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Problematic internet use in gamblers: impact on clinical and cognitive measures

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Abstract

Objective—Gambling is a commonplace phenomenon, existing along a continuum from occasional gambling, to functionally impairing gambling disorder. The Internet may act as a conduit for some gambling behaviors. The impact of problematic Internet use on clinical and cognitive features relevant to gambling has received very little research attention.

Method—206 adults aged 18-30 years, who gamble at least 5 times per year, were recruited from the general community, and undertook detailed clinical and cognitive assessments. Problematic internet use was defined using total score of five or more on Young's Diagnostic Questionnaire (YDQ), which is derived from diagnostic criteria for gambling disorder and substance use disorders. Demographic, clinical, and cognitive characteristics were compared between gamblers with versus without problematic Internet use.

Linear regression was used to evaluate the relative contribution of addictive-related, impulsive-related, and compulsive-related measures in predicting YDQ total scores in gamblers.

Results—Compared to the reference gambler group, gamblers with problematic internet use (18% of the sample, defined using a cut-off of five or more on the YDQ) reported lower quality of life, lower self-esteem; elevated rates of intermittent explosive disorder, gambling disorder symptoms, ADHD symptoms, antisocial personality disorder, and PTSD; and relative deficits in decision-making and spatial working memory. In linear regression, the extent of problematic internet use in gamblers was most strongly and significantly associated with higher gambling disorder symptoms, and higher ADHD symptoms.

Conclusions—These results indicate that problematic Internet use in gamblers is associated with worse quality of life, more problem/pathological gambling symptoms, more psychiatric morbidities, and select cognitive impairment. Refinement of definition of problematic Internet use, and exploration of its clinical and cognitive associations, is likely to be highly relevant to the treatment of gambling.

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Keywords

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Introduction

Despite being a recently developed technology, the internet is now all-pervasive in many parts of the world. In the USA, it is estimated that approximately 90% of adolescents and young adults use the internet, with high rates also being reported in Europe (e.g. the United Kingdom) and Asia.[1,2] While internet use is less common in other parts of the world, its use is escalating at a phenomenal rate, such as in Africa. There are clearly positive aspects of internet availability, including rapid access to global information sources and communication with others, but a proportion of individuals use the internet excessively, a putative entity referred to variably as 'problematic internet use', 'internet addiction', or 'compulsive internet use'.[3] Indeed the variety of terms pertaining to excessive use of the internet is indicative of a relative lack of consensus regarding optimal classification, and diagnosis, of such problems. Depending on the precise definition and population studied, prevalence estimates for problematic internet use vary from 1-35% in young people, being highest in Asia.[2] Precise definition and nosological classification aside, excessive internet use has been clearly linked with untoward consequences, including worse academic achievement,[4,5] greater risk of some mental disorders,[6] and even – rarely – severe physical health consequences such as deep vein thrombosis due to prolonged periods of inactivity.[7]

Whether or not problematic internet use should constitute a formal mental disorder remains contentious. Some argue that excessive use of the internet is not a disorder in itself, but rather is a consequence of, or incidental 'through-route' for, other problems: such as compulsive sexual behavior (e.g. pornography use), or compulsive shopping.[42,43] Another area of debate – which has influenced both the Diagnostic and Statistical Manual Version 5 (DSM-5)[8] and upcoming International Classification of Diseases Version 11 (ICD-11)[9] – regards how best problematic internet use should be categorized.

The field of addiction research has increasingly considered whether certain behaviors have addictive 'qualities'. In the DSM-5, gambling disorder was incorporated in the broader category of 'Substance-Addiction and Related Disorders', on the basis of evidence indicative of overlapping phenomenology, co-morbidity, and neurobiology with substance use disorders.[10–12] Various types of behavior have been posited as potential 'behavioral addictions', including grooming (excoriation disorder, hair pulling disorder), compulsive stealing (kleptomania), compulsive buying, compulsive sexual behavior, and problematic internet use. Some of these conditions are listed in DSM-5 as impulse control disorders (e.g. kleptomania), others as obsessive-compulsive related disorders (excoriation disorder, hair pulling disorder), while problematic internet use is listed only as a condition warranting further research.[13] The Working Group for the International Classification of Diseases Version 11 (ICD-11) argues for a broad category of impulse control disorders, including gambling disorder and compulsive sexual behavior, but – consistent with the DSM approach – considers that there are insufficient data to justify inclusion of problematic Internet use as

a formal entity.[9] Alternative nosological approaches towards problematic internet use may include considering it an impulse control disorder, or compulsive disorder. Prevailing neurobiological models of problematic internet use highlight the likely contribution of cognitive dysfunction relating to impaired decision-making (such as preference for more immediate reward), executive dysfunction (e.g. set-shifting difficulties), and impaired impulse control. [23, 41]. In the absence of consensus as to which cognitive deficits are the most prominent in sufferers, these findings may be interpreted in support of any of the three nosological approaches (addictive, impulsive, or compulsive).

The aim of this study was two-fold: firstly to describe differences between gamblers with problematic internet use and gamblers without problematic internet use on demographic, clinical, and cognitive measures; and secondly, to evaluate, from these measures, those most strongly associated with extent of problematic internet use severity in gamblers. We included structured screening assessments for mainstream mental disorders as well as impulse-control disorders; along with quality of life and self-esteem questionnaires; plus objective neurocognitive assessment using tests capturing aspects of flexible responding, decision-making, inhibitory control, and working memory. We hypothesized that problematic internet use in gamblers would be associated with lower quality of life, lower self-esteem, and more severe gambling symptoms, consistent with the notion of it representing a psychiatric disorder of interest and relevance, and a potential ‘gateway’ behavior for gambling. We further hypothesized that internet use disorder in gamblers would be most strongly predicted by impulsive measures, suggesting that it might best be conceptualized within this framework (rather than as a substance use and related addictive, or compulsive [obsessive-compulsive], type of disorder).

Method

Participants

Two-hundred and six individuals aged 18-29 years were recruited using media advertisements in two major US cities. The only inclusion criterion was gambling at least five times in the preceding year, as the study was part of a broader project examining gambling in young adults. The only exclusion criterion was an inability to understand/undertake the assessments. Participants provided written informed consent after receiving a complete description of the study, and attended the study centre to complete detailed questionnaires and to undertake structured psychiatric interview.

Assessments

Participants attended study centers in order to complete detailed demographic, clinical and cognitive assessment. Validated screening tools for problematic internet use are relatively sparse and under-researched. Problematic Internet use was quantified using Young’s Diagnostic Questionnaire (YDQ).[14] The YDQ is an eight item yes/no questionnaire, which was derived from prior criteria for substance use disorder and pathological gambling, but applied to maladaptive use of the Internet. The instrument considers preoccupation with the Internet, escalating quantities of time spent using the Internet, repeated unsuccessful attempts to cut back, restlessness/irritability when attempting to cut back, staying online

longer than intended, jeopardizing careers/scholarship/relationships, lying to others, and using the Internet to escape from life or emotional difficulties. As such, we felt that the YDQ appropriately captured a broad range of problematic internet use thoughts and behaviors. Problematic internet addiction was defined as endorsing five or more of these symptoms over the preceding 12-month period, consistent with Young's original operational criteria.[14]

Presence of current psychiatric disorders was evaluated using the Mini International Neuropsychiatric Inventory (MINI)[15] and the Minnesota Impulse Disorder Inventory (MIDI).[16] The MINI identifies mainstream psychiatric disorders such as mood and anxiety disorders, while the MIDI identifies impulse control disorders. Quality of life was measured using the Quality of Life Inventory (QOLI),[17] self-esteem with the Rosenberg Self Esteem Scale (RSE),[18] and emotional dysregulation with the Difficulties with Emotion Regulation Scale (DERS).[19] To quantify impulsive and compulsive tendencies, participants completed the Padua obsessive-compulsive inventory,[20] the Adult ADHD Self-Report Scale (ASRS v1.1, 2005),[21] and the Structured Clinical Inventory for Pathological Gambling (SCI-PG) (modified for DSM-5).[22] We also collated information regarding frequency of alcohol use, and numbers of cigarette packs smoked per day.

Cognitive testing was conducted using four paradigms from the Cambridge Neuropsychological Test Automated Battery (CANTABeclipse, version 3, Cambridge Cognition Ltd, UK). Based on existing models of Internet use disorder,[23, 41] we focused on top-down inhibitory control, decision-making, working memory, and set-shifting.

Top-down inhibitory control was measured using the Stop-Signal Task (SST). On the SST, a series of directional arrows were presented on the computer screen one per time, and volunteers made quick responses depending on the direction of arrows (left button for left-facing arrow; right button for right-facing arrow). On some trials, an auditory stop-signal ("beep") occurred a variable time after presentation of the go cue, indicating that the volunteer should attempt to omit a response for the given trial. By dynamically modulating the time between presentation of the arrow and the stop-signal, the task calculated the stop-signal reaction time – a measure of time taken to suppress a response that would normally be made. Longer stop-signal reaction times equate to worse top-down control.

Decision-making was measured using the Cambridge Gamble Task (CGT). On each trial, ten boxes were shown, some blue and some red, with a token having been hidden behind one of these. The participant selected the color of box they believed a token was hidden behind, and then decided how many points to gamble on having made the correct decision. The main measures of decision-making on the task were the proportion of points gambled overall, the proportion of rational decisions made (proportion of trials when the volunteer opted for the color that was in the majority), and the extent of risk adjustment (the extent to which individuals modulated the amount gambled depending on the probability of making correct choices).

Spatial working memory was assessed using the Spatial Working Memory Task (SWM). Volunteers had to find 'tokens' hidden behind boxes on the computer screen, and to avoid returning to boxes where tokens had previously been located. The key outcome measure

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from the task was the total number of errors made (inappropriately returning to boxes that had previously yielded tokens).

Set-shifting was assessed using the Intra-Dimensional/Extra-Dimensional Set-shift task (IED). This paradigm is based on the Wisconsin Card Sorting Task, but decomposes different aspects of rule acquisition and flexible responding, over nine task stages. Volunteers choose between two stimuli presented on the computer screen on each trial, and receive feedback as to whether their choice was ‘right’ or ‘wrong’. Through trial and error, the volunteer attempts to learn a rule about which stimulus is correct. The computer alters this underlying rule when the current rule has been learnt by the volunteer. The main measure on the task is the total number of errors made, adjusted for stages that were failed. Where this composite measure is statistically significant for a comparison of interest, then scores on individual task stages can be explored, to confirm the main cognitive problems driving the overall impairment on the task.

Data Analysis

Participants were grouped according to having Internet Addiction (IADQ score of five or more) or not (reference group). Demographic, clinical, and cognitive characteristics of the two study groups were tabulated and compared using one-way analysis of variance (ANOVA) or chi-square tests. For chi-square tests, Yates’ correction was applied where appropriate.

In order to identify variables that were most strongly associated with higher internet addiction scores (YDQ scores) in gamblers, variables related to impulsivity, compulsivity, and addiction that differed significantly between study groups were entered into linear regression (dependent variable: YDQ total score) across the whole study sample, using method Enter, p for entry <0.05, for exit >0.10. Conformity to model assumptions were tested using Durbin Watson, tolerance, Colinearity diagnostics, residual statistics (Mahalanobis distance), and manual inspection of data plots (including residuals).

Statistical significance was defined as $p<0.05$ uncorrected throughout. Data were analyzed using SPSS v22.

Results

Of the 206 participants enrolled into the study, 37 (18% of the sample) met criteria for problematic internet use based on the YDQ. Summative demographic, clinical, and cognitive characteristics of the two study groups are shown in Table 1, where it can be seen that the groups did not differ significantly in terms of age, gender, and levels of education. Compared to gamblers without problematic internet use, gamblers with problematic internet use showed significantly lower quality of life, lower self-esteem, more difficulties with emotional regulation, increased occurrence of mainstream mental disorders, increased occurrence of impulse control disorders, higher ADHD symptoms, and higher gambling disorder symptoms. The groups did not differ significantly in terms of alcohol or tobacco consumption, nor obsessive-compulsive scores. It can be seen that in comparison to participants without problematic internet use, those with problematic internet use showed

significantly greater occurrence of post-traumatic stress disorder, antisocial personality disorder, intermittent explosive disorder, and gambling disorder. In terms of cognitive functioning, problematic internet use was associated with relative impairments in decision-making (lower risk adjustment) and spatial working memory (more total errors), but did not differ from the reference group in terms of stop-signal inhibitory control or set-shifting.

Linear regression identified a statistically significant model that accounted for 19% of the variance in YDQ total scores across all gamblers, according to the R square statistic ($F=7.433$, $p<0.001$). Durbin Watson, Colinearity Diagnostics, Tolerance, and residual criteria were within threshold for model validity. Variables that were individually significant predictors for IDQ total scores were SCI-GD total scores (Beta standardized = 0.070, $t=4.133$, $p<0.001$), and ADHD symptoms (Beta standardized 0.212, $t=3.161$, $p=0.002$). Presence of current mainstream mental disorder (MINI), current impulse control disorder (MIDI), CGT Risk Adjustment, and SWM total errors were not statistically significant predictors in the model (all $p>0.20$). Casewise diagnostics identified two subjects who were outliers; exclusion of their data did not qualitatively affect the results of the regression model. The model constant was significant ($t=3.105$, $p=0.002$), unstandardized Beta = 1.137.

Discussion

In this study, we assessed the occurrence of problematic internet use in a non-treatment seeking sample of young adults who gamble at least occasionally, recruited from US settings. We also explored relationships between problematic internet use and other variables germane to the debate about the potential impact of Internet use on gambling. .

Problematic internet use and gambling behaviors

The finding that problematic internet use was evident in 18% of gamblers suggests that this is a common issue for gamblers, rather than a rarity or an entity that is only of academic interest. Rates may well be higher in psychiatric inpatient and outpatient populations of people with gambling problems. The global prevalence of problematic internet use is likely to grow over time, with increasing availability of the internet. The prevalence rate of problematic internet use seen here is comparable or only slightly higher as compared to other studies conducted in US settings, which found prevalence ranging from 9.8% to 15.2% in young people.[1] However, our sample focused on people who gamble at least five times per year, and so the findings may well not generalize to the background population.

Additionally, we found that problematic internet use in gamblers was associated with quality of life that was significantly impaired (in the ‘poor range’, akin to that previously reported in depression[25]), with associated concomitant impairment in terms of self-esteem. These findings are consistent with previous research which found low levels of self-esteem in people with excessive internet use, especially in those with more severe symptoms.[26]

It has been argued that problematic internet use may represent an avenue through which individuals undertake specific types of repetitive, addictive, or compulsive acts, rather than being an independent disorder. Our data highlight that problematic use of the internet is associated with higher rates of problem and pathological gambling symptoms amongst

people who gamble, highlighting the internet at a key 'keyway' through which gambling problems can manifest. Using gold-standard in-person clinical instruments, we found that the majority of cases of problematic internet use in gamblers were not associated with another type of impulse control disorder that would better account for the symptoms, including formal gambling disorder, in our sample. Thus it appear that problematic Internet use can contribute to worse gambling, but does not lead to pathological gambling in all people. Nonetheless, rates of gambling disorder were significantly higher in problematic internet users, and rates of compulsive sexual behavior and compulsive shopping disorder were numerically higher but not statistically significantly higher versus the reference group. Furthermore, extent of problem gambling was a significant predictor of extent of problematic internet use in our regression modelling.

How best should problematic internet use be conceptualized?

Optimal nosological classification of any psychiatric disorder is informed by understanding of etiology, comorbidity, and neurobiology.[24] Prevailing suggestions as to the preferred classification of problematic internet use include as a 'behavioral addiction', as an obsessive-compulsive (or, simply, compulsive) disorder, or as an impulse control disorder.[28,29] The current study was not designed to address etiology and therefore considered comorbidity and neurobiology in turn.

In an extensive review, Ko and colleagues reported that internet addiction has most frequently been associated, in existing literature, with ADHD, depression, social anxiety disorder, substance use disorder, and aggressive behaviors [26] (for discussion see also[2]). There are limitations in many of the available studies, such as use of non-gold standard instruments to assess presence or absence of disorders, and frequent failure to screen for impulse control disorders at all.

The concept of problematic internet use as a form of behavioral addiction, sharing parallels with substance addiction, is central to several working definitions of the disorder. In the current study, we used diagnostic criteria that were derived from modeling gambling disorder and substance use disorder.[14] Contrary to our expectations, we did not find any significant associations between problematic internet use and substance use disorders, based on careful structured clinical assessment, nor were significant relationships evident between occurrence of problematic internet use and self-reported frequencies of alcohol and nicotine consumption.

People with problematic internet use did not show higher rates of formal OCD (by structured clinical interview), nor did they exhibit higher than expected levels of obsessive-compulsiveness as indexed by the self-complete Padua inventory, which was developed to assess OC traits in normative populations.[20]

We did, however, find evidence in support of problematic internet use being related to the classically recognized impulse control disorders, problem gambling, and to ADHD. Overall presence of one or more impulse control disorders was significantly higher in problematic internet users than in controls, as was the extent of problem gambling as indexed by the SCI-GD. When individual impulse control disorders were considered, structured clinical

assessment identified significantly higher rates of gambling disorder and intermittent explosive disorder in the problematic internet users. Antisocial personality disorder was also more common in cases than in controls. Furthermore, self-rated maladaptive gambling and ADHD symptom scores were statistically significant predictors of the extent of problem internet use, on conservative regression modelling.

Cognitive domains potentially implicated in the pathophysiology of problematic internet use include failures of top-down inhibitory control, working memory, and decision-making (for review[23]). It should be noted that many cognitive and imaging studies in this field have focused on internet gaming addiction, rather than problematic internet use *per se*. Only a handful of studies have addressed cognitive functioning in problematic internet users.[23, 41]

In gamblers, we identified an association between problematic internet use and impaired spatial working memory, along with a non-global deficit in decision-making (less modulation of behavior as a function of gambling risk level), but intact top-down response suppression and set-shifting. Other studies that did not recruit participants on the basis of gambling symptoms are informative. One such prior study examined working memory in problematic internet users, albeit using a digit span task, and found deficits.[30] Other studies have reported deficits in decision-making using the Iowa Gambling Task and Game of Dice Task.[31,32] Two of three previous studies found intact top-down inhibitory control in problematic internet users versus controls, albeit using go/no-go rather than stop-signal tests (intact[31,33]; impaired[30]). As such, our data are broadly consistent with the majority of the small volume of existing literature, in that similarly affected cognitive domains were found.

It is potentially informative to qualitatively compare the profile of neuropsychological impairment observed here in problematic internet users to findings using the same computerized cognitive tasks in impulse control, addictive, and obsessive-compulsive disorders. Caution is needed because other studies did not focus on gamblers *per se*. Interestingly, impaired working memory and risk adjustment, but intact response inhibition, was previously found in compulsive buying disorder,[34] and in nicotine consumers.[35] Other conditions appeared to be associated with more global decision-making deficits, notably shoplifting,[36] and problem gambling with a history of trauma.[37] For OCD, decision-making was generally found to be intact while response inhibition was not.[38,39] In all, the current cognitive data suggest similarities between problematic internet use and some addictions and impulse control disorders, rather than with OCD. It is important to note that similar behavioral deficits across disorders could be driven by different neurobiological abnormalities. Functional neuroimaging work could help to address the neurobiological relationships between problematic internet use and other disorders.

Limitations

This study was undertaken in non-treatment seeking young adults recruited from US settings, who gambled at least 5 times in the preceding year, and so findings may not generalize to other populations, such as older individuals, people who do not gamble so frequently, or those presenting to mental health services. This being an exploratory study, we did not correct for multiple comparisons. Nonetheless, the relationship between problematic internet use, gambling symptoms, and ADHD symptoms, was robust in a secondary linear

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regression analysis, even accounting for all other variables. We used the total score from Young's Diagnostic Questionnaire (YDQ) to assess extent of problematic internet use; this instrument is brief and therefore convenient. We believe this to be a reasonable instrument as it is largely equivalent to the widely-accepted SCI-PG, used to assess problematic gambling behavior, in terms of over-arching symptom domains considered. Nonetheless, the YDQ may suffer from tendency to over-pathologize, and also lacks key items related to internet gaming disorder criteria and other nosological approaches. The threshold used on the YDQ for 'problematic internet use' requires further validation in future work; nonetheless, we feel the currently used threshold was consistent with other disorder criteria (gambling disorder, substance use disorder) and furthermore it did identify participants with impaired quality of life versus the reference group. Also, we used a complementary approach of linear regression to examine associations between total YDQ criteria scores and other measures, which confirmed an association with worse gambling symptoms and more ADHD symptoms. tThe field would benefit from future research to assess the validity and optimal type of symptom scale for internet addiction. Because the YDQ yields a total score of range 0-8, this would have limited the available variance in the regression modelling with respect to the dependent variable. Due to this issue and the sample size, subtler relationships between problematic internet use and other measures may have been overlooked.

Conclusions

The current findings demonstrate an association between problematic internet use and impaired quality of life in gamblers, suggesting that it is an entity that merits further clinical and research attention. In our study, problematic internet use appears to be more closely related, in terms of comorbidity, with classic impulse control disorders, and with ADHD, versus substance addiction, mood disorders, or OCD (including obsessive-compulsive personality traits as indexed by the Padua inventory). As expected, problematic internet use was associated with worse gambling symptoms in our sample, supporting the notion of the internet as a 'gateway' through which one might engage in rewarding behaviors. These findings add initial weight to one perspective, namely that problematic internet use might be considered more of an impulse control disorder or gambling-related disorder than an obsessive-compulsive or substance addiction and substance-related disorder.[40] There are various criteria that can be used to assess whether a particular set of symptoms constitutes a meaningful or cohesive psychiatric disorder for inclusion in diagnostic nosological systems. Working groups for both DSM-5 and ICD-11 considered problematic internet use, concluding that there was insufficient data for formal inclusion but highlighting the need for more research.[8,9] Inclusion of a disorder should be on the grounds of clinical utility and diagnostic validity.[24] Findings from the current study help to inform this on-going debate, by highlighting the salience of problematic internet use for understanding the clinical and cognitive presentations observed in gamblers. Problematic use of the internet may constitute a candidate treatment 'target' in the management of gambling disorder for a subset of patients.

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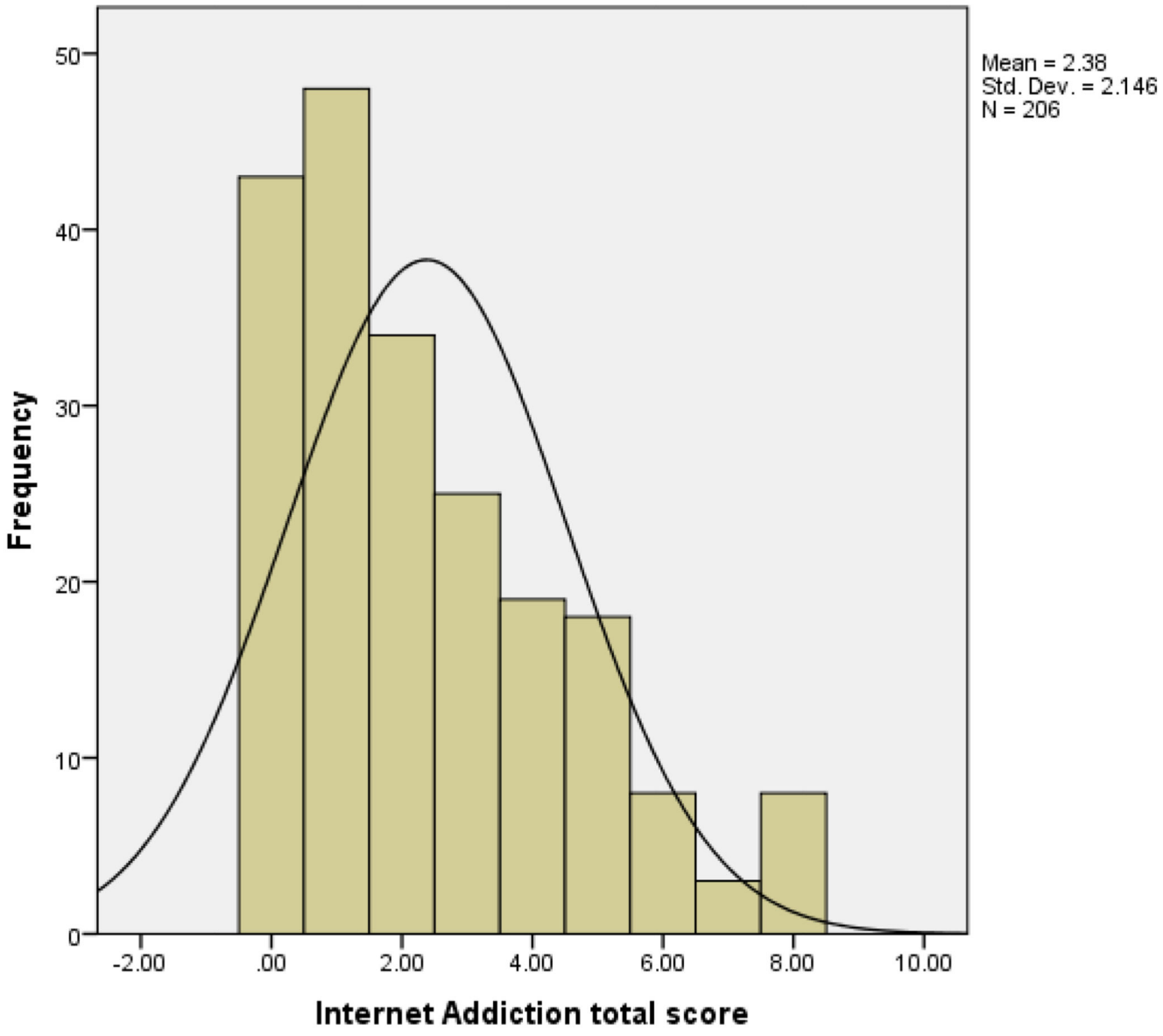

Fig 1.

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Table 1

Overview of demographic and clinical characteristics in the study groups.

	Controls (N=169)		Problematic internet use (N=37)		ANOVA	
	Mean	SD	Mean	SD	F	p
Age, years	22.99	3.72	24.14	3.47	2.870	.092
Gender, proportion of male subjects	0.59		0.53		0.327@	0.568
Education score	3.36	0.81	3.36	0.72	.002	.967
Quality of life t-score	45.93	12.56	39.68	12.50	7.020	.009 **
Alcohol consumption, drinks/week	1.55	1.42	1.51	1.35	.018	.893
Nicotine consumption, packs per day	0.16	0.33	0.13	0.31	.295	.588
Rosenberg Self Esteem total score	21.26	6.93	16.92	5.72	12.324	<0.001 ***
Difficulties with Emotion Regulation total score	73.50	19.99	84.28	22.68	8.193	.005 **
Current mainstream psychiatric disorder, MINI, proportion of subjects	0.43		0.68		7.229@	0.0072 **
Current Impulse Control Disorder, MIDI, proportion of subjects	0.11		0.24		4.423@	0.0355 *
Padua total score	24.48	70.71	37.30	28.92	1.169	.281
ADHD symptoms (ASRS Total Score)	8.79	5.22	11.16	5.64	6.082	.014 *
SCI-GD total score	1.34	1.87	3.08	3.22	19.323	<0.001 ***
Body mass index	24.74	5.33	27.38	8.33	5.887	.016 *

MINI: Mini International Neuropsychiatric Inventory; MIDI: Minnesota Impulse Disorder Inventory; ASRS: Adult ADHD Self-Report Scale. @ Chi-square test.

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Table 2

Proportion of subjects in each group with individual mainstream psychiatric disorders, as indexed by the Mini International Neuropsychiatric Inventory (MINI)

	Controls (N=169)	Problematic internet use (N=37)	Chi-square	
	Proportion	Proportion	X	P
Major depressive disorder	0.095	0.176	1.923	0.166
Manic episode	0.110	0.057	0.475	0.4909
Panic disorder	0.027	0.034	0.007	0.933
Agoraphobia	0.070	0.147	0.911	0.340
Social phobia	0.042	0.139	3.301	0.069
Obsessive-compulsive disorder	0.024	0.057	0.208	0.649
Post-traumatic stress disorder	0.006	0.081	5.492	0.0191 *
Alcohol use disorder, any	0.168	0.306	3.426	0.0642
Substance use disorder, any	0.143	0.152	0.012	0.913
Anorexia	0.006	0.027	0.068	0.794
Bulimia	0.024	0.057	0.208	0.649
General anxiety disorder	0.054	0.111	0.822	0.365
Antisocial personality disorder	0.077	0.222	6.433	0.011 *

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Table 3

Proportion of subjects in each group with individual impulse control disorders, as measured using the Minnesota Impulse Disorder Inventory (MIDI)

	Controls (N=169)	Problematic internet use (N=37)	Chi-square	
	Proportion	Proportion	X	P
Compulsive buying disorder, MIDI	0.024	0.108	3.757	0.0526
Kleptomania, MIDI	0.000	0.000	n/a	n/a
Trichotillomania, MIDI	0.000	0.000	n/a	n/a
Intermittent Explosive Disorder, MIDI	0.018	0.139	8.281	0.004 **
Pyromania, MIDI	0.006	0.000	n/a	n/a
Gambling disorder, MIDI	0.216	0.432	7.241	0.0071 **
Compulsive sexual behavior, MIDI	0.042	0.054	0.116	0.734
Binge-eating disorder, MIDI	0.036	0.027	0.066	0.797
Skin-picking disorder, MIDI	0.034	0.107	2.071	0.150

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Table 4

Cognitive performance in the study groups.

	Controls (N=169)		Problematic internet use (N=37)		ANOVA	
	Mean	SD	Mean	SD	F	P
SST SSRT (last half)	185.85	76.57	203.64	74.69	1.648	.201
CGT Overall proportion bet	0.54	0.16	0.59	0.13	3.376	.068
CGT Quality of decision making	0.93	0.11	0.91	0.11	1.062	.304
CGT Risk adjustment	1.29	1.25	0.81	1.05	4.755	.030 *
SWM Total errors	21.39	20.82	32.76	22.28	8.810	.003 **

IED: Intra-Dimensional/Extra-Dimensional set-shifting; SST: Stop-Signal Test; SSRT: Stop-signal reaction time; CGT: Cambridge Gamble Task; SWM: Spatial Working Memory task.