

# Internet Addiction: a qualitative overview

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## Abstract

**Introduction:** although for the vast majority the Internet is a useful and positive aid, for a minority its excessive use can progress to various forms of behavioural addiction. In 2013 DSM 5 considered the diagnosis of Internet Gaming Disorder in the supplementary section highlighting how more research and discussion would be required for this to be accepted as a diagnostic entity in future. In this paper we provide a brief overview of some of the epidemiological, diagnostic, neurobiological, comorbid (psychiatric) and treatment aspects of Internet Addiction.

**Methods:** the articles chosen were searched periodically through PubMed from 2012-2015.

**Results:** Internet Gaming Disorder is one way in which the use of the Internet is evident in behavioural addictions. Other social behaviours such as social networking, gambling, shopping, pornography, exploitation, bullying and dating are mediated through the Internet via a range of devices including computers, mobile phones and games consoles. Consequently the scientific exploration

of Internet Addiction will need to evolve to explore its component social behaviours.

**Discussion:** at what point would a scientific or clinical judgement be made that an individual has a behavioural addiction mediated through Internet? Some papers are reviewed here which have Internet Addiction in their title, which draw our attention to the issue of how our use of technology could be problematic. However further scientific study of the different behavioural phenotypes related to Internet use will give greater insight into the neurobiology of these types of addiction, its relatedness to other psychiatric conditions and its importance in the adverse socio-economic cost in relation to the many positive life changing and tangible benefits the Internet has brought to modern society.

**KEY WORDS:** Internet Addiction; neurobiology; depression; ADHD.

## Introduction

Internet has marked a great evolutionary leap in human communication and has clearly advanced human civilisation. However, for a minority of those who use internet it can lead to excessive use with varying resultant adverse effects on their lives, and for some users it progresses to an addiction. The aim of this paper is to provide a brief overview of some of the epidemiological, diagnostic, neurobiological, comorbid (psychiatric) and treatment aspects of Internet Addiction. We acknowledge that there exist numerous criticisms of the diagnostic construct and validity of the term Internet Addiction, which is open to scientific debate and research in the future.

## Methods

The articles chosen were searched periodically through PubMed from 2012-2015. There were many articles from the Far East. An international balance of publications was found in the selection of articles on epidemiology and more studies could have been referenced but the essential communication here is that the entities of problematic or pathological Internet use and Internet Addiction are common. The articles have not been selected through a formal systematic review, though the larger and more recent epidemiological prevalence

studies were highlighted. The search on PubMed was specifically 'internet'[ MeSH terms] OR ' internet' [All fields] AND 'behaviour, addictive' [MeSH terms] OR 'behavior'[All fields] AND 'addictive' [All fields] OR 'addictive behaviour' [All fields] OR 'addiction' [All fields]. More articles could have been included in the overview but as this is a changing field the ones highlighted are more current. There are also proportionally more articles in the neurobiology section which is designed to give a background to how addictions can affect the brain and insight into the growing scientific interest in understanding how the various behavioural addictions mediated by Internet affect the brain.

### Epidemiology

Shek et al. (1) evaluated 6121 students aged between 11 and 18 in Hong Kong using Chinese translations of both the Internet addiction scales developed by Goldberg and Young. The estimated prevalence of Internet addiction from these surveys was 22.9% and 19.1% respectively.

In a study (2) of 2200 Greek adolescents aged between 12 and 18 sampled using Young's diagnostic questionnaire of Internet addiction the prevalence of Internet addiction was found to be 8.2%.

Gentile et al. (3) looked at 3034 children (in Singapore) in school grades 3, 4, 7 and 8 over a two year period and estimated a prevalence of pathological game playing of 9%. The purpose of this study was to identify risk factors and adverse outcomes of pathological gaming: extended time in game play, socialising problems and impulsivity were seen as risk factors, whilst poorer academic performance and psychiatric morbidity were seen as adverse outcomes.

In a review of relevant literature, Ko et al. (4) noted widely varied prevalence rates of Internet Addiction Disorder, ranging from 1 to 36.7%, probably the result of differing methodologies and diagnostic criteria used in the global studies.

In a 2015 forthcoming publication (5), the estimated prevalence of Internet Gaming Disorder of 1.16% was described amongst 11,003 students aged 13-18 years in Saxony, Germany using the Video Game Dependency Scale.

### Diagnostic criteria

In 1996 Goldberg (6) proposed diagnostic criteria for Internet Addiction incorporating the specific characteristics of addictive behaviours as defined in the DSM-IV i.e. the development of tolerance, withdrawal anxiety on cessation of the activity, more time spent on the Internet to the extent that it becomes the most important activity and there is a persistent desire to use Internet, associated with unsuccessful attempts to reduce time on Internet.

Griffiths (7) modified the definition of Internet Addiction by incorporating the additional criteria of mood modification, conflict and relapse. Further considera-

tion was given to whether the origins of the addiction lay in the precise content, pornography, online gaming, social networking, the medium of communication, lack of face-to-face contact or even the act of typing. Consequently Kandell (8) defined Internet Addiction in the context of logging onto any material online. In 1998 Young (9) stated that for a diagnosis of Internet Addiction disorder to be made when a patient would have five or more the eight characteristic symptoms including preoccupation, tolerance, withdrawal, failure to control use, use longer than intended, functional impairment, lying and escape.

Ko et al. (10, 11) proposed diagnostic criteria for Internet Addiction in which six or more diagnostic criteria had to be met. These symptoms were preoccupation, uncontrolled impulse, usage more than intended, tolerance, withdrawal, impairment of control, excessive time and effort spent on Internet, and impairment of decision-making ability. These clinical features formed Criterion A. In order for Criterion B to be met there had to be evidence of functional impairment secondary to Internet use. In Criteria C there was a list of exclusion criteria such as psychotic disorder, bipolar I disorder and another impulse control disorders. Therefore people fulfilling criteria A, B and C could be diagnosed with Internet Addiction.

Despite the above, it needs to be noted that the diagnosis of Internet Addiction remains controversial. In 2008 Block (12) had advised diagnostic criteria in Internet Addiction to cover the areas of excessive Internet use, withdrawal symptoms, tolerance and adverse consequences. Internet Gaming Disorder has been included in section 3 of DSM 5, where new research has to be conducted and reviewed in order for it to be accepted as a valid diagnosis in the next revision. This more specific diagnosis had been recently reviewed by Ko (13) in terms of the specific presentation of individuals who excessively play massively multi-player online role-playing games (MMPORGs). This review in 2014 looked at the importance of adverse social and educational consequences, excessive use, withdrawal and tolerance. Internet gaming could be seen as an escape mechanism from daily life which could be considered in new diagnostic criteria in the future alongside the other four mentioned in the review and in addition to loss of interest in real world pursuits, deceptive behaviour and continuing with gaming despite personal suffering and social impairment and the impending loss of relationship, job or other social opportunity.

In 2014 van Rooij and Prause (14) looked at contemporary models of Internet Addiction that had been cited in the literature since 2010 and concluded that these models shared the clinical features of loss of control, social impairment and pre-occupation when not using the Internet. However the issues of tolerance, withdrawal, craving and mood symptoms in relation to Internet use were not resolved satisfactorily as these symptoms are often qualitatively different from physical withdrawal from an illicit drug of dependence. At what point does a clinician or researcher consistently determine that the clinical features of all behavioural phenotypes in Internet addiction are pathological?

Problematic pornography use on line is regarded as an emerging issue that had been recently studied with the focus on revealing deficient self-regulation as a symptom and future potential diagnostic criterion, through a specific methodology which needs to be replicated in further study (15).

Internet shopping in habits in relation to anxiety and obsessive symptom had been studied specifically using the Edwards Compulsive Buying Scale (16). Behavioural addiction through the use of on-line Social Networking Sites was also reviewed (17) which suggested how people of different personality types may be influenced. Individuals with good or poor social skills may use these sites for considerable benefit, though both could be sustained on these sites for long periods of time at considerable personal cost in terms of social and relationship difficulties, and declining performance in education and employment.

In the future it is likely that the discussion and research around diagnostic criteria for Internet Addiction will be split into its component parts in relation to gaming, use of social media, pornography, gambling and information gathering. The Internet is accessed for these behaviours, but at what point will the research community and clinicians formally decide that these common behaviours have made the transition to addiction, by creating consistent diagnostic criteria. The use of the term Internet Gaming Disorder in DSM-5 and the Young Internet Addiction Test have been important landmarks on the journey of this scientific discovery.

### The Neurobiology of Internet Addiction

There do not appear to be any animal model studies relating to Internet addiction, but the study of behavioural motivation and reinforcement in animals and humans points to the mesolimbic dopamine system as the region where addictive substances i.e. opiates, stimulants, nicotine, alcohol, cannabis, have an effect (18, 19). The mesolimbic dopamine system consists of dopaminergic neurones in the ventral tegmental area (VTA) projecting to the nucleus accumbens (NAc) and the medial prefrontal cortex in the limbic forebrain. This system mediates the biological basis of the rewarding aspects of drug use as well as craving owing to long term adaptations of the VTA-NAc system to chronic addictive drug use (20-22). The dopaminergic cells of the VTA undergo significant morphological changes during chronic addiction and there is evidence of increased levels of tyrosine hydroxylase and changes in glutaminergic transmission in these neurones as well as reductions in levels of neurofilament proteins. Meanwhile in the NAc there is evidence of upregulation of the cAMP pathway, changes in glutaminergic transmission and induction of transcription factors such as CREB and FosB (23). Individuals when online are frequently involved in goal directed tasks such as gaming. In a videogame where in eight men were asked to navigate a tank for financial gain (goal directed task), Koepp et al. (24) ob-

served increased release and binding of dopamine to its receptors, most notably in the ventral striatum. Specifically this study involved positron emission tomography to detect 11-C raclopride binding in the striatum and cerebellum. The reduction in raclopride binding was lowest in the ventral striatum and the extent of this reduction was positively correlated with how well the subject performed on the tasks. In this study a 13% reduction in (11C) RAC-binding potential in the ventral striatum suggested a doubling of dopamine concentration in the ventral striatum. This study had a very small sample and hence it is difficult to draw any generalizable conclusions.

Hou et al. (25) studied five male subjects with Internet Addiction Disorder for an average of six years compared to eight age - matched controls using single photon emission computed tomography (SPECT) to specifically measure the uptake of 99m-Tc-TRO-DAT in the striatum. In addition, the mass and volume of the corpus striatum was measured on the left and right. This imaging study demonstrated that there was a significant reduction in dopamine transporter (DAT) expression in the striatum. There was also a reduction in both weight and volume of the striatum and a reduced ratio of uptake of the DAT ligand in the striatum compared to the rest of the brain. These findings suggest that there is pronounced dopamine terminal loss in the striatum and other functional impairment of the dopaminergic system, as is seen in addiction to drugs (26-28).

Extracellular dopamine release in the striatum is associated with the euphoria of internet Addiction, pathological gambling and other addictions (29), but over the course of time and repeated stimulation of the striatum there is evidence of lesions in dopamine terminals (30) and decreased size of dopaminergic cell bodies in the striatum (31). Therefore one can postulate that Internet Addiction may cause damage to dopaminergic cells in the striatum.

In a diffusion tensor imaging study of seventeen Chinese adolescents with Internet Addiction disorder, matched with controls, there was evidence of significantly lower levels of fractional anisotropy in the orbito-frontal white matter, corpus callosum, cingulum, inferior fronto-occipital fasciculus, corona radiata and internal and external capsules. There were no areas of increased fractional anisotropy observed in this study (32). The research findings demonstrated the potential structural differences and altered functional connectivity of white matter fibres in the left genu of the corpus callosum and the left external capsule in the brains of those with Internet Addiction only. Reduced fractional anisotropy was suggestive of reduced functional connectivity, implying that having more emotional symptoms and higher Young Internet Addiction Test scores may relate to less strong connections of white matter in the left genu and the external capsule. Although no firm conclusions can be drawn regarding the neurobiological substrates of Internet addiction, this appears to be a promising area for further exploration.

In a PET study that compared D2 receptor density with glucose metabolism between 12 cases of Inter-

net Gaming Disorder and 14 control subjects (33), there was an implication that a long history of the condition was linked to lower D2 receptor density in the striatum and reduced glucose metabolism in the orbitofrontal cortex.

### Psychiatric comorbidity

Chan and Rabinowitz (34) studied 72 adolescents and 72 of their parents in the US in order to assess their range of media exposure. They also used the Young Internet Addiction scale and assessed these adolescents for features of ADHD. They noticed that if teenagers were on videogames for more than one hour then that they displayed more features of ADHD. They concluded that if teenagers spent more time in Internet gaming then it would have a detrimental effect on their scholastic achievement.

Ha et al. (35) studied a large sample of children in Taiwan. The first group was aged between 10 and 11 years and consisted of 455 children. In this group 13.8% (63/455) were believed to have Internet Addiction as shown by their scores on the Young's Internet addiction scale. Twelve of 63 children were randomly selected and the diagnostic interview K-SADS-PL-K was applied revealing that seven of these children would have qualified for a diagnosis of ADHD. About 20% i.e. 170 teenagers completed the Young's Internet Addiction scale and from this group another 12 students were randomly selected for assessment using the SCID IV interview schedule. Seven students fulfilled criteria for the diagnosis of ADHD.

Han et al. (36) prospectively studied 62 teenagers who had a history of ADHD for excessive use of videogames. The hypothesis was examining whether video gameplay and methylphenidate increased synaptic dopamine release in a way that could enable them to concentrate better. Fifty two of these subjects were male. They were given methylphenidate and followed up after eight weeks. There was an apparent reduction in the Young's Internet addiction scale score and total time of Internet use. However there was no control group in this study but they suggested that methylphenidate could reduce Internet use.

A prospective, randomly generated cohort study in Guangzhou, China (37) amongst 13-18-year-old high school students identified that the relative risk of depression amongst pathological users of Internet was 2.5 (95% confidence interval 1.3-4.3) compared to those who used Internet appropriately. There was no difference between these groups for the relative risk of developing anxiety. Initially 1122 students were sampled and 1041 were followed up using the Zung Anxiety Self-rating Scale and the Zung Depression Self-rating Scale.

In 2014 another important Chinese study (38) of 1098 parent-child dyads considered in conclusion that the presence of parental depression might be linked with a three times greater likelihood of a child/teenager developing an Internet Addiction as measured by the Young Internet Addiction Test.

Morrison and Gore (39) used the methodology of the on-lines questionnaire in order to administer the Internet Addiction Test, Internet Function and Beck Depression Inventory.

There were 1319 subjects in this study of which only 18 subjects were believed to have an Internet Addiction disorder, who expressed higher scores for depressive psychopathology than the others. This smaller group was also predominantly composed of younger males.

In Sweden a systematic review (40) investigating the link between problematic Internet use and psychiatric co-morbidity identified that the literature highlighted an association with depression and ADHD symptoms, which will be a focus for continuing research.

There has been a paucity of research in this field of comorbid psychiatric conditions in the presence of Internet Addiction, which needs to be addressed by future research as the diagnosis of Internet Addiction inferred from the score on the Young Internet Addiction Test is refined, by exploring different behavioural addictions in relation to Internet use and new additional rating scales.

### Treatment

No drug is licensed for use in the treatment of Internet Addiction, and psychological interventions remain the preferred treatment.

Young (41) reported improvements in functioning in college students addicted to Internet after eight sessions of CBT. The outcomes measured included improved time management, improved motivation, improved sexual functioning and improved social relationships.

Multi-family group work in China (42) had been trialed in 92 families of which 46 adolescents were regarded as having an Internet Addiction. The importance of the parent's communication and closeness to their child, in addition to meeting their adolescent's needs were identified themes after three months and post intervention follow up.

Orzack et al. (43) unsuccessfully trialed the use of a combination of cognitive behavioural therapy and motivational interviewing in groups of men aged over 40 years with problematic Internet related sexual behaviour. Although depressive symptoms alleviated there was no improvement in their use of the Internet.

Du et al. (44) completed a randomised control trial with 56 subjects. Twenty four were randomised into an eight session CBT treatment course and the remainder did not receive treatment. Teenage subjects demonstrated improved time management skills and reduced impact of adverse psychological symptoms.

In a study looking at methylphenidate Han et al. (36) demonstrated reductions in the intensity of the clinical features of Internet Addiction Disorder but this trial did not have a control group. It seems logical to also state that, akin to the pharmacological management of gambling addiction, SSRIs, mood stabilisers and opiate blockers may have a role to play in the treatment of Internet Addiction.

## Conclusion

Whilst well-adjusted individuals are able to harness Internet to maximum benefit, there will be a significant minority who will not. We hope this brief paper stimulates further debate on the topic of Internet Addiction among key stake holders such as young people, parents, teachers, health professionals and policymakers. Even the term Internet Addiction could be modified into a number of specific behavioural addictions enabled by Internet use and other modern technologies e.g Internet Gaming Disorder. The research community has a duty to understand these issues more precisely in order to have insight into the beneficial and hazardous effects modern technology and to identify and treat psychiatric conditions and comorbidities.

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