Proposed diagnostic criteria for internet addiction

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ABSTRACT

Objective The objective of this study was to develop diagnostic criteria for internet addiction disorder (IAD) and to evaluate the validity of our proposed diagnostic criteria for discriminating non-dependent from dependent internet use in the general population. **Methods** This study was conducted in three stages: the developmental stage (110 subjects in the survey group; 408 subjects in the training group), where items of the proposed diagnostic criteria were developed and tested; the validation stage ($n = 405$), where the proposed criteria were evaluated for criterion-related validity; and the clinical stage ($n = 150$), where the criteria and the global clinical impression of IAD were evaluated by more than one psychiatrist to determine inter-rater reliability. **Results** The proposed internet addiction diagnostic criteria consisted of symptom criterion (seven clinical symptoms of IAD), clinically significant impairment criterion (functional and psychosocial impairments), course criterion (duration of addiction lasting at least 3 months, with at least 6 hours of non-essential internet usage per day) and exclusion criterion (exclusion of dependency attributed to psychotic disorders). A diagnostic score of $2 + 1$, where the first two symptoms (preoccupation and withdrawal symptoms) and at least one of the five other symptoms (tolerance, lack of control, continued excessive use despite knowledge of negative effects/affects, loss of interests excluding internet, and use of the internet to escape or relieve a dysphoric mood) was established. Inter-rater reliability was 98%. **Conclusion** Our findings suggest that the proposed diagnostic criteria may be useful for the standardization of diagnostic criteria for IAD.

Keywords Diagnostic criteria, internet addiction, inter-rater reliability, pathological internet use, symptom criterion, validation.

INTRODUCTION

Behavioural addiction affects a vast number of individuals and occurs when people find themselves unable to control the frequency or amount of a previously harmless behaviour such as love, sex, gambling, work, internet and chatroom usage, shopping or exercise. Behavioural addictions are considered impulse-control disorders and share many underlying similarities to substance addictions, including aspects of tolerance, withdrawal, repeated unsuccessful attempts to cut back or quit and impairment in everyday life functioning [1].

Internet addiction appears to be a relatively common behavioural addiction, the prevalence of which has been estimated to range from 1% to approximately 14% [2–6]. Internet addiction is comprised of at least three subtypes: excessive gaming, sexual preoccupations and e-mail/text-messaging [2]. As noted by Block [2], all share the following four components: (i) excessive use, which may be associated with a loss of sense of time or a neglect of basic drives; (ii) withdrawal, leading to feelings of anger, tension and/or depression when the computer is inaccessible; (iii) tolerance, including the need for more advanced computer equipment and software and/or more hours of use; and (iv) negative social repercussions. Risk factors for internet addiction have been reported to include age and age of first exposure to internet use, accessing the internet for the purposes of gaming, social factors, having internet access at home, male gender, university level education and unsatisfactory financial situation [4–7].

New York psychiatrist Ivan Goldberg first proposed in 1995 that internet addiction may be considered a disorder, and since that time a number of researchers have published studies using the term 'internet addiction disorder' (IAD) [2,8–10]. Indeed, considerable effort has

been made to include 'internet addiction', 'pathological internet use (PIU)', 'problematic internet use' or any of its derivatives in the 2012 *Diagnostic and Statistical Manual version IV* (DSM-V) [2]. Excessive internet use is considered an impulse-control disorder that does not involve, but does share characteristics of, substance dependency. These include: salience (a preoccupation with the activity which dominantly occupies cognitive and emotional processing and behavior), mood modification (e.g. euphoria), tolerance (an ongoing process in which larger doses are needed progressively), withdrawal symptoms (tension, anxiety, depression, irritability), conflict (arguments, deception, social isolation and disintegration) and relapse [11,12].

Several diagnostic criteria and screening tools have been created in order to quantify this phenomenon: Young's eight-item Diagnostic Questionnaire of Internet Addiction (DQ) adapted from the DSM-IV criteria for pathological gambling [13], Young's 20-item Internet Addiction Test (IAT) adapted from criteria used to diagnose compulsive gambling and alcoholism [14] and other less frequently used dichotomous instruments, including those developed by Shapira *et al.* [15], Griffiths [16] and more recently, Ko *et al.* [17]. Young defines problematic non-essential internet usage (non-business/non-academic) resulting in significant impairment or distress by the presence of five (or more) of eight items on the DQ. This stringent cut-off score of five out of eight (as opposed to five out of 10 for pathological gambling), and its modified version [18], in which the presence of the first five symptoms and at least one of the last three symptoms is required (5 + 3 criteria) have, however, been shown to be overly rigorous, as the endorsement of three or four symptoms on Young's DQ differentiates adequately non-dependent from dependent internet use [19]. Such a conclusion, although not yet corroborated fully by other studies, suggests that use of the Young's DQ with current cut-off values results in conservative estimates. The fact that the original Young's DQ and the modified Young's DQ both use one cut-off point to determine internet dependency also precludes demonstration of variation in the severity of symptoms. IAD is regarded generally as a continuum in which internet users progress gradually from no or modest symptoms to exhibiting extreme pathological behaviours.

Internet addiction has become a major problem in China and other Asian countries in recent years. However, there are currently no standard diagnostic process or criteria available to identify clearly individuals with IAD. Hence, the goal of the present study was to develop diagnostic criteria for identifying IAD based on the clinical characteristics of a population of Chinese patients with IAD. Eight symptoms were identified on the basis of a primary survey and the validity and reliability

of these symptoms for discriminating non-dependent from dependent internet usage in the general population was determined.

METHODS

Development of the internet addiction diagnostic criteria

Based on clinical experience and previously published diagnostic criteria [12–18], eight primary clinical features of internet addiction were established by the investigators and surveyed in a total of 110 consecutive patients admitted to the Addiction Medicine Centre, General Hospital of Beijing Military Region between November 2005 and February 2006, for problematic internet use resulting in significant losses/impairments in psychosocial function (e.g. impaired learning, working and social functions). Patients were excluded from the study if they had physical health problems and/or other comorbid psychiatric disorders such as attention deficit hyperactivity disorder, conduct disorder, neurosis and substance use disorder. The eight items included: (1) pre-occupation with the internet; (2) withdrawal symptoms; (3) tolerance; (4) unsuccessful attempts to control internet use; (5) continued excessive internet use despite knowledge of negative psychosocial problems; (6) loss of interests, previous hobbies, entertainment as a result of, and with the exception of, internet use; (7) use of the internet to escape or relieve a dysphoric mood; and (8) and deception of family members, therapists or others. The proposed internet addiction symptom criterion are listed in Table 1. The mean age of participants was 17.9 ± 2.9 years (range: 12–30 years), and more than 91.8% ($n = 101$) were males. The average time of continuous non-essential internet use was 9.6 ± 2.8 hours (range: 4–18 hours, Table 2). Subjects were interviewed individually by experienced psychiatrists who used the diagnostic criteria as a checklist. The incidence of each item was calculated individually and in combination (concurrent presentation of either items 3–8 or items 1 and 2 combined). Only 48.2% ($n = 53$) of subjects endorsed item 8, and only 47.3% ($n = 52$) of subjects endorsed items 1, 2 and 8 concurrently. Item 8 was thus eliminated preliminarily from the diagnostic criteria.

From March 2006 to March 2007, 408 patients (training group) admitted to the same medical centre for pathological internet use affecting psychosocial function negatively were diagnosed using the proposed diagnostic criteria. Mean age was 17.6 ± 2.7 years (range: 12–27 years), and 92.6% ($n = 378$) were male. The average time of continuous non-essential internet use was 9.3 ± 3.2 hours (range: 2–24 hours, Table 2). One year after discharge from the hospital, 353 patients were followed-up

Table 1. Definitions of the eight internet addiction disorder (IAD) symptoms.

Symptom no.	Definition
1	Preoccupation: a strong desire for the internet. Thinking about previous online activity or anticipation of the next online session. Internet use is the dominant activity in daily life
2	Withdrawal: manifested by a dysphoric mood, anxiety, irritability and boredom after several days without internet activity
3	Tolerance: marked increase in internet use required to achieve satisfaction
4	Difficult to control: persistent desire and/or unsuccessful attempts to control, cut back or discontinue internet use
5	Disregard of harmful consequences: continued excessive use of internet despite knowledge of having a persistent or recurrent physical or psychological problems likely to have been caused or exacerbated by internet use
6	Social communications and interests are lost: loss of interests, previous hobbies, entertainment as a direct result of, and with the exception of, internet use
7	Alleviation of negative emotions: uses the internet to escape or relieve a dysphoric mood (e.g. feelings of helplessness, guilt, anxiety
8	Hiding from friends and relatives: deception of actual costs/time of internet involvement to family members, therapist and others

Table 2. Demographics and characteristics of subjects involved in the first stages of the study.

	Total (n = 518)		Survey stage (2005/11–2006/2) (n = 110)		Testing stage (2006/3–2007/3) (n = 408)	
Age (years)[a]	17.7 ± 2.7	(12, 30)	17.9 ± 2.9	(12, 30)	17.6 ± 2.7	(12, 27)
Gender[b]						
Male	479	92.5%	101	91.8%	378	92.6%
Female	39	7.5%	9	8.2%	30	7.4%
Education level[b]						
Elementary school	8	1.5%	2	1.8%	6	1.5%
Middle school	180	34.7%	38	34.5%	142	34.8%
High school	233	45.0%	46	41.8%	187	45.8%
College and beyond	97	18.7%	24	21.8%	73	17.9%
Working status[b]						
Student	198	38.2%	43	39.1%	155	38.0%
Working	12	2.3%	6	5.5%	6	1.5%
Suspended from school	100	19.3%	16	14.5%	84	20.6%
Quit school	186	35.9%	45	40.9%	141	34.6%
Unemployed	22	4.2%	0	0.0%	22	5.4%
Area of residence[b]						
North	153	29.5%	29	26.4%	124	30.4%
Northeast	52	10.0%	11	10.0%	41	10.0%
East	161	31.1%	37	33.6%	124	30.4%
Middle South	101	19.5%	21	19.1%	80	19.6%
Southwest	22	4.2%	6	5.5%	16	3.9%
Northwest	29	5.6%	6	5.5%	23	5.6%
Hours of continuous internet use for non-studying or non-working purposes[a]	9.4 ± 3.1	(2.24)	9.6 ± 2.8	(4.18)	9.3 ± 3.2	(2.24)

[a]Continuous parameters are presented as mean ± standard deviation (minimum, maximum). [b]Categorical parameters are presented as *n* (percentage).

and re-assessed. Most of the patients no longer met the diagnostic criteria of IAD. However, internet use dependency persisted in 11 patients (3.1%, 11/353) who suffered psychotic disorders (e.g. schizophrenia, borderline personality disorder), suggesting that those patients were misdiagnosed at first. At this point the diagnostic criteria

were revised by the research team to include four domains: symptom criterion (eight symptoms), clinically significant impairment criterion (functional impairments, including loss of social function), course criterion (duration of internet addiction must have lasted for 3 months, with at least 6 hours of non-essential internet

usage per day) and exclusion criterion (pathological internet use as accounted for by psychotic disorders). The minimum of 6 hours was determined with reference to the finding that average time of internet use was 9.3 ± 3.2 hours. The 3-month course criterion was chosen in order to facilitate identification of IAD in high school and college students and was based on the length of summer vacation (2 months) plus the first month of the new semester, which was the consensus of IAD experts in several medical centres.

Criterion-related validation and inter-rater reliability

To evaluate the discriminatory potential, criterion-related validation and diagnostic accuracy of the final proposed diagnostic criteria for internet addiction, two additional studies were conducted. From May 2007 to August 2007, 417 subjects selected randomly from four middles schools in Beijing were recruited for a study of criterion-related validation. Basic demographic information including age, gender and level of education was collected, as were data regarding the inclusion, impairment and course of criterion (if any). Twelve of these students were unable to complete the trial; hence 405 participants were included in the analysis. Each student was first diagnosed by one of four psychiatrists who was an expert in internet addiction, while the final diagnosis was made by a team of four psychiatrists. The investigator then made an independent judgement based on the symptom criterion list item-by-item. Validation was performed by comparing the diagnostic results from the four psychiatrists and the judgement of the investigator.

From August 2007 to December 2007 a total of 150 patients from out-patient departments in eight randomly selected medical centres around the country, whose chief complaint was preoccupation with the internet which affected study, work or general functioning, were recruited in order to assess internal consistency. Subjects were diagnosed independently by two experienced psychiatrists, according to the proposed diagnostic criteria. A total of 30 psychiatrists were involved in these assessments over the eight medical centres.

No participants in either the criterion-related validation or the inter-rater reliability study exhibited psychotic symptoms.

Statistical analysis

Continuous variables are presented as mean $\pm$ standard deviation (SD), while categorical variables are presented as frequency and percentage. Student's *t*-test, χ^2 or Fisher's test were used to examine differences between internet-dependent and non-dependent groups where appropriate. Area under the receiver operating characteristic (ROC) curve (AUC) was used to evaluate the accuracy

of the diagnostic results using a logistic regression model. Goodness-of-fit was defined as follows: excellent = AUC 0.9–1; good = AUC 0.8–0.9; fair = AUC 0.7–0.8; poor = AUC 0.6–0.7. Additionally, AUC was used to confirm which model was preferred. A higher AUC indicated a higher accuracy of diagnosis. Diagnostic results were measured for sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, negative likelihood ratio and the Youden index. Kappa coefficient and consistency rate were assessed to examine inter-rater reliability of the proposed diagnostic criteria (with the exception of item 8 of the symptom criterion, and the exclusion criterion, for lack of applicability). The cut-off point of the diagnostic criteria and the contents of the diagnostic criteria were determined after analysing all parameters tested. All statistical assessments were two-sided; a *P*-value less than 0.05 was considered statistically significant. Statistical analyses were performed using SAS version 9.1.3 statistics software (SAS Inc., Cary, NC, USA).

RESULTS

At the primary survey stage ($n = 110$), the incidence of each single and combined symptom combination was calculated (Table 3). Symptom 1 (96.4%) and symptom 2 (95.5%) occurred most frequently, while 95.5% of participants exhibited both symptoms 1 and 2. The incidence of individual symptoms 3–7 ranged from 72.7% to 86.4%. The incidence of symptom 8 (48.2%) was the lowest. The frequency of patients having at least three of

Table 3. Frequency of incidence for each symptom and symptom combination for internet addiction (IA) patients at survey stage ($n = 110$).

IA symptoms	n	(%)
Symptom 1	106	(96.4%)
Symptom 2	105	(95.5%)
Symptom 3	95	(86.4%)
Symptom 4	92	(83.6%)
Symptom 5	91	(82.7%)
Symptom 6	91	(82.7%)
Symptom 7	80	(72.7%)
Symptom 8	53	(48.2%)
Symptoms 1 and 2 appear at the same time	105	(95.5%)
Symptoms 1, 2 and 3 appear at the same time	92	(83.6%)
Symptoms 1, 2 and 4 appear at the same time	87	(79.1%)
Symptoms 1, 2 and 5 appear at the same time	86	(78.2%)
Symptoms 1, 2 and 6 appear at the same time	86	(78.2%)
Symptoms 1, 2 and 7 appear at the same time	77	(70.0%)
Symptoms 1, 2 and 8 appear at the same time	52	(47.3%)
Any three of eight symptoms appear at the same time	110	(100.0%)

the eight symptoms was 100%. The percentage of individuals having both symptoms 1 and 2, together with any one of symptoms 3–7, ranged between 70.0% and 83.6% (Table 3).

A total of 405 participants selected randomly from four middle schools in the Beijing area were included in the validation stage. Of these, 29 participants were diagnosed with IAD. Among the 405 participants, those in the IAD group (16.2 ± 1.3 years) were significantly older than those in the non-IAD group (15.4 ± 1.5 years, $P = 0.0031$); 79.3% of IAD patients were male, which was significantly higher than that in the non-IAD group (46.0%). No significant difference was found in education levels between the two groups. No participants met the exclusion criterion; however, only 13.8% of participants who were diagnosed as non-IAD showed clinically significant impairment, while 93.1% of participants in the IAD group did. Furthermore, 2.7% of participants who were diagnosed as non-IAD met the course criterion. In the IAD group, 28 participants (96.6%) spent at least 6 hours per day using the internet for non-work or study-related purposes, while only one participant (0.3%) in the non-IAD did the same (Table 4).

Table 5 shows the diagnostic accuracy of each individual symptom, symptom combination and combined symptoms plus the three additional criteria. Symptoms 1 and 2 showed the highest diagnostic accuracy rate (98.02% for both). With the occurrence of both symptoms 1 and 2, the diagnostic accuracy rate was as high as 99.01%. Symptom 8 showed 61.98% accuracy, the lowest accuracy rate among the symptoms. For any three of eight symptoms appearing at the same time, the diagnostic accuracy rate was a maximum of 96.3%, while the diagnostic sensitivity and specificity rates were a maximum of 100% and 96.01%, respectively. If the 2 + 1 rule (i.e. when symptoms 1 and 2 appeared at the same time, together with at least one of the symptoms among symptoms 3–7) was used together with the three additional criteria, the diagnostic accuracy rate reached 99.26%, while the diagnostic sensitivity and specificity reached 89.66% and 100%, respectively.

A symptom criterion list excluding symptom 8 was used in the third stage of the study. A total of 150 participants were included for the assessment of internal consistency. The average age was 17.7 years (SD = 2.8). The ratio of males to females was 9:1. The education level is shown in Table 6. The statistical results in Table 7 show that the average consistency rate of the diagnoses made by different psychiatrists based on individual symptoms on the questionnaire ranged between 89.3% (symptom 7) and 98% (symptom 2). The kappa coefficients fell into a range between 72.7% and 86.9%. The highest kappa coefficient was 86.9% for individual symptoms 1 and 2. The kappa coefficient reached 94.9% and 94.5% for the determination of the functional impairment and the criterion for the course of the disorder, respectively. The

Table 4. Characteristics of the internet addiction group (IAD) and normal group recruited for validation of the proposed diagnostic criteria.

Parameters	IAD (n = 29)		Non-IAD (n = 376)		P-value
Age (years)[a]	16.2 ± 1.3	(14.18)	15.4 ± 1.5	(12.19)	0.0031[*]
Gender[b]					
(Male, %)	23	(79.3%)	173	(46.0%)	0.0005[*]
(Female, %)	6	(20.7%)	203	(54.0%)	
Class[b]					
Grade 2 of junior middle school	3	(10.3%)	60	(16.0%)	0.2731
Grade 3 of junior middle school	2	(6.9%)	60	(16.0%)	
Grade 1 of high school	8	(27.6%)	85	(22.6%)	
Grade 2 of high school	11	(37.9%)	83	(22.1%)	
Grade 3 of high school	5	(17.2%)	88	(23.4%)	
Criterion for impairment[b]					
Did not meet	2	(6.9%)	324	(86.2%)	< 0.0001[*]
Met	27	(93.1%)	52	(13.8%)	
Criterion for the daily time of internet[b]					
Did not meet	1	(3.4%)	375	(99.7%)	< 0.0001[*]
Met	28	(96.6%)	1	(0.3%)	
Criterion for the course of disorder[b]					
Did not meet	0	(0.0%)	366	(97.3%)	< 0.0001[*]
Met	29	(100.0%)	10	(2.7%)	

*Significantly different between IAD and non-IAD groups under the significance level of 0.05. [a]Continuous parameters are presented as mean ± standard deviation (minimum, maximum). [b]Categorical parameters are presented as *n* (percentage).

Table 5. Evaluation of accuracy for detection of internet addiction group (IAD) from symptom criterion list and three clinical criteria ($n = 405$).

IAD symptom/clinical diagnostic criteria	IAD (n = 29)		Non-IAD (n = 376)		Sen.	Spec.	Accuracy	AUC	PPV	NPV	Youden	Positive LR[a]	Negative LR[b]
Symptom 1	28	(96.6%)	7	(1.9%)	96.55%	98.14%	98.02%	0.973	80.00%	99.73%	94.69%	51.86	0.04
Symptom 2	28	(96.6%)	7	(1.9%)	96.55%	98.14%	98.02%	0.973	80.00%	99.73%	94.69%	51.86	0.04
Symptom 3	23	(79.3%)	8	(2.1%)	79.31%	97.87%	96.54%	0.886	74.19%	98.40%	77.18%	37.28	0.21
Symptom 4	22	(75.9%)	9	(2.4%)	75.86%	97.61%	96.05%	0.867	70.97%	98.13%	73.47%	31.69	0.25
Symptom 5	22	(75.9%)	10	(2.7%)	75.86%	97.34%	95.80%	0.866	68.75%	98.12%	73.20%	28.52	0.25
Symptom 6	23	(79.3%)	11	(2.9%)	79.31%	97.07%	95.80%	0.882	67.65%	98.38%	76.38%	27.11	0.21
Symptom 7	21	(72.4%)	11	(2.9%)	72.41%	97.07%	95.31%	0.845	65.63%	97.86%	69.49%	24.75	0.28
Symptom 8	23	(79.3%)	148	(39.4%)	79.31%	60.64%	61.98%	0.700	13.45%	97.44%	39.95%	2.01	0.34
Symptoms 1 and 2 appeared at the same time	28	(96.6%)	3	(0.8%)	96.55%	99.20%	99.01%	0.979	90.32%	99.73%	95.75%	121.01	0.03
Symptoms 1, 2 and 3 appeared at the same time	23	(79.3%)	3	(0.8%)	79.31%	99.20%	97.78%	0.893	88.46%	98.42%	78.51%	99.40	0.21
Symptoms 1, 2 and 4 appeared at the same time	21	(72.4%)	3	(0.8%)	72.41%	99.20%	97.28%	0.858	87.50%	97.90%	71.62%	90.76	0.28
Symptoms 1, 2 and 5 appeared at the same time	21	(72.4%)	2	(0.5%)	72.41%	99.47%	97.53%	0.859	91.30%	97.91%	71.88%	136.14	0.28
Symptoms 1, 2 and 6 appeared at the same time	22	(75.9%)	1	(0.3%)	75.86%	99.73%	98.02%	0.878	95.65%	98.17%	75.60%	285.24	0.24
Symptoms 1, 2 and 7 appeared at the same time	21	(72.4%)	1	(0.3%)	72.41%	99.73%	97.78%	0.861	95.45%	97.91%	72.15%	272.28	0.28
Any three of eight symptoms appeared at the same time	29	(100.0%)	15	(4.0%)	100.00%	96.01%	96.30%	0.980	65.91%	100.00%	96.01%	25.07	0.00
Three clinical diagnostic criteria + (symptom 2 + 1 rule)	26	(89.7%)	0	(0.0%)	89.66%	100.00%	99.26%	0.948	100.00%	99.21%	89.66%	#DIV/0	0.10

Sen.: sensitivity; Spec.: specificity; AUC: area under receiver operating characteristic (ROC) curve; PPV: positive predicted value; NPV: negative predicted value; Youden: Youden index; Positive LR: positive likelihood ratio: Negative LR: negative likelihood ratio. [a]False positives (%) = (the number of patients who had a specific symptom and were then diagnosed with non-IAD/the number of patients who had a specific symptom) × 100%. [b]False negative (%) = (the number of patients who did not have a specific symptom but were diagnosed with IAD/the number of patients who did not have a specific symptom) × 100%.

Table 6. Demographics of participants in third stage (inter-consistency testing, *n* = 150).

Parameters	*n = 150*	
Age (years)[a]	17.7 ± 2.8	(13.27)
Gender[b]		
Male	139	(92.7%)
Female	11	(7.3%)
Education level[b]		
Middle school	54	(36.0%)
High school	65	(43.3%)
College and beyond	31	(20.7%)

[a]Continuous parameters are presented as mean ± standard deviation (minimum, maximum). [b]Categorical parameters are presented as *n* (percentage).

Table 7. Consistency among different psychiatrists (*n* = 150).

IAD symptoms/clinical criteria/diagnostic results of IAD	Consistency rate[a]	Kappa
Symptom 1	95.3%	86.9%
Symptom 2	98.0%	86.9%
Symptom 3	96.7%	83.0%
Symptom 4	94.7%	81.4%
Symptom 5	94.0%	82.3%
Symptom 6	93.3%	80.2%
Symptom 7	89.3%	72.7%
Impairment degree	99.3%	94.9%
Criterion of the course of disorder	98.7%	94.5%
Diagnosis of IAD		
All psychiatrists	98.0%	91.9%
Chief psychiatrists	98.8%	94.6%
Attending psychiatrists	97.5%	89.5%
Residents	96.2%	88.5%

[a]The consistency rate indicates the inter-rater consistency for diagnoses between two psychiatrists who diagnosed the same patient independently. IAD: internet addiction disorder.

overall statistical results showed that the consistency rate between two psychiatrists was 98.0% on the final diagnosis of IAD. The kappa coefficient was 91.9%. The consistency rates of the diagnosis among the chief psychiatrists were 98.8%, 97.5% for attending psychiatrists and 96.2% for residents. The kappa coefficients were 94.6%, 89.5% and 88.5%, respectively.

DISCUSSION

The objective of this study was to develop diagnostic criteria for IAD and to evaluate the criterion-related validity and discriminatory potential of the criteria. Our final proposed diagnostic criteria, established after a series of statistical analyses evaluating diagnostic accuracy, specificity, sensitivity, positive and negative predicative rate and inter-rater reliability, consist of seven items of symptom criteria and three additional criteria: exclusion,

clinically significant impairment and course (Table 8). We believe that the inclusion of these three additional domains may allow for a more specific and accurate approach to diagnosis.

Items 1–8 of our initial symptom criterion list included those used similarly in other diagnostic criteria such as Young's DQ [13] and those of Ko *et al.* [17]. Item 5 of the Young's DQ ('Has stayed online longer than originally intended') was omitted. Unlike Ko *et al.*, in items 5 and 7 of our symptom criterion list, 'use of internet for a period of time longer than expected' and 'excessive time spent on internet activities and leaving the internet'—the variable 'time', was defined in terms of daily internet use for at least 6 hours, and met the symptom criterion for at least 3 months. Item 8 of Ko *et al.*'s diagnostic criteria ('excessive effort spent on activities necessary to obtain access to the internet') was also omitted.

We have suggested previously that due to cultural differences, the use of the internet as a conduit for social interaction in China is generally viewed favourably [20]. Indeed, this is evidenced by the widespread availability of internet cafes providing access to a variety of massive multi-player online games and the high prevalence rate of IAD among Chinese adolescents (13.7% or approximately 10 million Chinese teenagers) [21]. Fears about the increasing number of adolescents with IAD have escalated to the extent that the Chinese government implemented an 'anti-online game addiction system' to discourage more than 3 hours of daily game use in April 2007 [21]. The general acceptability of internet use and its local accessibility may also explain the low diagnostic accuracy, sensitivity and specificity of item 8 (deception of actual costs/time of internet involvement to family members, therapist and others). It is also possible that the notion of internet addiction as a clinical disorder with real negative consequences remains underdeveloped in China.

Comparisons between the contents of the diagnostic criteria and the cut-off score proposed by those who follow Young's DQ model are premature, as there is no standardized instrument that effectively measures IAD cross-culturally. There are, however, important distinctions to make in critiquing our proposed diagnostic criteria. For the cut-off score we employed a 2 + 1 rule, in which the client had only to endorse the first two items (preoccupation, withdrawal symptoms) and one or more of the last five items. This resulted in the best diagnostic accuracy (99.26%), specificity (100.0%) and positive predictive value (100.0%). This finding must be interpreted cautiously, however, as unlike previous studies we did not employ the use of validated inventories which produce a dichotomous classification, such as Young's 20-item IAT [14], Morahan-Martin and Schumacher's PIU test [22] or the Chen Internet Addiction Scale [23]. Instead, we

Table 8. Proposed internet addiction diagnostic criteria.

(a) Symptom criterion
All the following must be present:
Preoccupation with the internet (thinks about previous online activity or anticipates next online session)
Withdrawal, as manifested by a dysphoric mood, anxiety, irritability and boredom after several days without internet activity

At least one (or more) of the following:
Tolerance, marked increase in internet use required to achieve satisfaction
Persistent desire and/or unsuccessful attempts to control, cut back or discontinue internet use
Continued excessive use of internet despite knowledge of having a persistent or recurrent physical or psychological problem likely
  to have been caused or exacerbated by internet use
Loss of interests, previous hobbies, entertainment as a direct result of, and with the exception of, internet use
Uses the internet to escape or relieve a dysphoric mood (e.g. feelings of helplessness, guilt, anxiety)

(b) Exclusion criterion
Excessive internet use is not better accounted for by psychotic disorders or bipolar I disorder

(c) Clinically significant impairment criterion
Functional impairments (reduced social, academic, working ability), including loss of a significant relationship, job, educational or
  career opportunities

(d) Course criterion
Duration of internet addiction must have lasted for an excess of 3 months, with at least 6 hours of internet usage
  (non-business/non-academic) per day

relied exclusively upon the global clinical impressions of IAD as determined by the psychiatrists before they attempted to re-diagnose the same subjects according to the proposed diagnostic criteria. Moreover, the cut-off score of 3 months may have been overly lenient, resulting in an over-representation in the proportion of individuals with internet dependency problematic enough to warrant a diagnosis of IAD [24].

Internet overuse may be considered as the subthreshold for diagnosis. Individuals who overuse the internet may be still be impaired by their abnormal behaviour, and may develop IAD in the long term. Early intervention for patients with internet overuse may prevent the development of more serious addictive behaviour in the future. Patients with internet overuse may be diagnosed using our diagnostic criteria. The severity of disorder can also be classified based on how well they meet the criteria, and a system of dimensional diagnosis can be established. The purpose of dimensional diagnosis is to utilize public health resources more effectively, such that patients with subthreshold disorders such as internet overuse may not require admission to a medical centre for treatment. The threshold severity of symptoms for which intervention is warranted remains unknown. It is our ultimate goal to establish categorical criteria based on dimensional components, together with our diagnostic criteria and comorbid psychiatric disorders. Eventually, we hope to integrate prevention, early identification, management, improvement and cure into one IAD medical care plan.

This study has a number of limitations that warrant mention. Only 29 of 405 high school subjects were identified as having IAD in the validation stage of the study. There is an obvious need for a larger-scale study. Indeed, based on our findings regarding the prevalence of IAD, more than 1000 subjects should be recruited to obtain sufficient statistical power. The fact that data were obtained from a single medical centre and that high school students were recruited mainly from the Beijing area are further limitations. However, most of the patients in our centre were referred from a nation-wide network of hospitals, and we note that inter-rater reliability was determined by recruiting patients from eight different medical centres around the country. Although the final judgement regarding diagnosis in the validation stage of the study was made by a diagnostic team of four psychiatrists, each student was diagnosed initially by a single psychiatrist. Hence there may have been some degree of bias between different psychiatrists. A more objective rating scale similar to the Hamilton Depression Rating Scale for Depression or the Beck Depression Inventory should be established. Such a scale should incorporate factors including duration of internet addiction, time spent using the internet, nature of problematic internet use, comorbid psychiatric disorders, behavioural disposition, health status, social skills, school/work performance and family variables. An item-response theory analysis of the items in our inventory would be particularly helpful in the differentiation of addiction from overuse and in assessing the overall validity of the diagnostic criteria, as has been performed with other diagnostic entities in the DSM.

The diagnostic criteria established in this study should be regarded only as a first step in the development of standardized diagnostic criteria for internet addiction.

More work is needed in determining the true incidence and prevalence of the condition cross-culturally and in clarifying the natural history of this problematic behavior. While these proposed diagnostic criteria do not resolve the potential problems with Young's DQ, they may serve as a reference for future studies in which the objective would be to develop and rework criteria for the diagnosis of IAD.

In conclusion, patients admitted to the medical centre for problematic internet use resulting in significant losses/impairments in psychosocial function had at least three of eight symptoms listed in our symptom criterion list. Preoccupation and withdrawal were the main characteristics of IAD. These two symptoms showed the highest rate of diagnostic accuracy. When a patient had both symptoms 1 and 2, together with any one of symptoms 3–7, the so-called 2 + 1 rule, the diagnostic accuracy was very high. If the 2 + 1 rule were used as symptom criterion and the patient also met three additional criteria (exclusion, clinically significant impairment and course), the diagnostic accuracy rate reached a maximum of 99.26%, and the diagnostic specificity reached 100%. The consistency rate between any two psychiatrists showed almost perfect agreement, suggesting that the diagnosis of IAD should not be markedly different among raters in different medical centres.

Declarations of interest

None.

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