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The relationship between internet addiction, attention deficit hyperactivity symptoms and online activities in adults

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ABSTRACT

Aim: The objective of this study was to examine the relationship between Internet Addiction (IA), Attention Deficit Hyperactivity Disorder (ADHD) symptoms and online activities in an adult population.
Methods: A sample of 400 individuals aged 18 to 70 completed the Adult ADHD Self-Report Scale (ASRS), Young's Internet Addiction Test, and their preferred online activities.
Results: A moderate association was found between higher levels of ADHD symptoms and IA. The best predictors of IA scores were ADHD symptoms, age, playing online games and spending more time online.
Conclusion: Our findings further support a positive relationship between ADHD symptoms and excessive internet use.

1. Introduction

The internet has become an essential part of our everyday lives. Growing evidence suggests that a number of individuals display signs of problematic internet related behaviours, which resemble symptoms of other behavioural addictions [1]. Excessive internet use can have a negative impact on several aspects of an individual's life, such as social and work commitments [2,3]. Internet addiction (IA), also known as pathological Internet use, refers to an individual's inability to control their use of the Internet resulting in marked distress and/or functional impairment [3,4].

Previous research suggests that IA is prevalent in both eastern and western countries, with prevalence rates ranging from 1% to 36.7% [5]. A number of factors could be behind this wide prevalence estimations; different methodologies, questionnaires, diagnostic criteria, or differences in the prevalence of IA due to cultural factors. For example, populations in East Asian countries report higher levels of excessive internet use and online gaming addiction than western populations [6–8].

Characteristics associated with IA are similar to the ones reported in substance abuse disorders; preoccupation, changes of mood, tolerance, withdrawal, distress, and functional impairment [9]. Even though it is not included in the current edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM), it is worth noting that behavioural addictions are increasingly gaining more recognition. For example, the increasing number of individuals affected by non-chemical addictions has resulted in the inclusion of "Internet Gaming Disorder" in the latest version of the DSM [10]. The potential addictive nature of certain behaviours is further supported by studies showing that behavioural addictions such as IA share similar family factors with substance abuse [11].

Several factors have been associated with excessive internet use; psychopathological [2,12], social [2], personality traits [13,14]. ADHD has been repeatedly linked to addiction [15]. ADHD is a behavioural disorder defined by either an attentional dysfunction, hyperactive/impulsive behaviour or both (DSM-5 [10]). It is the most common neurodevelopmental disorder [16] and its worldwide prevalence in children and adolescence is 3.4% [17]. The symptoms persist into adulthood in roughly half of the children diagnosed with ADHD [18]. Therefore, ADHD has also been validated as an adulthood disorder, with remaining symptoms in adults including distractibility and difficulties with maintaining goal-directed behaviour rather than hyperactivity. In addition to this, ADHD psychopathology can be viewed dimensionally, with inattentive and hyperactive-impulsive symptoms distributed continuously in the general population [19,20].

Certain traits found in those with ADHD (e.g. impulsivity, boredom, restlessness) have been shown to play a key role in addiction [21]. In particular, being diagnosed with ADHD has been linked to illegal substance use at a younger age, when not treated with medication and stimulant therapy [22]. Individuals with ADHD also demonstrate addictive behaviour with forms of interactive media [21]. In addition to this, problematic use of technology has been found in individuals with high level of ADHD symptoms but without a diagnosis [23,24]. Previous research suggests that there is a positive relationship between ADHD and IA in adolescents and young adults [5,11,25]. Ko et al. [5] found that students with IA are more likely to have adult ADHD. A 2-year prospective study found that adolescents diagnosed as ADHD were the most likely to be addicted to the Internet than other psychiatric symptoms such as hostility and social phobia [26]. The biopsychosocial

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model of ADHD proposes that "being easily bored" and "having an aversion for delayed rewards" are two key symptoms in ADHD [27]. Both symptoms can be related to excessive interne use; being online can decrease the feeling of boredom and provide immediate rewards. Thus, ADHD could be a possible risk factor that may lead to IA.

All studies examining the relationship between ADHD symptoms and IA were conducted in Asian countries. Due to observed differences in IA prevalence between Western and Eastern countries and cultural differences, the results cannot be automatically generalised in other cultures [28]. In addition to this, previous studies have focussed on children, adolescents, or young adults (college students). The objective of this cross-sectional study was to evaluate the relationship between ADHD symptoms and IA in the general adult population in the UK. We hypothesized that the level of ADHD symptoms would be associated with the severity of IA. Another aim of this study was to evaluate the association between IA, ADHD symptoms and online activities. Evidence from substance use disorders research suggests that there are potential ADHD subtype differences in the prevalence of addiction [22]. Another aim of the study was to examine the contribution of inattention and hyperactivity, as well as overall ADHD symptoms, to IA.

2. Method

2.1. Participants

420 participants took part in the study (59.9% females). Participants completed the study online after receiving a personal email. Participants were recruited via the University of Sheffield list of volunteers. The list of participants was opt-out with a maximum exposure of 8306 (employees at the University), and the response rate in our study was around 5%. Only healthy individuals without any existing mental health disorders were eligible for the study. This was specified when recruiting participants. A question was also added to the online survey enquiring whether the participants had been diagnosed with any mental health disorder. Only participants who gave a negative response were included in the analysis ($N = 400$).

2.2. Measures

2.2.1. Young's Internet Addiction Scale

Young's Internet Addiction test (IAT) was used to measure symptoms of IA [1]. The IAT consists of 20 questions with the Likert scale of one (rarely) to five (always) and examined the degree of preoccupation, compulsive use, behavioural problems, emotional changes, and impact on life related to Internet usage. The range in the IAT is between 20 and 100. Previous research suggests that significant addiction is reflected when the IAT score is ≥80 and a range 50–79 indicates occasional or frequent problems due to Internet use [1]. Only 3 participants had an IAT score >80 in our sample. Therefore, we defined the subjects with scores over 50 as the problematic internet use group ($n = 33$) and with scores under 50 as the non-IA group ($N = 367$).

2.2.2. ADHD symptoms

ADHD symptoms were measured with the Adult ADHD Self-Report scale (ASRS) [29]. The ASRS is an instrument consisting of the 18 DSM-IV-TR criteria and was developed in conjunction with the World Health Organization (WHO), and the Workgroup on Adult ADHD. The scores obtained through the ASRS have been found to be predictive of symptoms consistent with ADHD [29,30]. The ASRS contains eighteen items from DSM-IV-TR [10] but measures the frequencies of the symptoms. Subjects are asked to report how often they experience each symptom in a period of six months on a five-point Likert scale which ranges from 0 for never, 1 for rarely, 2 for sometimes, 3 for often, and 4 for very often [29,30]. The ASRS has a two-factor structure which includes an inattention scale and a hyperactivity/impulsivity scale. Each subscale contains nine items. The ASRS examines only current adult symptoms of ADHD. Scores on the ASRS can range between 0 and 72. The reliabilities (Cronbach's alpha) for the two subscales of inattention (0.75) and impulsivity (0.77) as well as for the total ASRS (0.85) were satisfactory. The original questionnaires are formatted with darkly shaded boxes in certain items which signify more severe symptoms, but these were removed from the questionnaire administered to our participants to avoid potential bias in the responses.

Participants were categorised into high ($N = 53$) and low ADHD ($N = 347$) groups based on their overall ASRS scores using the recommended cut-off points [29,31]; ASRS score above 17 in either Part A or Part B of the questionnaire.

2.2.3. Online activities

Participants were also asked to select up to 5 online activities they engage in most often: online shopping, social networking, online gambling, online gaming, Massively Multiplayer Online Role-Playing Games (MMORPGs), television (on-demand entertainment such as Netflix), blogging, and video watching (e.g. YouTube), video game watching, web browsing, video surfing, and how long they spend online per week (excluding work related internet use).

2.2.4. Sociodemographic data

Demographics were collected for all participants. These details included age, gender, and level of education.

2.3. Analysis

Only data of the participants who completed all questionnaires without any omission and reported having no mental health disorders were selected for analysis ($N = 400$). First the relationship between the variables of interest was examined; IA, ADHD symptoms, age.

Then, participants were split into problematic internet use and non-IA groups and the associations between IA and a series of online activities were examined by chi-square tests. Differences in ADHD symptoms between groups were investigated by *t*-tests.

Finally, the associations between problematic internet use, ADHD symptoms, age, and online activities were examined by stepwise multiple linear regression.

3. Results

3.1. Demographics

The mean age was 30.23 ($SD = 12.17$, Range = 18–70). The majority of the participants were female (55%) and 2% non-binary/other. Most of the participants were British (84.6%) and all were native or excellent English speakers. 39% of the participants had an undergraduate degree, 18% had a postgraduate degree, and the rest of the participants did not have a degree.

3.2. Descriptive analysis

The mean score on the IAT was 28.51 ($SD = 13.9$, Min = 5, Max = 81). Scores were normally distributed as revealed by the Kolmogorov-Smirnov test statistic ($p > 0.05$).

Age was negatively correlated with IAT scores ($r = -0.25$, $p < 0.01$), suggesting that younger participants had more signs of addictive use. Males reported higher number of IA symptoms ($M = 29.9$, $SD = 14.4$) than females ($M = 27.1$, $SD = 13.2$), $t = 2.1$, $p < 0.05$.

The average score on the ASRS was 32 ($SD = 10.3$, Min = 7, Max = 68). The distribution of the ASRS scores is shown on Fig. 1. Participants reported more inattentive than hyperactive symptoms; the mean on the ASRS inattentive subscale was 17.8 ($SD = 5.9$) compared to 14.2 ($SD = 5.9$) on the hyperactive subscale. These values were similar to those reported in studies using comparable populations [23,32,33]. The two subscales were positively correlated, $r = 0.5$, $p < 0.01$. No gender differences were found in the ASRS

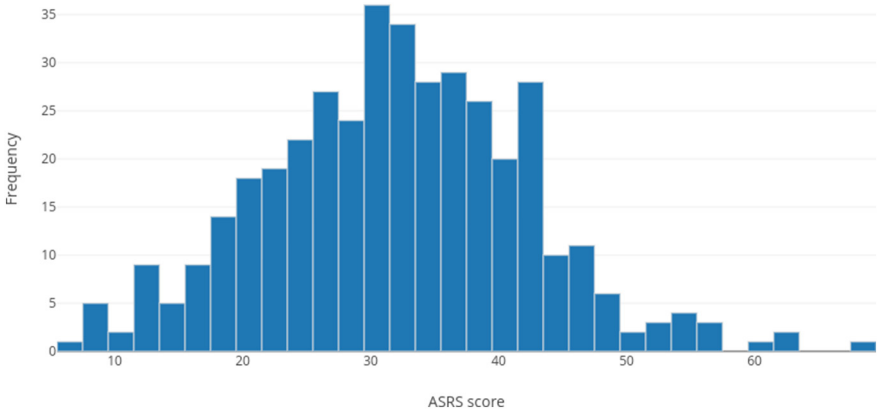

Fig. 1. Distribution of ASRS scores.

scores and in any subscales. A weak negative correlation was found between age and ADHD symptoms ($r = -0.14$, $p < 0.01$), with older participants reporting fewer ADHD symptoms.

3.3. Relationship between ADHD symptoms and internet addiction

The relationship between ASRS and IAT was examined. Moderate correlations were found between overall ASRS scores and the IAT, with individuals with higher ADHD symptoms reporting more addictive tendencies, $r = 0.52$, $p < 0.01$.

The relationship between ASRS subscales and IA was also investigated. Inattention scores positively correlated with IAT scores, $r = 0.51$, $p < 0.01$ respectively. A positive association was also found between the hyperactivity subscale of the ASRS and IAT scores, $r = 0.39$ $p < 0.001$. Correlations between IAT and total ASRS scores and ASRS subscales remained significant ($r = 0.51$, $p < 0.01$) after controlling for age.

3.4. Differences between problematic internet use and non-IA groups

Differences between individuals with suspected IA and individuals without IA in ADHD symptoms and preferred online activities were examined (Table 1). No differences between the two groups were found in social networking, online shopping, online gambling, blogging, online gaming, or demographics. Specific types of online activities were most commonly reported by the problematic internet use group, including video surfing, video game watching, MMORPGs, and Television (Table 1).

The problematic internet use group reported a significantly higher number of overall ADHD symptoms (Table 1). The mean score obtained by participants in the problematic internet use group was similar to the ASRS scores obtained when using clinical samples [31].

3.5. Differences between high and low ADHD groups

Differences between high and low ADHD groups and preferred online activities were examined (Table 2). No differences between the two groups were found in social networking, online shopping, blogging, and time spent online. Specific types of online activities were most commonly reported by the high ADHD group, including online gaming, video game watching, MMORPGs, online gambling, and television (Table 2).

The mean IAT score for the high ADHD group was 40.2, approaching the cut-off point for suspected IA. No differences were found in age or gender ratios between high and low ADHD groups.

3.6. Investigating predictors of IAT score

To determine the relative contribution of these variables to the IAT score, a stepwise linear regression was conducted with IAT score as the dependent variable and the following independent variables; ASRS, age, video surfing, television, MMORPGs, time spent online. The results indicated that ASRS scores ($b = 0.54$, $t = 5.33$, $p < 0.01$), age ($b = -0.32$, $t = -3.4$, $p < 0.01$), MMORPGs ($b = 6.2$, $t = 2.3$, $p < 0.01$), and time spent online ($b = 0.12$, $t = 2$, $p < 0.05$) remained significant predictors of IA. Video surfing and television were not significant predictors of IAT scores ($p > 0.05$), when controlling for the above variables. The model could predict 30% of the variance in IA scores.

4. Discussion

In this study, we examined the relationship between ADHD symptoms and IA in the general population. Our findings indicate that higher

Table 1
Differences between problematic use and non-IA groups.

	Non-IA group ($N = 367$)	Problematic internet use group ($N = 33$)	t (df = 399)/χ^2	p
Time spent online (hours per week)	21.1 (15.5)	34.8 (16.9)	−4.3	<0.01
ASRS	31 (9.7)	43.72 (9.5)	−7.13	<0.01
Inattention	17.2 (5.6)	24.6 (5.9)	−7.13	<0.01
Hyperactivity	13.8 (5.7)	19.13 (5.5)	−5.1	<0.01
Age	30.4 (11.6)	28.03 (7)	−1.7	0.08
Online activities (%)				
Video surfing (e.g., YouTube)	107 (29.2%)	15 (45.5%)	4.35	<0.05
Video game watching (e.g., twitch)	46 (12.53%)	13 (39.4%)	18.43	<0.01
MMORPGs	26 (7.1%)	12 (36.4%)	31.6	<0.01
Television (e.g. Netflix)	146 (39.8)	20 (60.6%)	6.25	<0.05

Table 2
Differences in reported online activities between high.

	High ADHD ($N = 53$)	Low ADHD ($N = 347$)	t (df = 399)/χ^2	p
IAT	40.2 (17)	26.72 (12.6)	−6.9	<0.01
Online activities (%)				
Online gaming	25 (47.17%)	80 (23%)	13.8	<0.01
Video game watching (e.g., twitch)	19 (35.85%)	40 (12%)	21.6	<0.01
MMORPGs	13 (24.53%)	25 (7.2%)	16	<0.01
Online gambling	9 (16.98%)	21 (6.1%)	7.9	<0.01
Television (e.g. Netflix)	32 (60.38%)	134 (38.62%)	8.8	<0.01

levels of ADHD symptoms are associated with increased IA. This result is consistent with previous research on children and adolescents [5,25,32]. These findings further support a positive relationship between ADHD symptoms and excessive internet use.

ADHD symptoms, both in inattention and hyperactivity subscales, had significant positive correlations with the degree of IA. A stronger relationship was found between inattention symptoms and IA. This suggests that attentional aspects of ADHD could potentially explain its relationship with IA. Similar findings have been reported in studies in young adults, with inattention symptoms showing stronger correlations with excessive internet use [33].

The best predictors of IA scores were ASRS scores, age, playing MMORPGs, spending more time online. Previous research has identified MMORPGs as being more addictive than any other types of both offline and online games [34]. This could be due to the open ended nature of MMORPGs, the character development, and the length of the quests players need to complete [35].

In our study 8.2% of the participants met the criteria of definite or probable IA, as measured by IAT. This prevalence of IA in children is similar to the prevalence reported in adults in Western countries [5]. This number is significantly higher in East Asian countries in both adults and adolescents [5,6,7].

A number of explanations can be offered for the positive relationship between ADHD symptoms and IA. Previous research has found that both individuals with ADHD and individuals with IA are more likely to have sensation-seeking personality traits [36,37]. Sensation seeking refers to a personality trait defined as need for novel, varied, and complex experiences and sensations, and willingness to take risks in order to achieve this [37]. Sensation seeking is one of the predictors of excessive Internet use [14]. Adults with ADHD compared with controls and relatives have higher levels of sensation seeking traits, especially boredom susceptibility [36,38]. This could potentially contribute to the relationship between IA and ADHD.

Abnormal reward processing has been reported in individuals with ADHD and high ADHD symptoms [39,40,41]. In particular, ADHD has been associated with aversion for delayed reward and preference for immediate rewards [40,41]. Using the internet provides the individual with immediate responses and rewards, which might partly explain the relationship between ADHD and excessive internet use. Certain cognitive deficits associated with ADHD, such as impaired response inhibition [42] and cognitive control [41] could also result in high IA risk. Future studies should attempt to empirically test the relationship between cognitive functioning and IA.

Due to the nature of the study we cannot determine the direction of the relationship between ADHD and internet addiction; IA could have resulted in an increase in inattention and hyperactivity/impulsivity, which would manifest as increased ADHD symptoms. Further research is needed to conclusively whether ADHD is a significant risk factor for the development of IA, or a result of IA.

Our study identified a number of online activities more common in individuals with high level of ADHD symptoms. More specifically, ADHD was linked to online gaming, video game watching, MMORPG games, online gambling, and television. Previous studies have shown that a positive relationship between frequent gaming and ADHD [23,43]. Watching others play video games, on services such as Twitch, and television, on services such as Netflix, was also more frequent among the ADHD group. This suggests than potential differences in online activities between high and low ADHD groups extend beyond online gaming and should be further investigated. In addition to this, both video game watching and television were more frequent among the problematic internet use group, suggesting a potential addictive nature. Furthermore, online gambling was more common among participants with high level of ADHD symptoms. This is consistent with previous studies showing that having more severe symptoms of ADHD is associated with increased frequency of gambling behaviours [44,45]. The relationship between online gambling, IA, and ADHD should be further investigated.

Even though a variety of online activities were investigated in our study, certain activities such as pornography or collecting digital content were not included in our list. Future studies should investigate potential links between other types of online activity, problematic internet use and ADHD symptoms.

Age was another significant predictor of IA in our study. More specifically, younger individuals were more likely to report excessive internet use. Previous research has been focussed on younger samples (mainly college students), while in our study participants were recruited from the general population and the mean age was 30.23. Age has been shown to negatively correlate with IA and behavioural addictions in general [46]. The age range of the participants in our study was wide (18–70) but the relatively small sample did not allow us to look at potential age group differences. Future studies should further examine this relationship.

The following limitations can be identified in our study. First, the methodology of our study does not allow us to examine whether the relationship between ADHD symptoms and excessive internet use is causal, since it is cross-sectional. Future research should establish whether inattention symptoms lead to increased risk of addictive internet use or whether high levels of mobile phone use can affect inattention levels. Another limitation of our study is that it is based on self-reports. Internet use was measured using questionnaires and not an empirical measurement. Finally, our study used a non-clinical population. However, our findings are similar to those obtained in studies with younger clinical populations [11]. This further supports the dimensional theory of ADHD and shows that using subclinical populations could provide us with information of clinical relevance. Future studies could include a clinical assessment (e.g. structured interview) instead of self-reports to assess the presence of ADHD or other disorders.

To our knowledge, this is the first study to investigate the relationship between ADHD symptoms, IA, and online activities in the general population in a non-Asian country. The results suggest that the relationship between ADHD and IA is not guided by cultural or geographical factors. The present results are expected to contribute to our understanding of behavioural addictions and inform clinical practice.

Disclosure statement

The authors have no conflicts of interest or financial ties to disclose.

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