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The Impact of Video Games on Mental Health: A Review of Therapeutic and Harmful Effects

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Posted Date: 15 April 2025

doi: 10.20944/preprints202504.1300.v1

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 doi:10.20944/preprints202504.1300.v1

Review

The Impact of Video Games on Mental Health: A Review of Therapeutic and Harmful Effects

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Abstract: There is extensive literature covering the use of video games in the assessment and treatment of mental disorders, as well as their harmful effects. A review of research papers published between 2002 and 2023 on this topic was conducted. Video games are useful for assessing cognitive abilities and symptoms of Attention Deficit Hyperactivity Disorder (ADHD). Research on video games as therapeutic tools includes ADHD, cognition, developmental coordination disorder, autism spectrum disorder, affective disorders, and substance use. Within the review of research on the harmful effects of video games, addiction to them stands out, encompassing studies in cognition, genetics, and neuroimaging; the literature also includes the emergence or worsening of violent behaviors, as well as sleep and mood disorders. There has been controversy, with no causal relationship being demonstrated. Conclusions: Video games can be tools for cognitive assessment and treatment of ADHD and other disorders. The long-term effects of video games should be examined.

Keywords: videogames; addiction; mental disorders; assessment; review; violence; treatment; children; adolescents

Introduction

Video games are simulations of worlds or problematic spaces where the player must prepare for action and achieve objectives from a particular perspective [1]. Video games can be classified according to genre (action, adventure, fighting, platform, puzzles, racing, role-playing, shooters, simulation, sports, strategy, and miscellaneous) or purpose (casual, educational, serious, or exergames).

As entertainment for almost all children and adolescents, the implications regarding their use have been extensively studied and discussed; in fact, clinicians and researchers in the mental health field often have to answer questions about the effectiveness and safety of video games.

In the research on the effects of video games on mental health, various biases have been pointed out, and several topics have not been fully explored. For example, the mechanisms by which video games can be therapeutic or harmful or what type of patients would be affected by video games. The present review addresses these points by answering the following questions: 1. Are video games useful in the psychiatric evaluation of children and adolescents? 2. What is the evidence regarding the usefulness of video games as therapeutic tools in mental health? 3. Is there an association between the use of video games and the presence or severity of any mental disorder in children and adolescents?

 doi:10.20944/preprints202504.1300.v1

Methods

A systematic review was performed according to Tawfik criteria [2] . The following MeSH terms were searched in PubMed: ("video games" AND "mental health"); ("video games" AND "symptoms"); ("video games" AND "child" OR "adolescent"); ("video games" AND "assess*"); |("video games" AND "therapeutics" OR "treatments" OR "therapy" OR "treatment"); ("video games" AND "cogniti*"); ("video games" AND "addiction"); ("video games" AND "sleep*"); ("videogames" AND "violen*"). Articles published from 2000 onwards were selected based on the following inclusion criteria: a) research studies investigating the use of video games in children, adolescents, or young adults with mental disorders, b) studies analyzing the utility of video games as assessment tools or therapeutic interventions, c) studies examining the harmful effects of video games, d) systematic reviews and meta-analyses, e) studies specifying the dependent variable and describing the methodology employed. Articles that only proposed methodological designs were excluded.

The titles or abstracts of the found articles were reviewed to identify those meeting the inclusion criteria. Additionally, the reference lists of some articles were examined to identify other relevant publications. The full text of these articles was independently evaluated by at least two authors to determine the quality of the studies, considering their design and potential biases. The last search was conducted on October 26, 2023.

Results

1. Are video games useful in the psychiatric evaluation of children and adolescents?

The studies examined the utility of video games in assessing cognition and symptoms in children and adolescents aged 3 to 17 years. The advantages of their use include availability, the possibility of evaluating a large number of individuals simultaneously, and the reduction of errors in test scoring. Other benefits include language barrier independence and the potential for result analysis through artificial intelligence, enabling outcome prediction using a data-driven approach [3].

Regarding the use of video games for assessing specific disorders, those created for Attention Deficit Hyperactivity Disorder (ADHD) stand out. The major limitation of these studies is the small sample sizes [4]. Table 1 shows the video games tested as tools for cognitive assessment or ADHD diagnosis.

2. What is the evidence regarding the usefulness of video games as therapeutic tools in mental health?

The studies included 4354 participants, with sample sizes from 10 to 824. The videogames were tested in children, adolescents, and young adults diagnosed with ADHD, cognitive impairments, developmental coordination disorder, autism, mood disorder, anxiety, or substance use disorders. The results of each one are shown in Table 2.

ADHD

The research in children and adolescents included pilot studies and clinical trials that lasted up to 20 weeks. They explored serious games designed in universities or research centers and exergames. A control group was included, and standardized instruments were used to determine efficacy in almost all the reviewed studies. Among the methodological weaknesses of most studies, the lack of follow-up and the fact that authors did not consider the pharmacological treatment of patients in the analysis can be mentioned. The results of the studies show the effect of video games on attention, behavioral inhibition, and other executive functions such as working memory and processing speed.

Within this group, the studies on the multitasking-based game for inhibitory control known as the EVO project, created by Akili Interactive ©, stand out. After conducting a pilot study [24], the game was modified and named AKL-T01 to be evaluated in a study comparing its efficacy with that of a control condition [26]. Subsequently, its effects were examined in a crossover study involving

 doi:10.20944/preprints202504.1300.v1

ADHD patients with and without pharmacological treatment, showing that playing for periods of 4 weeks was associated with a reduction in symptom severity [27]. Finally, Gallen et al. [28] demonstrated that using the video game for 4 weeks was associated with changes in electrophysiological functioning, specifically in the circuit known as the midline frontal theta, described as a marker of attention and cognitive control abilities. This game was named EndeavorRx and was recommended by the FDA as an adjunctive treatment for ADHD in 2020 [69].

Cognition

The reviewed literature comprises clinical trials with a maximum duration of 10 weeks, focusing on serious games and exergames. Some studies included a control group, and standardized instruments were employed to assess the efficacy of interventions. Methodological weaknesses include small sample sizes, lack of follow-up, and failure to explore ecological validity.

Developmental Coordination Disorder

The reviewed literature includes a pilot study and clinical trials with a maximum duration of 16 weeks, one of which had a long-term follow-up. The majority utilized the Movement Assessment Battery for Children (MABC-2) as the assessment tool. Although the video games belonged to the category of exergames, manufacturers did not fund the included studies. Limitations include a small sample size, an incomplete description of the number or duration of gaming sessions, and failure to explore ecological validity.

Autism

The reviewed literature includes a pilot study and clinical trials with a maximum duration of 27 weeks conducted in children and adolescents. Serious games, exergames, and augmented reality were explored using standardized instruments to determine the efficacy of video games on aspects such as autism symptoms, motor skills, facial and emotional recognition, social interaction, and executive functions. Although some reported efficacy, it is important to note that most studies included small sample sizes, follow-up evaluation was not included, and there was no assessment of ecological validity.

Mood and Anxiety Disorders

The reviewed literature included studies with a maximum duration of 9 weeks, with a maximum follow-up of 18 months. Exergames and serious games were explored, some of these based on standardized therapies, and the use of video games was compared with other control conditions such as biofeedback or psychotherapy.

Within this group, the studies on the e-therapy game to develop skills to deal with stress, depressive and anxiety symptoms known as SPARXS, created by the University of Auckland, New Zealand, stand out. After conducting a pilot study [63], it was compared with the treatment as usual, showing no differences in the efficacy on depressive symptoms [62]. It was also tested in the Netherlands, showing effectiveness [61]. And a large sample of adolescents showed to improve their coping skills and depressive symptoms in a 6 month follow up in Australia [60].

Substance Use Disorders

To date, randomized clinical trials and pilot studies have been published evaluating the efficacy of video games in reducing excessive consumption or increasing knowledge about the harms caused by alcohol, tobacco, and marijuana. Information remains scarce, and there is a need to explore the effectiveness of video games in aspects such as motivation for consumption, as well as studies with longer follow-up periods.

3. Is there an association between video game use and the presence or severity of any mental disorder in children and adolescents?

 doi:10.20944/preprints202504.1300.v1

There is the notion that video game use has a harmful effect on mental health in children and adolescents. The evidence regarding the role of video games in the development of addictive behaviors, violence, affective disorders, and sleep disorders has been explored and is presented as follows:

Gaming Disorder

The increasing amount of time children and adolescents spend on video games, and the association of video games with psychological stress, sleep disturbances, and the development of behaviors resembling addiction symptoms led to the recent addition of diagnostic categories "Gaming Disorder" and "Hazardous Gaming Disorder" within the section of disorders due to addictive behaviors of the eleventh edition of the International Classification of Diseases (ICD-11) [61–63] and "Internet Gaming Disorder" (IGD) in the section of conditions needing further study, of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [64], Due to the fact that the existing information relies on low quality studies with small sample sizes, and the lack of operationalization diagnosis criteria [70].

The study of the neurobiological bases of this disorder has included cognitive evaluations (particularly in the default mode networks responsible for emotional processing, self-monitoring, memory, and the attention control networks); the search for variations in the genes encoding monoamine receptors and in the enzymes responsible for their catabolism (DRD2, 5HTTLPR, and COMT) [71], as well as neuroimaging techniques assessing the functioning of neural networks involved in reward sensitivity, as depicted in Figure 1.

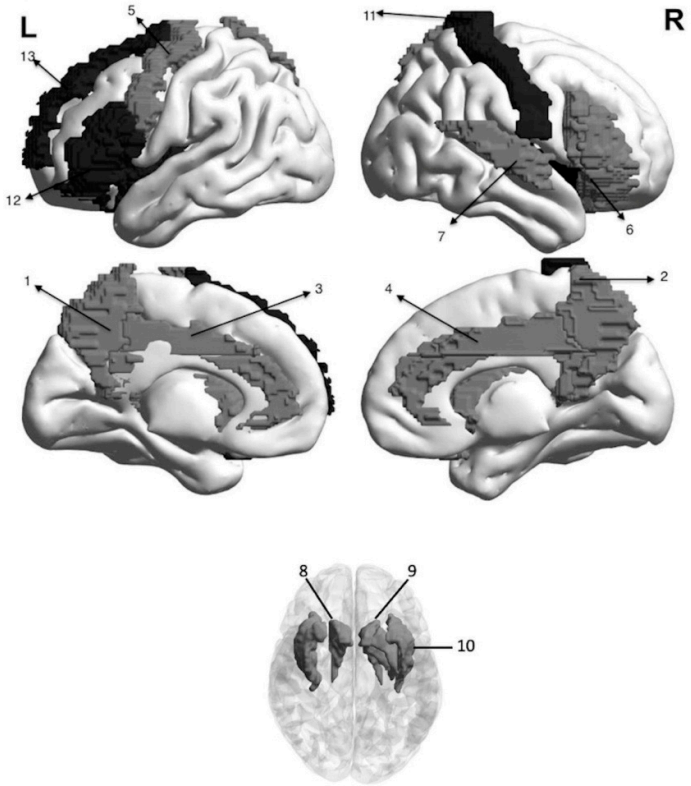

Figure 1. Areas with variations in activation patterns associated with video game use disorder. Hyperactivated areas (gray).- 1. Right precuneus. 2. Left precuneus. 3. Left cingulate. 4. Right cingulate. 5. Left precentral gyrus. 6. Right inferior frontal gyrus. 7. Right superior temporal gyrus. 8. Right caudate nucleus. 9. Left striatum. Hypoactivated areas (black).- 10. Insula. 11. Right postcentral gyrus. 12. Left inferior frontal gyrus. 13. Left

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superior frontal gyrus. Created with BrainNet Viewer, a network visualization tool for human brain connectomics [72].

Aggressive behavior

The association of video games with aggressive behavior has been extensively studied, with controversial results. Anderson and colleagues showed that exposure to violent video games increased aggressive thoughts, hostility, physiological activation (increased blood pressure and heart rate), and aggressive behavior while decreasing empathy and prosocial behavior [73]. A later meta-analysis confirmed this association and showed that playing video games with prosocial content increased prosocial behaviors [74].

However, the methodology of the studies that showed the association between the use of violent video games and aggression was repeatedly questioned by Ferguson and colleagues, highlighting the following points:

- - A valid classification of the degree of violence in video games was not used.
- - The studies did not document the exposure time adequately.
- - The studies included a wide variety of manifestations of aggression, which increased the effect size; when the statistical analysis considered violent behavior as the outcome, the obtained effect size approached zero [75].
- - The studies did not include important covariates as statistical controls, so any observed effects may be spurious consequences of third variable relationships.
- - The existence of publication bias, as there were a greater number of studies confirming the hypothesis of a relationship between video game use and aggression, and a smaller number of studies that did not. This group published longitudinal studies without significant association [76,77].

Given this, Prescott and colleagues conducted a meta-analysis that included longitudinal studies strictly establishing the exposure time to violent video games and measuring explicit aggression. The results showed an association with effect sizes of around 0.08, even when controlling for variables such as sex, age, alcohol consumption, sports practice, psychopathology in the subject, family and peers, personality, academic skills, visuospatial cognition, parenting styles, and social violence. This meta-analysis found no evidence of publication bias [78].

The effect of violent video games has also been examined from a neurobiological perspective, in studies comparing gamers vs non-gamers. Imaging studies showed decreased activation in brain areas associated with emotional processing and empathy and increased activation in areas involved in planning, and problem-solving [79,80]. Based on the former, some authors postulated the theory of desensitization to emotional responses [81], although other studies did not support it [82,83]. The reported changes in the different brain areas are shown in Table 3.

Neurophysiology studies focused on paradigms involving the presentation of violent images while recording the electroencephalogram or evoked potentials. Most described modifications in the amplitude of N1, P1, P2, and P300 waves, with the latter being the most reported. One study observed a lower latency of the P2 component on occipitotemporal montage and a lower activation of the limbic and temporal areas in response to the social inclusion images post-violent video game compared with the non-violent one, suggesting a reduction in the emotional response during social interaction [89]. Similarly to imaging studies, the reported changes were not specific and could be associated with information processing [90,91].

Effects on Sleep

The effects of video games on sleep in children and adolescents have been explored with questionnaires and polysomnography. Studies using questionnaires showed a reduction in the number of hours of sleep, with a delay in sleep onset [92, 93]. Interestingly, a study conducted in

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Chile that applied a questionnaire to children aged 9 to 12 reported that 70% of them knew that playing video games at night affected their sleep [94].

Studies using polysomnography showed contrasting results. Some showed a lower amount of slow-wave sleep, longer sleep latency, and sleep efficiency reduction below the clinically accepted [95], even compared to subjects who spent a similar amount of time watching television [96]. Still, other studies did not show effects on sleep architecture [97].

Cognition

The evaluation of the effect of video games on cognition has been studied in a small number of cross-sectional clinical trials focused on memory and attention processes. In one of them, a positive correlation was found between inattention and time spent playing games [98]. Another study reported that playing violent video games was associated with poorer performance on verbal memory tests a few hours later, particularly those involving verbal learning [99]. Some authors suggested that sleep duration mediates the relationship between video gaming and sustained attention [100].

Mood

Empirical evidence to date includes four non-controlled trials conducted on subjects aged 10 and older with regular video game use, in whom emotional regulation, depression, and anxiety were assessed. Although an association between time spent playing and lack of emotional dysregulation, they did not establish causality [101–104].

Some studies showed an association between IGD with depression and anxiety, while showing an association with large effect sizes, the specific predictive relationship between the two variables remains vague [105,106]. A recent study comparing subjects with IGD to healthy controls suggested that the relationship between this diagnosis and depressive symptoms is mediated by dysfunction in the default mode network, the left amygdala, and the dorsolateral prefrontal cortex [107].

Conclusions

The accessibility of video games has included them among non-pharmacological treatments for various mental disorders such as ADHD, autism, developmental coordination disorder, and substance abuse prevention. Studies have shown particular utility in managing affective disorders and ADHD, although longitudinal studies are needed to determine the effect of video games on the individual's functioning.

Although the characteristics of video game use disorder, and the effect of video games on sleep, cognition, mood, and particularly the role of violent video games in generating aggressive behavior have been extensively studied; many questions remain unanswered, such as the effect of video games on neurodevelopment and its impact on academic and social performance. Future studies should focus on standardizing the variables considered in the study design, and the methods for classifying video games, and should explore the mechanisms by which video games might cause changes in brain function and long-term behavior.

Conflicts of Interest: The authors declare no conflicts of interest.

Author Contributions: REU.-Conceptualization; Validation; Formal Analysis; Investigation; Writing**;** RDS.-Validation; Formal Analysis; Investigation; Data curation; Writing; GPO.-Methodology; Validation; Formal Analysis; Investigation; Writing**;** DRT.-Validation; Formal Analysis; Investigation; Data curation; Writing.

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