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Gaming disorder: current research directions

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Research into gaming disorder (GD) is dynamic and growing, generating multiple new research directions. The present narrative review covers important recent studies of GD between 2019 and 2021, and addresses the following topics: (1) conceptualization, assessment, and prevalence, (2) comparison of GD frameworks proposed by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, and the International Classification of Diseases 11th Revision, (3) clinical studies, (4) neurobiological studies, (5) gambling elements in video games, and (6) impacts of the COVID-19 pandemic on gaming and GD. The most important findings in these areas and study limitations are discussed, and future research directions are proposed.

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Introduction

Gaming disorder (GD) involves recurrent videogaming behavior, leading to serious functional impairment in important areas (e.g. personal, social, family, occupational, and educational). GD is characterized by poor control, increasing priority given to gaming over other interests and everyday activities and continuation of gaming inspite of negative consequences [1]. Research into problematic or addictive use of video games dates to the 1980s and has increased over time. Owing to the research evidence accumulated, Internet gaming disorder (IGD) was included in Section 3 ('Emerging measures and models') of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) as a condition requiring further research [2]. Six years later, in 2019, the World Health Organization (WHO) recognized GD as an official diagnosis by including it in the International Classification of Diseases 11th Revision (ICD-11) [1]. Consequently, research into GD is dynamic and growing, generating multiple new research directions.

The authors reviewed recent studies of GD between 2019 and 2021 using several search databases (e.g. PubMed, Web of Science, and Google Scholar) and based on their subjective impression and professional experience in the field, decided to cover the following topics in the present narrative review as important current areas of GD research: (i) conceptualization, assessment, and prevalence, (ii) comparison of DSM-5 and ICD-11 frameworks, (iii) clinical studies, (iv) neurobiological studies, (v) gambling elements in video games, and (vi) impacts of the COVID-19 pandemic on gaming and GD.

Conceptualization, assessment, and prevalence

As in other new research areas, the conceptualization and assessment of GD have varied. Multiple terms have been used to describe GD and multiple measurement tools have been developed and employed. As reviewed previously [3], 18 different measures have been identified, each of which differed regarding the precise criteria assessed. This situation has improved with the inclusion of IGD in the DSM-5 because the measures developed subsequently were mostly based on the DSM-5 framework, operationalizing the nine IGD criteria. According to an updated review [4], these tools were indeed more unified, and some of them (e.g. IGDT-10 [5], IGDS9-SF [6]) had stronger support for their psychometric properties than others. However, none of the measures was found to be markedly superior.

The inclusion of GD in the ICD-11 was another important milestone in the unification of the field by providing a consensual term for the condition (i.e. GD) and a conceptualization and definition with a wide range of scholarly support [7] although see also [8]. Several assessment tools have been developed since GD was included in the ICD-11, all intending to operationalize the

GD definition provided by the WHO but doing so in different ways. For instance, the Gaming Disorder Test [9] is a very brief instrument, assessing GD with only 4 items. The GAMES test is a 9-item instrument developed among a community youth population in Japan [10], while the Gaming Disorder Scale has a self-report [11] and a parent-report version [12], both having 10 items with the same content. Furthermore, an international collaboration ('The WHO Collaborative Project on the Development of International Screening Tools for Disorders due to Addictive Behaviors') led by the WHO was also announced at the 6th International Conference on Behavioral Addictions. This initiative aims to develop diagnostic and screening tools to assess GD and possibly hazardous gaming in both clinical and research settings [13]. Nevertheless, it is not clear yet whether a gold-standard tool exists or will be accepted by clinical or research communities, or numerous tools will be used in parallel without general consensus.

The global prevalence estimate of GD according to two recent meta-analyses [14,15] was 3.05% (95% confidence interval: [2.38, 3.91]) and 3.3% (CI: [2.6–4.0]), respectively, and 1.96% [0.19, 17.12] and 2.4% [1.7–3.2] when considering only representative sample studies. Prevalence estimates for males were higher than for females, and they were also higher in Asia than in Europe. Relatedly, another meta-analysis of prevalence estimates of GD in Southeast Asia [16] reported an estimate of 10.1% (95% confidence interval: [7.3, 13.8]). However, it is worth emphasizing that screening instruments overestimate prevalence rates, particularly in the case of rare disorders such as GD [17].

Comparison of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition and International Classification of Diseases 11th Revision frameworks

Another important line of investigation involves the comparison of the DSM-5 and ICD-11 frameworks. A debate regarding the nine IGD criteria (e.g. [18]) has potentially impacted the development of GD criteria in the ICD-11, and simplistically, it may be argued that only the most consensual IGD criteria have been included, with an emphasis on functional impairment due to gaming (see Table 1). This view is supported by a recent Delphi expert consensus study [19]. A large international panel of GD experts with experience in the clinical and/or research field critically evaluated the nine DSM-5 criteria and the criteria derived from the ICD-11 clinical guidelines for GD to obtain accord on the criteria with respect to diagnostic validity (the degree to which a certain criterion is an attribute of the condition), clinical utility (the degree to which a certain criterion is able to differentiate normal from problematic behavior), and prognostic value (the degree to which a certain criterion is essential in predicting chronicity, persistence, and relapse). The results indicated agreement that the DSM-5 escapism/mood regulation, deception, and tolerance criteria were less helpful in differentiating between

Table 1

Criteria for IGD and GD as proposed in the DSM-5 and ICD-11.

	DSM-5 IGD criteria	ICD-11 GD criteria
Approach to assign a diagnosis	Polythetic (i.e. the individual must meet a certain number of criteria to qualify for a diagnosis)	Monothetic (i.e. the individual must meet precisely the set of necessary and sufficient criteria that define a condition)
Functional impairment	Persistent or recurrent gaming "leading to clinically significant impairment or distress as indicated by five or more of the nine criteria."	"The behavior pattern is of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning."
Information regarding the duration of the condition	12 months	12 months or more, although the required duration may be shortened if all diagnostic requirements are met and symptoms are severe
Criteria		
Preoccupation	Included	Not included
Withdrawal symptoms	Included	Not included
Tolerance	Included	Not included
Diminished/lost control	Included	Included
Diminished/lost interest in other activities	Included	Included
Continued use, despite negative consequences	Included	Included
Deception	Included	Not included
Escapism or relieving a negative mood	Included	Not included
Negative consequences (e.g. relationships, work/school performance)	Included	Included

normal and problematic gaming and may declare nonproblematic patterns of gaming as pathological. Additionally, there was agreement that the ICD-11 diagnostic guidelines would permit clinically valid and precise diagnosis of GD without pathologizing intensive but nonproblematic gaming.

Furthermore, given that the GD definition in the ICD-11 seems to follow a monothetic approach (i.e. the individual must meet precisely the set of necessary and sufficient criteria that define GD) compared with the DSM-5's polythetic approach on IGD (i.e. the individual must meet a certain number of criteria to qualify for a diagnosis), it is expected that the ICD-11 diagnosis may be more stringent than the DSM-5 diagnosis. Empirical studies comparing the two diagnostic frameworks [20,21] consistently found that all (or almost all) of those meeting the GD criteria met the IGD criteria too, while only part of those meeting the IGD criteria met the criteria for GD, supporting the aforementioned claim. For instance, a study examining treatment-seeking individuals who engaged in gaming in Korea [21] found that 61% met the diagnostic criteria for IGD, compared with 36% meeting the diagnostic criteria for GD. Moreover, GD diagnoses were associated with more intense and severe patterns of gaming and higher likelihoods of attention-deficit/hyperactivity disorder and coping motivations (i.e. playing to cope with being bored or stressed, to distract from everyday problems, or escape from aversive emotions) than were IGD diagnoses.

Clinical studies

Reviews evaluating treatment-efficacy studies [22–24] describe methodological flaws (e.g. small sample sizes, the absence of randomization, blinding and control groups, not enough information on effect sizes, recruitment and sample characteristics, and little information on treatment adherence), which limit confirmation for the effectiveness of different treatment methods. In previous years, an upsurge in the amount of treatment-efficacy studies [24], and a steady improvement in the quality of treatment evidence could be observed [25]. Nevertheless, there is still a great need for improvement. According to King and colleagues [25], studies should have follow-up assessments occurring through at least half a year or longer, evaluations of clinical change by qualified professionals (e.g. psychiatrists), and better assessment of treatment outcomes and underlying processes. Additionally, evidence-based treatment manuals are necessary, as very few manualized treatment protocols exist to date. One such protocol is the manualized cognitive behavioral therapy (CBT), called short-term treatment for Internet and computer game addiction (STICA) [26] applied in German and Austrian outpatient clinics. According to a recent high-quality randomized clinical trial, STICA appeared effective in the short term (at a 6-month follow-up period) [26]. Another similar brief manualized CBT program for adolescents with GD and Internet-use disorder is the PROTECT+, which also seems to be effective at a one-year follow-up period according to a single-arm trial [27].

Neurobiological studies

Neurobiological studies in the GD field have proliferated in the recent years. According to a systematic review of structural and functional magnetic resonance imaging studies on neural correlates of GD [28], prefrontal brain areas, temporoparietal regions, and frontolimbic and subcortical regions were found to function differently in adolescents having GD in comparison with non-GD controls. These differences may underlie detriments in cognition (e.g. decision-making), emotion processing (e.g. emotion regulation, impulsivity), and executive functions (e.g. working memory, attention), which suggests a need for treatments addressing deficits in executive and cognitive-affective areas. Among adults with and without IGD, a meta-analysis observed structural differences with reduced gray-matter volumes in regions implicated in emotional regulation, decision-making, and cognitive and motor control (e.g. ventromedial and dorsolateral prefrontal, anterior cingulate, and premotor cortices). Further, with and without IGD were also distinguished on brain activations during 'hot' and 'cold' executive functioning tasks [29], suggesting that both domains may benefit from targeted interventions. Emerging neuromodulation studies in conjunction with regulation of craving and emotion investigations suggest that targeting activity in the dorsolateral prefrontal cortex may enhance control processes in these domains, perhaps via top-down control (e.g. [30]). Neuroimaging measures integrated into treatment trials (e.g. involving a craving behavioral intervention) suggest specific regional activities and functional-connectivity patterns during cue elicitation (e.g. involving the amygdala) and resting state (e.g. involving the orbitofrontal cortex, hippocampus) link to better outcomes [31,32]. These findings complement longitudinal naturalistic studies that suggest that subcortical activations during cue elicitation are linked to emergence of IGD and recovery from IGD [33,34], with gender-related differences observed (e.g. [35]). Emerging studies are using data-driven and/or machine-learning approaches to identify brain patterns linked to IGD and clinically relevant features thereof (e.g. [36]). However, similar to clinical trials, neurobiological studies often have important limitations such as heterogeneous GD classifications, small sample sizes, preponderance of male participants, and limited follow-up assessments.

Gambling elements in video games

Two important recent changes include the introduction of digital purchase options (i.e. microtransactions) and gambling-like features in video games. More specifically, individuals can now buy virtual goods within games, which may either distinguish them from fellow players due to their rarity or may give them competitive advantages. Among gambling-like elements integrated in video games, perhaps the most prominent are the so-called 'loot boxes' or 'loot crates'. These are consumable virtual items sold for real money or provided as in-game rewards, involving randomly selected virtual items with a small chance for highly desired ones. Loot boxes are prevalent in video games, especially on mobile platforms, and multiple games featuring loot boxes are available for children [37]. This situation has raised serious concerns about underage gambling and that loot boxes may act as a gateway for types of gambling among minors [38], thus evoking debate among researchers and policymakers about the need for regulation [39]. Some countries decided to introduce regulations. For example, in 2018, Belgium banned loot boxes entirely claiming that they infringed legislation regarding gambling (see e.g. https://www.bbc.com/news/technology-43906306). Furthermore, loot box purchase has been associated with problem gaming and problem gambling as well (e.g. [40,41]). A secondary analysis of self-report data (e.g. spending on loot boxes, revenue, and problem-gambling status) suggests that individuals spending considerable amounts of money on loot boxes are those with moderate- and high-risk gambling [42]. More specifically, the study found that the aggregate association between problem gambling and spending on loot boxes was $\rho = 0.34$, $p < .001$, while there was no association between earnings and spending on loot boxes ($\rho = 0.02$, $p = .09$). This finding suggests that gaming companies may disproportionately profit from vulnerable consumers, raising ethical concerns and consumer-protection issues.

The impact of the COVID-19 pandemic on gaming and gaming disorder

The novel coronavirus disease, COVID-19, brought about severe restrictions, including quarantines in numerous countries globally, and has led to higher participation in Internet use, including gaming. A study analyzing engagement with the most frequently played games on Steam [43] found that time spent playing video games had greatly increased during key points of the pandemic (e.g. the period after the date when COVID-19 was declared a pandemic by the WHO), and that these increases were considerably noteworthy for multiplayer games, suggesting that people may have been using video games largely for social opportunities they provide (e.g. playing together with friends). Furthermore, players distributed their gaming more equally across days of the week compared with times before the pandemic when gaming was more prominent during the weekends, suggesting that the pandemic also considerably modified how individuals organize their work/education and leisure time. Relatedly, the results of a cross-sectional study comparing a pre-COVID group with a COVID group suggest that gaming for social purposes may reduce emotional distress experienced during self-isolation [44]. These findings resonate with data, suggesting that among youth, problematic gaming led to psychological distress before the pandemic, whereas problematic smartphone use led to psychological distress during the pandemic [45].

While these studies suggest that gaming might be beneficial in the lockdown periods, researchers [46,47] have cautioned that increased gaming may pose a risk for vulnerable individuals. Recent studies provide support for this possibility. According to a cross-sectional survey of the general population in China comparing present data and recalled prepandemic data [48], there was a significant increase in Internet use spent recreationally during the pandemic, and around 44% of respondents reported heightened problematic Internet-use scores. Less social support, more severe effects of COVID-19 on mental health, and overengagement in videogaming were reported as potential risk factors for these increases. Another survey conducted among Chinese adolescents [49] indicated that poor social support, school-related stress, and maladaptive emotion regulation mediated between academic stress due to COVID-19 and depression and IGD symptoms. Last, a longitudinal study involving a large sample of children and adolescents from China [50] found that both videogaming and IGD increased significantly during the pandemic, although the effect size in the case of IGD was very small. According to the longitudinal results, prepandemic depressive and anxiety symptoms predicted IGD and gaming during the pandemic, especially for boys. Prepandemic depressive and anxiety symptoms were indirectly associated with IGD symptoms during the pandemic via the perceived impacts of COVID-19 on diverse areas of life (e.g. educational activities, lifestyle habits, and social activities).

Conclusions and future research directions

The inclusion of GD in the ICD-11 can be seen as a milestone in the unification of the field and subsequent research. The numbers of clinical trials and neurobiological studies have increased; however, quality improvement is still necessary. Homogeneous GD measurement, larger sample sizes, the inclusion of control groups, longer follow-up assessments, and clear reporting of results are arguably most important in generating valid and reproducible results. More longitudinal studies are needed to understand potential causality in the

development, maintenance, and treatment of GD. Moreover, rapid changes in video games and gaming behaviors create new challenges for researchers, clinicians, and policymakers. One such challenge is the gaming–gambling convergence, but numerous others could also be mentioned, such as the use of virtual reality technology in gaming. Last, the COVID-19 pandemic and related restrictions have also impacted gaming and GD, which we are only starting to understand.

Authors' contribution

OK and ZD took part in conceptualization and planning. OK and MNP wrote the first draft. All authors commented and revised the paper, read, and approved the submitted version. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of interest statement

The authors report no conflicts of interest with the topic of this work. MNP has consulted for and advised Opiant Pharmaceuticals, Idorsia Pharmaceuticals, Baria-Tek, AXA, Game Day Data, and the Addiction Policy Forum; has been involved in a patent application with Yale University and Novartis; has received research support from the Mohegan Sun Casino and Connecticut Council on Problem Gambling; has participated in surveys, mailings, or telephone consultations related to drug addiction, impulse-control disorders, or other health topics; and has consulted for law offices and gambling entities on issues related to impulse control or addictive disorders.

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The other authors report no disclosures.

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Data availability

No data were used for the research described in the article.

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