13.9$ years	Autoregressive cross-lagged panel model	Game Addiction Scale Mean score for each participant ranged from 1 to 4.43 6% at t_0 and 4% at t_1 had mean score of ≥ 3	Time spent on games Loneliness Life satisfaction Social competence Self-esteem	GD symptoms at t_0 predicted loneliness at t_1 and vice versa; social competence and self-esteem at t_0 negatively predicted GD symptoms at t_1, but not vice versa; no significant relation between GD symptoms and life satisfaction; GD symptoms at t_0 predicted GD symptoms at t_1

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Liau et al. (2015) [54]	Two-year longitudinal study	$N_0 = 2998$ $N_1 = 2605$ $N_2 = 2532$ n_{male} at $t_0 = 2179$ (72.68%) Mean age = n/a	Dual trajectory growth model	Pathological Gaming Scale Mean score at $t_0 = 2.27$, $t_1 = 2.05$, and $t_2 = 1.78$	Personal strengths Family factors: parent–child closeness, adult involvement in media and family environment Depression	Higher initial levels (t_0) and increases in GD symptoms (t_0–t_2) related to higher levels of depressive symptoms at t_2
Lin et al. (2020) [55]	Two-year longitudinal study	$N_0 = 1089$ $N_1 = 1024$ $N_2 = 908$ n_{male} at $t_2 = 480$ (52.86%) Mean age at $t_0 = 11.27$ years	Autoregressive cross-lagged model	Pathological Gaming Scale Mean score at $t_0 = 1.47$, at $t_1 = 1.38$, at $t_2 = 1.00$	Parental psychological control Deviant peer affiliation	GD symptoms at t_1 predicted parental psychological control at t_2; parental psychological control at t_0 and t_1 predicted GD symptoms at t_1 and t_2; GD symptoms at t_0 predicted deviant peer affiliation at t_1; GD symptoms as consistent predictor of GD symptoms at later assessments
Liu et al. (2018) [56]	Four-year longitudinal study	$N = 563$ $n_{male} = 439$ (77.97%) Mean age at $t_0 = 18.31$ years	Autoregressive cross-lagged model	Chinese Internet Addiction Scale Mean score = n/a	Depression	GD symptoms at t_0, t_1, and t_2 predicted depression at t_1, t_2, and t_3 and vice versa GD symptoms as consistent predictor of GD symptoms across all time points

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Marmet et al. (2018) [57]	Five-year longitudinal study	$N_0 = 5987$ $N_1 = 5516$ $N_{analysed} = 5067$ $n_{male} = 5067$ (100%) Mean age at $t_0 = 19.97$ years	Autoregressive cross-lagged model	Game Addiction Scale Mean score = n/a Prevalence of GD at $t_0 = 8.8\%$ and $t_1 = 6.3\%$	Adult attention hyperactivity disorder Alcohol use disorder Cannabis use disorder Tobacco use disorder Depression Mental health Life satisfaction Poor performance at work / school	Participants with GD at t_0 more likely to show ADHD at t_1, and vice versa; Participants with GD at t_0 had higher depression scores, lower mental health (quality of life) scores, and lower life satisfaction at t_1, but no lower performance at work or school; GD symptoms at t_0 predicted GD symptoms at t_1
Molde et al. (2019) [58]	Two-year longitudinal study	$N_0 = 10{,}081$ $N_1 = 5809$ $N_{analysed} = 4601$ n_{male} of $N_{included\ in\ analysis} = 2172$ (47.2%) Mean age at $t_0 = 48$ years	Autoregressive cross-lagged panel model	Game Addiction Scale Mean score at $t_0 = 2.56$ and $t_1 = 2.33$	Problematic gambling	GD symptoms at t_0 predicted problematic gambling at t_1, but not vice versa; GD symptoms at t_0 predicted GD symptoms at t_1
Rapinda et al. (2021) [59]	Short-term multi-wave study	$N_0 = 289$ $N_1 = 237$ $N_2 = 185$ n_{male} of $N_0 = 164$ (56.7%) Mean age = n/a Age range at t_0: 18—74 years	Autoregressive cross-lagged panel model	Internet Gaming Disorder Scale Short Form Mean score at $t_0 = 18.90$, $t_1 = 17.22$, and $t_2 = 14.90$	Gaming habits Gaming timeline Depression	GD symptoms at t_1 predicted higher depression scores at t_2; higher depression scores at t_0 and t_1 predicted GD symptoms at t_1 and t_2; GD symptoms at t_0 predicted GD symptoms at t_1 and at t_2

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Scharkow et al. (2014) [60]	Three-year longitudinal panel study	$N_0 = 4500$ $N_1 = 2190$ $N_2 = 902$ n_{male} of $N_0 = 2745$ (61%) Mean age at $t_0 = 35.1$ years	Autoregressive cross-lagged panel model	Game Addiction Scale Mean score at $t_0 = 1.5$, $t_1 = 1.5$, and $t_2 = 1.4$	Personality traits Life satisfaction Perceived success	Young adults with higher GD symptoms at t_1 had less perceived success at t_2; age ≥ 40: higher GD symptoms at t_0 associated with significantly lower life satisfaction at t_1; higher GD symptoms at t_1 associated with less perceived success at t_2; GD symptoms stable across all three assessment occasions
Schmitt and Livingston (2015) [61]	One-year longitudinal study	$N_0 = 477$ $N_{analysed} = 383$ n_{male} of $N_0 = n/a$ Mean age at $t_0 = 18$ years	Hierarchical linear regression model	Revised Video Game Addiction Scale Mean score = 16.80	Expectations about engagement in college education Cumulative GPA Number of reported drug and alcohol violations	GD symptoms at t_0 negatively predicted first year college GPA and drug and alcohol violations at t_1
Seay (2007) [62]	14-month longitudinal study	$N_0 = 1503$ $N_1 = 1089$ $N_2 = 79$ $N_{analysed} = 499$ $N_{aggregated\ pool} = 2790$ $N_{aggregated\ pool} = 2455$ n_{male} of $N_{aggregated\ pool} = 2455$ (88%) Mean age of $N_{aggregate\ pool} = 27.89$ years	Regression analysis with lagged predictors	Engagement Addiction Scale II Mean score = n/a	Personality Play motivation Play hours Affinity Social Integration Social dimension Depression	No association between GD symptoms and depression; GD symptoms at t_0 accounted for 47% of the variance in GD symptoms at t_1
She et al. (2022) [63]	Two-wave longitudinal study	$N_0 = 1239$ $N_1 = 1200$ n_{male} of $N_0 = 633$ (52.8%) Mean age at $t_0 = 15.6$ years	Cross-lagged model	DSM-5 IGD symptoms checklist Probable IGD at $t_0 = 12.4\%$ and at $t_1 = 11.7\%$	Parental psychological control Parental abuse Parental support Parent–child relationship	GD symptoms at t_0 did not significantly affect parental variables at t_1 GD symptoms at t_0 predicted GD symptoms at t_1

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Sibilla et al. (2021) [28]	Three-wave longitudinal online survey study	$N_0 = 360$ $N_2 = 157$ $N_{analysed} = 147$ $n_{male} = 68$ (46.3%) Mean age = 31.98 years	Cross-lagged model	Internet Game Disorder Symptoms Scale Mean score at $t_0 = 2.71$, $t_1 = 2.53$, and $t_2 = 2.56$	Time spent playing Presence Avatar identification Self-esteem Well-being	GD symptoms at t_0 predicted engaged life at t_1; GD symptoms did not affect self-esteem, meaningful life or pleasant life over time; the reverse relation was significant, except for pleasant life; GD symptoms were a stable predictor of GD symptoms across all assessments
Su et al. (2018) [64]	Three-wave longitudinal study	$N_0 = 1830$ $N_1 = 1680$ $N_2 = 1490$ n_{male} of $N_2 = 813$ (54.6%) Mean age at $t_0 = 12.03$ years	Autoregressive cross-lagged model	Internet Addiction Scale Mean score at $t_0 = 1.27$, $t_1 = 1.29$, and $t_2 = 1.27$	Parental monitoring Parent–child relationship	GD symptoms at t_0 predicted poorer mother–child and father–child relationship at t_1; positive indirect effect of GD symptoms on parental monitoring via father–child relationship; greater GD symptoms at t_1 predicted lower parental monitoring at t_2 and vice versa; GD symptoms were a consistent predictor of GD symptoms

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Teng, Griffiths et al. (2020) [65]	One and a half year longitudinal study	$N_0 = 1054$ $N_1 = 924$ $N_2 = 931$ n_{male} of $N_2 = 354$ (38%) Mean age at $t_0 = 18.25$ years	Autoregressive cross-lagged panel model	Internet Gaming Disorder Scale Short Form Mean score at t_0 for boys = 1.67 (girls = 1.23), at t_1 for boys = 1.94 (girls = 1.40), at t_2 for boys = 2.09 (girls = 1.39)	Parent-adolescent attachment Peer attachment	GD symptoms at t_0 (t_1) negatively predicted father attachment quality at t_1 (t_2), but not vice versa; GD symptoms at t_0 (t_1) negatively predicted peer attachment at t_1 (t_2) and vice versa; GD symptoms did not predict mother attachment quality; Across all waves, GD symptoms were a consistent predictor of GD symptoms
Teng et al. (2021) [66]	Two-wave longitudinal study	$N_0 = 2111$ $N_1 = 1778$ n_{male} of $N_1 = 901$ (50.7%) Mean age = n/a	Cross-lagged panel model	Internet Gaming Disorder Scale Short Form Mean score at $t_0 = 1.73$ and $t_1 = 1.77$	Video game use Perceived COVID-19 impacts Depression Anxiety	GD symptoms at t_0 did not predict depressive and anxiety symptoms and video game use at t_1, the reverse relationship was significant; GD symptoms at t_0 predicted GD symptoms at t_1
Teng, Pontes et al. (2020) [67]	Three-wave longitudinal study	$N_0 = 1054$ $N_1 = 924$ $N_2 = 931$ n_{male} of $N_2 = 354$ (38%) Mean age at $t_0 = 18.25$ years	Cross-lagged panel model	Internet Gaming Disorder Scale Short Form Mean score at $t_0 = 1.47$, $t_1 = 1.62$, and $t_2 = 1.69$	Self-esteem Social support Life satisfaction	GD symptoms at t_0 (t_1) as negative predictor of self-esteem, perceived social support, and life satisfaction at t_1 (t_2), but not vice versa
Vadlin et al. (2018) [68]	Three-year longitudinal study	$N_0 = 1868$ $N_1 = 1576$ n_{male} of $N_1 = 662$ (42%) Mean age = n/a Adolescents born in 1997 and 1999	Logistic regression analysis	Gaming Addiction Identification Test Mean score = n/a Problematic gamer at $t_0 = 23.6\%$ and $t_1 = 19.7\%$	Problematic gambling Gambling activities Frequency and duration of gaming activities	GD symptoms at t_0 explained 0.7% of variance in problematic gambling at t_1; Of those with GD at t_0, 46.1% still pertained to the GD-group at t_1

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Van den Eijnden et al. (2018) [69]	Two-year longitudinal study	N_0 = n/a N_1 = n/a N_2 = 538 n_{male} of N_2 = 263 (48.9%) Mean age at t_2 = 12.9 years	Structural equation model	Internet Gaming Disorder Scale Mean score at t_0 = 9.79 and t_1 = 9.73	Gaming hours Frequency of social media use Social media disorder symptoms Perceived social competence Life satisfaction GPA Level of education	GD symptoms at t_0 had a negative effect on life satisfaction at t_1 and on perceived social competence at t_1 and t_2; GD symptoms had no effect on GPA
Van Rooij et al. (2010) [70]	Two-wave repeated cross-sectional survey	N_0 = 4559 N_1 = 3740 n_{male} of N_1 = 1945 (52%) Mean age at t_1 = 14.34 years	Latent class analysis	Compulsive internet use scale Weekly hours online gaming Mean score IGD-group at t_0 = 2.9 and t_1 = 2.8	Self-esteem Loneliness Depression Social anxiety	Significant differences between GD-group and non-GD-group in depressive mood at t_1, loneliness at t_1 and t_2, and self-esteem at t_1 and t_2; 50% of the GD group was still in this group at t_1
Wang et al. (2022) [71]	Two-wave longitudinal study	N_0 = 1825 N_1 = 1047 n_{male} of n_1 = 504 (48%) Mean age at t_1 = 12.45 years	Cross-lagged panel model	Internet Gaming Disorder Test (IGDT-10) Mean score = n/a	Depression Shyness	GD symptoms at t_0 positively predicted depression at t_1, but not vice versa; no relation between GD symptoms and shyness; GD symptoms at t_0 predicted GD symptoms at t_1
Wartberg et al. (2019) [72]	Prospective longitudinal study	N_0 = 1095 N_1 = 985 n_{male} of N_1 = 499 (50.7%) Mean age at t_0 = 12.99 years	Structural equation model	Internet Gaming Disorder Scale Mean score = n/a	Emotional distress Hyperactivity and inattention Parental depression Parental anxiety	GD symptoms at t_0 as predictor of GD symptoms, emotional distress, parental anxiety, hyperactivity and inattention at t_1
Weinstein et al. (2017) [73]	Six-month prospective longitudinal study	N_0 = 5777 N_1 = 4594 $N_{analysed}$ = 2316 n_{male} = 885 (38.2%) Mean age = 49.21 years	Cross-lagged model	Criteria checklist Mean score at t_0 = 0.56 and t_1 = 0.47	Internet gaming Health Psychological need satisfaction Physical and social activity	GD symptoms at t_0 predicted GD symptoms and psychological need satisfaction at t_1; GD symptoms at t_0 did not predict lower health at t_1

Table 2 (continued)

Authors	Design and time points	Sample characteristics	Statistical analysis of longitudinal data	GD measure and mean symptom severity	Other measures	Main findings concerning negative consequences
Wright and Wachs (2022) [74]	One-year longitudinal study	$N_0 = 202$ $N_1 = 202$ $n_{male} = 174$ (86%) Mean age at $t_0 = 11.69$ years	Structural equation modelling	Problematic Online Gaming Questionnaire Mean score at $t_0 = 3.16$	Console-gaming aggression Subjective health complaints Depression	GD symptoms at t_0 predicted depressive symptoms and subjective health complaints at t_1
Yang et al. (2021) [75]	One-year longitudinal study	$N_1 = 591$ n_{male} of $N_1 = 249$ (42.1%) Mean age = n/a	Cross-lagged model	Internet Gaming Disorder Scale Probable GD at $t_0 = 10.1\%$ and $t_1 = 9.1\%$		GD symptoms at t_0 predicted GD symptoms at t_1

DSM-5 Diagnostic and statistical manual of mental disorders 5th edition, *ICD 11* International statistical classification of diseases and related health problems 11th edition, *GD* Gaming disorder, *GPA* grade point average, *IGD* internet gaming disorder

Five studies investigated self-reported aggression. While one study could identify aggression as antecedent of symptoms of GD, the reverse relationship was observed in two studies. Furthermore, one study found that GD was a consistent predictor of aggression, among boys, while the reverse relationship was only partly consistent. Another study found that an increase in GD scores caused an increase in conduct problems (e.g. theft, vandalism, quarrels and fights, not informing parents about whereabouts). In addition, one study reported that symptoms of GD predicted deviant peer affiliation.

Interpersonal and Social Factors

School performance, mostly assessed via grade point average (GPA), was investigated in seven studies. The result pattern is not uniform. Three studies found no evidence of a causal relationship between symptoms of GD and poor school performance. In contrast, four studies found that symptoms of GD were associated with a deterioration of GPA at a later time point.

Various parental styles seem to be affected by symptoms of GD. Lower parental care and higher parental control were predicted by higher scores of GD in one study. Reciprocal relationships were observed in two other studies. Concerning intrusive parenting, another study observed a relatively stable predictive effect of GD symptoms, among boys. The reverse relationship was less consistent. Another study observed that symptoms of GD predicted more reactive rules among boys and girls, a lower quality of communication among girls, but a higher frequency of communication among boys. Finally, one study reported that symptoms of GD predicted poorer mother–child and father-child relationships. Furthermore, symptoms of GD consistently predicted poorer father attachment quality and peer attachment quality, but not mother attachment quality in one study. Finally, another study did not find any association between GD symptoms and parental variables, such as parental psychological control, parental abuse, parental support, and parent–child relationships.

Physical Health

Research on the effect of symptoms of GD on physical health seems to be scarce and relatively mixed. While one study did not find a relationship between physical health and symptoms of GD, another study found a positive association between GD symptoms and physical activity. On the other hand, symptoms of GD were shown to predict lower levels of sport and exercise ($n = 1$) and lower physical health ($n = 1$). Accordingly, an association of symptoms of GD with subjective health complaints was observed ($n = 1$). Moreover, it was shown that GD symptoms can lead to dry eye

symptoms, musculoskeletal pain, and near miss accidents ($n = 1$).

Discussion and Conclusions

The aim of the research presented here was to review systematically negative consequences of symptoms of GD by focusing on longitudinal studies that considered the temporal order of the effects. A total of 48 studies met the inclusion criteria and were subject to a thorough analysis. The results revealed that a very heterogeneous field of possible negative consequences of symptoms of GD pertaining to the domains of mental health, psychological factors, behavioural factors, social and interpersonal factors, and physical health has been researched. For many of these domains, only few studies are available and findings of different studies are often mixed. In this regard, it is important to acknowledge that symptoms of GD have been assessed with a wide range of different measures, and samples differed considerably regarding the age of participants, the gender distribution, and the cultural background. The moderating effects of these variables have so far not been investigated systematically in previous studies and this is beyond the scope of the present review.

Negative Consequences of Gaming

The most consistent finding is an association between symptoms of GD and depression. This association has been investigated in 21 studies and only seven of them did not observe this association, probably due to the investigation of children and adolescents (e.g. [39, 46]) or the assessment of engagement in computers instead of problematic gaming [62]. However, it is important to acknowledge that a reciprocal association has been observed in several studies suggesting that gaming is associated with an increase in depressive symptoms, which in turn is associated with an increase in gaming. Such a reciprocal association suggests that the development of problematic gaming may be associated with a shift from feelings of gratification from gaming to relief from negative affect as described in the I-PACE model of addictive behaviours [79]. In line with this, there is evidence from several studies that symptoms of GD are associated with loneliness, lower live satisfaction, and more psychological distress, and reciprocal relationships have been observed as well in some studies. In this regard, another important finding is that some studies reported that symptoms of GD are associated with less perceived social competence, low self-esteem, and an increase in interpersonal problems including aggression and conduct problems. While these findings are less convincing given the lower number of studies that investigated these association and also contradictory, it can be assumed that it is getting

more and more difficult for the individual to engage in social activities as alternative to gaming or to seek help for problematic gaming behaviour. It is thus not surprising that many studies found a consistent association between gaming at baseline and at follow-up, and it can be hypothesized that the negative consequences of gaming increase the probability of further gaming. However, future studies are warranted to support this assumption.

Clinical Implications and Public Health Considerations

Being exposed to the negative effects of gaming can cause an individual to think about a behaviour change, and treatment methods like motivational interviewing help to identify ambiguity and increase motivation to change (e.g. [22•]). For clinical practice, it may thus be helpful to assess systematically individual negative consequences, for example by using a Q-Sort task [80] with a list of negative consequences. Cognitive behavioural interventions can then help to reduce problematic gaming (e.g. [81••, 82••, 83]). However, it is also important to bridge personal and structural barriers to seek help from professional healthcare providers. In this regard, significant others, for example parents or partners of individuals with problematic GD, can play an important role. As demonstrated by Szász-Janocha and colleagues [84] these persons also experience a range of negative consequences. However, while a minority of them sought help for themselves, none of them had sought psychological help for their partner. Thus, it seems also important to inform the public about negative consequences from gaming and the development and maintenance of this disorder.

There is no doubt that the inclusion of GD in ICD-11 is also associated with public health implications across countries [85•]. The findings outlined above, especially regarding physical and mental health, also underline the necessity to discuss GD from a public health perspective. For example, Rumpf and colleagues [86, 87] reported that individuals with GD were not able to work or fulfil normal activities on 7.5 days in the last twelve months, which compares to 7.2 days due to cardiovascular conditions. In adolescents, GD may be associated with poor school performance and absenteeism [88, 89]. The WHO Collaborative Project on the Development of New International Screening and Diagnostic Instruments for Gaming Disorder and Gambling Disorder [90] aims at the development of a gold standard instrument to detect gaming. Such instruments will facilitate the identification of individuals at risk, support healthcare providers in screening problematic gaming, and help to develop and evaluate prevention and training strategies to reduce GD symptoms, individual harm, and associated healthcare costs. While in Asian countries, GD has been recognized as a public health problem and government as well as non-government organizations have developed strategic plans,

most Western countries only started to discuss the burden of harm in depth [91] and to develop prevention measures [81••].

Strengths and Limitations

The current study has several strengths. By restricting the eligibility criteria to longitudinal designs, it was assured that the studies included in the review take into account the temporal pattern of the interplay between variables. In addition, the findings from the original studies were synthesized separately for the different domains allowing clearer conclusions to be drawn. A main limitation is that no meta-analysis was done which would have made it easier to draw clear conclusions. However, given the studies were very heterogeneous with regard to the assessment of GD and further psychopathology, the duration of the longitudinal assessment, as well as sample characteristics, this was not possible to implement. In addition, it is important to acknowledge that even though only longitudinal studies were included, causal interpretations should be made with caution as a number of factors (e.g. comorbid mental disorders, negative life events) that were not controlled for might have led to the occurrence of, for example, depressive symptoms. This is especially important as no risk of bias assessment was performed. A further limitation is that the study screening and selection process were carried out by only one researcher (LD). However, specific and clear eligibility criteria were developed to reduce bias and the systematic implementation of these criteria was supervised by SSL. A further limitation is that the studies included in the systematic review included only few participants with a diagnosis of GD.

Future Directions

When investigating negative psychosocial consequences of GD, future studies should use established instruments and validated cut-offs to categorize and label participants adequately as showing risky or pathological gaming behaviour. Thereby, research with samples showing more severe use is urgently needed. In addition, gender differences should be investigated systematically as so far, much of the research concentrated on male individuals. Moreover, future studies could employ a longitudinal design to follow individuals that successfully reduce their gaming and investigate driving motives behind their maintained behaviour change.

Conclusion

Overall, the findings of the systematic review indicate that a wide variety of negative consequences has been investigated. The most consistent finding is an association between symptoms of GD and depression. In addition, symptoms of GD are an important predictor for symptoms of GD in the future. For other domains, there are few studies and findings are mixed with several studies reporting no association with negative consequences. Future studies should further investigate negative consequences of gaming as well as moderating factors as negative consequences can drive behaviour change.

Declarations

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Papers of particular interest, published recently, have been highlighted as:
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•• Of major importance

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