Internet Addiction and Attention Deficit Hyperactivity Disorder Among Schoolchildren

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ABSTRACT: **Background:** Use of the internet and videogames by children and adolescents has risen dramatically over the last decade. Increasing evidence of internet and videogame addiction among children is causing concern due to its harmful physical, emotional and social consequences. There is also emerging evidence for an association between computer and videogame addiction and attention deficit/hyperactivity disorder (ADHD).

Objectives: To investigate the relationship between ADHD and internet addiction.

Methods: We compared 50 male schoolchildren, mean age 13 years, diagnosed with ADHD to 50 male schoolchildren without ADHD on measures of internet addiction, internet use and sleep patterns.

Results: Children with ADHD had higher scores on the Internet Addiction Test (IAT), used the internet for longer hours, and went to sleep later than those without ADHD.

Conclusions: These findings indicate an association of ADHD, sleep disorders and internet/videogame addiction.

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KEY WORDS: attention deficit/hyperactivity disorder (ADHD), problematic internet use (PIU), internet and videogame addiction

Use of the internet, computer and videogames by children and adolescents has increased dramatically over the last decade, averaging 3 hours per day in the general population [1]. Addiction is a condition characterized by compulsive engagement in rewarding stimuli, despite adverse consequences. Problematic internet use (PIU), or addiction, is characterized by excessive or poorly controlled preoccupations, urges or behaviors regarding internet use that lead to impairment or distress. Three different models have been proposed for internet addiction [2,3].

- Internet addiction has been conceptualized as an impulse control disorder which is a part of the obsessive-compulsive disorder spectrum. Impulse control disorders are characterized by impulsivity, i.e., failure to resist a temptation, urge or impulse that may harm oneself or others
- The DSM-V task force has created a separate category of compulsive internet usage disorder from the non-specified impulse control disorder
- Some psychiatrists have argued that internet addiction should be included in the behavioral addiction spectrum since it exhibits the features of excessive use despite adverse consequences, withdrawal phenomena, and tolerance that characterize many substance use disorders. One of the major types of internet addiction is online gaming, which is classified as a behavioral addiction [2,3].

There is growing evidence for computer and videogame addiction among children that is causing concern due to its harmful physical, emotional and social consequences [2-4]. However, it has not yet been determined whether internet addiction and computer and videogame playing meet criteria for a syndrome, e.g., the DSM-V or ICD-10 definition of behavioral and psychological signs and symptoms that cause distress or impairment. Some experts, such as Morahan-Martin [5], argue that harmful use of the internet disturbs normal life and may be considered as an impulse control rather than an addictive behavior or a clinical diagnosis.

The DSM-5 working group concurred that evidence from current research does not support establishing a new diagnostic category for Problematic Internet Use (PIU). The working group moved from a broad conceptualization (along the lines of PIU) to a more narrow one, focusing primarily on pathological online gaming and avoiding use of the term “addiction.” Thus, the DSM-5 still does not offer sufficient guidance regarding how to approach individuals with suspected internet-related psychopathology or how to design or interpret research studies on this topic. Instead, clinicians and researchers have to rely on proposed definitions, along with several screening and assessment instruments developed for PIU and problematic videogame use [6,7].

The diagnostic assessment of internet or computer game dependency remains challenging. Different studies in different countries have used different scales to assess the prevalence of problematic internet use or addiction. Several questionnaires are used for diagnosis of internet addiction, the most popular of which – the Internet Addiction Test (IAT) – was designed by Young [8]. Young's questionnaire includes six factors: salience, excessive use, neglect of work, expectation, lack of control, and neglect of social life (although young internet users reported mainly neglect of school work and social life) [9]. It has been widely validated [2,6-8].

Attention deficit/hyperactivity disorder (ADHD) is a complex disorder with multiple causes including genetic and environmental factors. The condition is usually diagnosed in childhood when difficulties emerge during play and school. It is marked by deficiency of concentration, short attention span, psychomotor restlessness and impulsiveness (American Psychiatric Association) [9]. Several cross-sectional studies have shown an association between ADHD and internet addiction among children and adolescents [10-14]. ADHD has also been associated with sexual addiction [15] and gambling [16].

The purpose of the present study was to investigate the relationship between problematic internet use and ADHD or ADD among pupils in a Jewish religious school. It was predicted that participants who were diagnosed with ADHD would show higher ratings on Young's IAT questionnaire [8], that pupils with ADHD would spend more time on the internet than those without ADHD, and that due to extensive hours on the internet, pupils with ADHD would go to sleep later than those without ADHD.

SUBJECTS AND METHODS

The study group included 100 male participants with a mean age of 13 years (SD = 0.72, range 13–15). Fifty had a diagnosis of ADHD and 50 did not; the mean age of these two groups was 13 years 9 months (SD = 0.80) and 14 years (SD = 0.60) respectively. With regard to place of birth, 96 were born in Israel and 4 abroad. The pupils underwent a psycho-didactic diagnosis and were accordingly admitted to a special school. They were also treated with medication for ADHD including methylphenidate amphetamine and dextroamphetamine. These students were often admitted after several failures in other schools and were assimilated in a highly supportive environment. The study was approved by the Institutional Review Board of the University of Ariel.

Internet addiction was measured using Young's Internet Addiction Test (IAT) [8], which consists of 20 items measuring compulsive use of the internet on a scale of 1 (never) to 6 (always). The cutoff point of internet addiction is a score of 80 and above. In our study the IAT had a Cronbach internal validity of α=0.927. The participants were also asked to indicate how many hours they spend on the internet each day and what time they go to sleep. The questionnaire had a Cronbach internal validity of α=0.88.

Table 1. Patterns of hours spent on the internet in all participants

	Hours spent on the internet every day				
No ADHD diagnosis	1	1–3	3–5	6	Total
N	18	18	13	1	50
% within diagnosis	36%	36%	26%	2%	100%
ADHD diagnosis	14	12	14	10	50
% within diagnosis	28%	24%	28%	20%	100%

Table 2. Patterns of sleep in all participants

	Hour going to bed				
No ADHD diagnosis	8:30–10:30 p.m.	After 11 p.m.	2–3 a.m.	4.00 a.m.	Total
N	19	23	6	2	50
% within diagnosis	38%	46%	12%	4%	100%
ADHD diagnosis	7	11	16	16	50
% within diagnosis	14%	22%	32%	32%	100%

RESULTS

A comparison of IAT scores between pupils with ADHD diagnosis and pupils without ADHD diagnosis using paired *t*-tests showed that the ADHD group had higher IAT scores (1, 98) = 4.018, $P < 0.01$. The average IAT score of the ADHD group was 2.93 (SD = 1.06) and of the non-ADHD group 2.22 (SD = 0.65).

A chi-square test comparing the distribution of hours spent on the internet showed that the group with ADHD diagnosis spent more hours on the internet than the group without ADHD diagnosis: $\chi^2 = 9.101 < 0.05$. Table 1, demonstrating the patterns of hours spent on the internet by all participants, shows that more students with ADHD diagnosis spent between 1 and 3 hours a day on the internet than those without ADHD diagnosis. There was no difference between groups in the number of students who spent 3–5 hours a day on the internet. More pupils with ADHD diagnosis spent at least 6 hours a day on the internet compared to those without ADHD.

In addition, chi-square test comparing the hour of going to sleep showed that more ADHD students went to sleep after 12 p.m. than non-ADHD students: $\chi^2 = 25.21$, $P < 0.001$. Table 2, on the patterns of sleep in all the students, indicates that more pupils without ADHD went to sleep between 8:30 and 10:30 p.m. and after 11 p.m. whereas more pupils with ADHD diagnosis went to sleep between 2 and 4 a.m.

The participants used the internet for online communication and gaming but not for online sex or gambling.

DISCUSSION

This study has shown that children with ADHD are more addicted to the internet, spend more time online, and go to sleep later than those without ADHD diagnosis. The results support existing studies that have established the association between internet addiction and ADHD. Yoo et al. [12] who studied 535 elementary school students (mean age 11.0 ± 1.0 years) found significant associations between the level of ADHD symptoms and the severity of internet addiction (measured by the IAT). Their findings also suggested that the presence of ADHD symptoms may be one of the major risk factors for internet addiction. In adolescents (grades 9 and 10), Chan and Rabinowitz [11] reported a significant association between time spent playing internet games for more than one hour a day and Young's IAT [8] scores and ADHD symptoms of inattention but not hyperactivity. Other studies using Young's IAT [9] in South Korea found an association between internet addiction and ADHD in 11 year old children [12]. The same finding was noted in Taiwan, using Chen's Internet Test in adolescents [13] and among college students [14].

Why do children and adolescents with ADHD turn to the internet and computer videogames? One explanation is the need to escape from daily problems both emotionally and socially to a safe place free of demands and obligations [15]. Internet use and computer gaming were suggested as an inadequate means of coping with frustration, stress and fears [16]. Secondly, and consistent with the stress-coping mechanism, it has been suggested that in-game reinforcement and skill significantly influence a number of affective measures, most notably excitement, arousal and frustration [17]. Thirdly, excessive computer game playing may be maintained through stimulatory effects on reward and sensitization [18], similar to the long-term changes in the brain reward circuitry thought to maintain substance dependence. Computer and videogames can serve to stimulate children and adolescents with ADHD who suffer from reward deficiency syndrome (RDS) and low dopamine availability in the brain reward system [19]. RDS refers to the breakdown of several neurotransmitters in the brain that belong to the reward system and results in aberrant conduct. The theory argues that reward deficiency may predispose individuals to addictive, impulsive and compulsive behaviors [19]. Dopamine is a prevailing brain neurotransmitter that controls the sense of satisfaction and well being [20-22]. Dopamine deficiency drives individuals to engage in activities that will stimulate brain dopamine function, such as consuming drugs and alcohol, but people may also engage in computer and videogames to enhance dopamine release [2-4].

Finally, computer programs such as Online Neuroplasticity-based Training for the Remediation of ADHD in Children (ONTRAC) can actually improve cognitive ability in children with ADHD [23]. ONTRAC is designed to selectively target ADHD-specific deficits in five critical neurocognitive domains: alertness, sustained and selective attention, working memory, impulsive response control, and suppression of distracting interference. Alternatively, pharmacological treatment with stimulants has shown some efficacy in the treatment of children diagnosed with both internet addiction and ADHD [16]. A pharmacological open-label treatment study using extended-release methylphenidate in 62 Korean children with internet video game addiction and co-morbid ADHD found that after 8 weeks of treatment there was a significant reduction in measures of internet use and internet use duration, and this improvement was positively correlated with improvement in measures of attention. These findings led the investigators to suggest that internet videogame playing might be a form of self-medication for children with ADHD. Future studies should examine the efficacy of medications for treatment of ADHD occurring concurrently with internet addiction.

LIMITATIONS

The limitations of this study include the relatively small sample size, only-male participation, and lack of control over variables such as psychological treatment and medication, enrichment and intelligence, and family background.

CONCLUSIONS

This study has shown that children with ADHD are more addicted to the internet, spend more time online, and go to sleep later than those without ADHD. The psychobiological and psychosocial mechanisms that mediate this association should be investigated further, as should the impact of medications for ADHD on internet addiction. In view of the evidence showing an association between internet addiction and ADHD, clinicians, educational professionals and parents of children with ADHD should monitor use of the internet by children and adolescents

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References

1. Weiss MD, Baer S, Allan BA, Saran K, Schibuk H. The screens culture: impact on ADHD. *Atten Defic Hyperact Disord* 2011; 3: 327-34.
2. Weinstein A, Lejoyeux M. Internet addiction or excessive internet use. *Am J Drug Alc Abuse* 2010; 36 (5): 277-83.
3. Weinstein A. Computer and video game addiction. *Am J Drug Alc Abuse* 2010; 36 (5): 268-76.
4. Weinstein A, Weizman A. Emerging association between addictive gaming and attention-deficit/hyperactivity disorder. *Curr Psychiat Rep* 2012; 14 (5): 590-7.
5. Morahan-Martin J. Internet abuse: emerging trends and lingering questions. In: Barak A, ed. Psychological Aspects of Cyberspace: Theory, Research, Applications. Cambridge, UK: Cambridge University Press, 2008: 32-69.
6. Weinstein A, Feder L, Rosenberg K, Dannon P. Internet addiction: criteria, evidence and treatment. In: Rosenberg K, Feder L, eds. Internet Addiction Disorder: Overview and Controversies. Burlington: Elsevier Science USA, 2014: 99-117.
7. Aboujaoude E, Weinstein A. Problematic internet use: an overview. In: Aboujaoude E, Starcevic V, eds. Mental Health in the Digital Age: Grave

Dangers, Great Promise. Oxford: Oxford University Press, 2015.

8. Young KS. Caught in the Net. New York: John Wiley & Sons, 1998.
9. Widyanto L, McMurran M. The psychometric properties of the internet addiction test. *Cyberpsychol Behav* 2004; 7 (4): 443-50.
10. American Psychiatric Association. Diagnostic and Statistical Manual of the American Psychiatric Association. Washington, DC: American Psychiatric Association, 2000.
11. Chan PA, Rabinowitz T. A cross-sectional analysis of video games and attention deficit hyperactivity disorder symptoms in adolescents. *Ann Gen Psychiatry* 2006; 5:16.
12. Yoo HJ, Cho SC, Ha J, et al. Attention deficit hyperactivity symptoms and internet addiction. *Psychiatry Clin Neurosci* 2004; 58 (5): 487-94.
13. Yen JY, Ko CH, Yen CF, Wu HY, Yang MJ. The comorbid psychiatric symptoms of internet addiction: attention deficit and hyperactivity disorder (ADHD), depression, social phobia, and hostility. *J Adolesc Health* 2007; 41 (1): 93-8.
14. Yen JY, Yen CF, Chen CS, Tang TC, Ko CH. The association between adult ADHD symptoms and internet addiction among college students: the gender difference. *Cyberpsychol Behav* 2009; 12 (2): 187-91.
15. Grusser SM, Thalemann R, Albrecht U, Thalemann CN. Excessive computer usage in adolescents – results of a psychometric evaluation. *Wien Klin Wochenschr* 2005; 117 (5-6): 188-95.
16. Han D, Lee Y, Na C, et al. The effect of methylphenidate on internet video game play in children with attention-deficit/hyperactivity disorder. *Comp Psychiatry* 2009; 50 (3): 251-6.
17. Chumbley J, Griffiths M. Affect and the computer game player: the effect of gender, personality, and game reinforcement structure on affective responses to computer game-play. *Cyberpsychol Behav* 2006; 9 (3): 308-16.
18. Thalemann R, Wolfling K, Grusser SM. Specific cue reactivity on computer game-related cues in excessive gamers. *Behav Neurosci* 2007; 121 (3): 614-18.
19. Blum K, Chen AL-C, Braverman EB, et al. Attention-deficit-hyperactivity disorder and reward deficiency syndrome. *J Neuropsychiatry Dis Treat* 2008; 4 (5): 893-918.
20. Blum K, Kozlowski GP. Ethanol and neuromodulator influences. A cascade model of reward. In: Ollat H, Parvez S, Parvez H, eds. Alcohol and Behaviour: Basic and Clinical Aspects Progress in Alcohol Research. Utrecht, Netherlands: VSP International Science Publishers, 1990: 131-50.
21. Blum K, Cull JG, Braverman ER, Comings DE. Reward deficiency syndrome. *Am Scientist* 1996; 84: 132-45.
22. Blum K, Payne JE. Alcohol and the addictive brain: new hope for alcoholics from biogenetic research. New York: Free Press Simon and Schuster, Inc, 1991.
23. Mishra J, Merzenich MM, Sagar R. Accessible online neuroplasticity-targeted training for children with ADHD. *Child Adolesc Psychiatr Ment Health* 2013; 7: 38.