



ORIGINAL ARTICLE

Risks of Abnormal Internet Use Among Adolescents with Attention-deficit/Hyperactivity Disorder



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Purpose: This aim of the study is to investigate the risks among adolescents with attention-deficit/hyperactivity disorder (ADHD) who develop compulsive Internet use (CIU) and adolescents who do not develop CIU.

Methods: Seventy-eight adolescents with ADHD completed general demographic questionnaires that included information on body mass index, subtype, comorbidity, and behavioral problems. The family characteristics included information on parental ADHD diagnosis, psychiatric symptoms, and media exposure problems. The respondents were categorized as ADHD with CIU or ADHD with non-CIU, based on the Internet addiction cutoff point by the standardized measurements of the Chen Internet Addiction Scale.

Results: The results revealed 12.8% of the adolescents with ADHD had CIU. They were characterized by average height, tendency to withdraw, having a young father, and playing computer games for more than 1 hour daily.

Conclusion: More attention to ADHD adolescents with CIU is warranted. An early intervention program is suggested for their social withdrawal tendency.

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1. Introduction

During the past decade, the problems of compulsive internet use (CIU) have emerged around the world. The prevalence rate of CIU among adolescents varies and is 1.5–8.2% in the United States and Europe.¹ Many students have a CIU problem, but whether CIU is an independent behavior problem or a disease secondary to a psychiatric disorder is controversial.² In the *Diagnostic and Statistical Manual of Mental Disorders–5* (DSM-5) Section III, IAU is listed tentatively as Internet gaming disorder (IGD).³ There has been tremendous interest in the association between CIU and various psychiatric problems such as emotional problems, depressive problems, hostility, impulsivity, and aggressive behavior.^{4–8} Using meta-analysis, Ho et al⁹ reported that CIU may be associated with ADHD in youths. In addition, growing evidence has recently

suggested the screen/Internet culture has a potential hazard impact toward developing children with ADHD, and results in the loss of time for other necessary development. However, very little attention has been specifically focused on the perspective of children with ADHD and their family. It is not very clear how the core symptoms of ADHD and oppositional–defiant disorder (ODD) interact with screen/Internet abuse.¹⁰

Empirical evidence shows family risks should be analyzed.¹¹ Chan et al¹² reported that if a family allows their adolescents with ADHD to play computer games more than 1 hour a day, their children could develop a CIU problem.¹² Furthermore, family characteristics or psychopathology, ADHD combined subtype, ODD, and male sex are risk factors that may increase symptom severity of ADHD and need to be further analyzed while exploring the underlying relationship between ADHD and CIU.^{13–15}

The purpose of this study is to investigate how the following two types of risks influence the development of CIU in a psychiatric outpatient ADHD adolescent population: (1) early adolescent psychopathology [e.g., age, sex, body weight, body height, body mass index (BMI) value, subtype, comorbidity, school problems such as school performance and interpersonal relationship, nail biting,

Conflicts of interest: None.

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treatment adherence] and (2) external family or environmental risks (e.g., parental mental illness, family growth atmosphere). This study may help change clinician's concern into awareness about what kind of adolescent with ADHD and their family characteristics are associated with compulsive Internet overuse during clinical practice.

2. Methods

2.1. Participants and data collection

Seventy-eight consecutive families with an early adolescent with ADHD were recruited for this study from the child–adolescent psychiatric outpatient department of Mackay Memorial Hospital in Taipei, Taiwan. The ADHD diagnosis was confirmed by a board certified child psychiatrist through diagnostic interviews using the *Diagnostic and Statistical Manual of Mental Disorders-IV-TR* (DSM-IV) criteria.¹⁶ Informed consent was obtained from all participants. Participants were excluded if the children had organic psychosis, autism, mental retardation, or neurological or systemic disease. Patients for this study were recruited from the outpatient unit of Mackay Memorial Hospital, which is a major medical center in Taipei, Taiwan. The hospital's Institutional Review Boards (IRB) approved the design of the study.

2.2. Methods

Children with ADHD and their parents filled out a designed demographic questionnaire using standardized measurements, which included the Chen Internet Addiction Scale for Internet addiction; the Swanson, Nolan, and Pelham, Version IV ADHD questionnaire (SNAP-IV) for ADHD symptoms; the Child Behavior Checklist (CBCL) for common child behavioral problems; the Adult ADHD Self-rating Scale (ASRS) to determine if the parent has ADHD; and Symptom Check List (SCL-90) for parental psychiatric symptoms. Demographic data collected on the children with ADHD included age, sex, ADHD subtypes, comorbid conditions, school performance, interpersonal relationships, family characteristics (e.g., father's age, mother's age, socio-economic status). Knowledge of ADHD, and marital discord were rated by choosing “yes” or “no” to the questions “whether they know what ADHD is”, and the parent's subjective feelings toward marriage (satisfied or not satisfied). Media exposure and computer-related behavior was assessed using eight “yes/no” questions administered by the clinical staff. These questions included the duration of Internet use (≥ 1 hour or < 1 hour), time spent watching TV (≥ 1 hour or < 1 hour), playing computer games (≥ 1 hour or < 1 hour), and playing Internet games (≥ 1 hour or < 1 hour).

2.3. Chen Internet Addiction Scale

The Chen Internet Addiction Scale (CIAS) is a self-reported questionnaire with good reliability and validity consisting of 26 questions on a four-point scale that assesses the five dimensions of Internet use-related problems: compulsive use, withdrawal, tolerance, interpersonal and health problems, and time management problems.¹⁷ The internal reliability of the scale and the subscales in the original study ranged from 0.79 to 0.93. Higher CIAS scores indicated increased severity of Internet addiction. The CIAS yielded a good diagnostic accuracy of 89.6%. The screening cutoff point had high sensitivity (85.6%) and the diagnostic cutoff point had the highest diagnostic accuracy, and correctly classified 87.6% of participants.

2.4. Swanson, Nolan, and Pelham, Version IV questionnaire

The SNAP-IV questionnaire consists of the following items: inattention, hyperactivity/impulsivity, and oppositional symptoms. These items reflect the core symptoms of ADHD and oppositional–defiant disorder as defined in DSM-IV. The psychometric properties of SNAP-IV–Chinese in Taiwan has shown intraclass correlation coefficients for the three subscales of 0.59–0.72 for the parent form and 0.60–0.84 for the teacher form. All subscales of the parent and teacher forms provide an excellent internal consistency with a Cronbach α greater than 0.88.¹⁸

2.5. Child Behavior Checklist

The CBCL is designed to obtain competencies and behavior problems of children aged 4–18 years. The questionnaires, which are completed by the parents, contain 118 items to assess specific behavioral and emotional problems. The CBCL was translated into Chinese via a two-stage translation process.¹⁹ The internal consistency and 1-month test–retest reliability (all α values and reliabilities > 0.6 , except for thought problems) of this Chinese version is satisfactory for Taiwanese patients.²⁰ In the interest of parsimony, the present study only analyzed the following 10 scales: aggressive behaviors, attention problems, anxiety/depression, social problems, delinquent behaviors, somatic complaints, thought problems, withdrawal, internalization tendency, and externalization tendency.

2.6. Adult ADHD Self-rating Scale

The Adult ADHD Self-rating Scale (ASRS) symptom checklist has been developed in conjunction with the World Health Organization (WHO), and the workgroup on Adult ADHD that included Lenard Adler, Ronald C. Kessler, and Thomas Spencer.²¹ It is a tool to help screen for ADHD in adult patients and is consistent with the DSM-IV criteria. A score of 0–16 indicates a person does not have ADHD; 17–23 indicates a person has ADHD; and 24 or above indicates severe ADHD.

2.7. Parental Symptoms

We measured the parents' self-reported symptoms on nine primary dimensions: somatization, obsessive-compulsive behavior, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoses. The Symptom Checklist-90-Revised (SCL-90-R) is a 90-item self-report system developed in the 1980s by Derogatis.²² Three global indices were used: the Global Severity Index (GSI), Positive Symptom Total (PST), and Positive Symptom Distress Index (PSDI). The GSI is the average rating applied to all 90 items. The PST is derived by counting the number of items endorsed with a positive response. The PSDI is the average of only the items receiving a positive response. The SCL-90-R was translated into Chinese in 1982 and has good psychometric measurement reliability with a Cronbach α coefficient range of 0.77–0.90. The Chinese version of this scale has been widely applied in psychiatric ADHD studies and in nonpsychiatric clinical studies in Taiwan.^{23,24}

2.8. Statistical analyses

The Mann–Whitney *U* test was used to compare BMI value, CBCL, parents' ADHD score, and the parental symptom score (SCL-90). Fisher's exact test was used for categorical variables' comparisons. We used the Pearson coefficient to evaluate the correlation of the parental symptom score. Multivariate logistic stepwise regression

analysis was used to analyze the CIAS total score, CIAS-symptom tendency, CIAS-related problem and Internet addiction. A multiple correlation analysis was conducted separately. For all analyses, statistical significance was set at $p < 0.05$.

3. Results

3.1. Demographic characteristics

Of the 78 ADHD children, 10 (12.8%) children were classified in the compulsive Internet users group (CIU group) and remaining 68 children were classified in the noncompulsive Internet users (NCIU group), based on the cutoff point of 57 on the CIAS score developed by Ko et al.²⁵ As Table 1 shows, 10 (12.8%) of 78 ADHD adolescents visiting the outpatient department had CIU. The ADHD adolescents in the CIU group was significantly taller than those in the NCIU ($p = 0.02$). The mean age of the total sample was 13.22 ± 3.04 years, and 60.8% of them were early adolescents (age range, 10–14 years) (data not shown). The ADHD adolescents of older school grade (junior high or senior high school age) were more likely to be classified in the CIU group ($p = 0.014$). No significant association was noted between Internet addiction and intrinsic risks (e.g., age, sex, symptom severity expressed as subtype, comorbidity) or extrinsic risks (e.g., BMI, birth order, sibling with ADHD, school performance, interpersonal relationship, or nail biting), or other common behavioral problems in ADHD adolescents (Table 2).

3.2. Media exposure problems

The CIU group was more likely to play computer games for more than one hour per day ($p < 0.05$) (Table 3).

Table 1 Demographic features of ADHD with compulsive Internet use and ADHD with noncompulsive Internet use

	CIU M ± SD (n = 10)	Non-CIU M ± SD (n = 68)
Body height*	153.90 ± 13.78	139.76 ± 16.66
Body weight	48.96 ± 23.62	37.27 ± 14.00
BMI	20.25 ± 6.43	17.95 ± 3.30
Age*	14.70 ± 3.02	12.98 ± 3.01
Sex (n = 74)		
Boy	10	51
Girl	0	13
Grade (n = 71)		
Elementary*	3	48
Junior	4	11
Senior	2	3
Birth order (n = 65)		
Only child	0	10
None or only child	8	47
Sibling ADHD (n = 43)		
No	5	29
Yes	1	8
SP (n = 65)		
Good	3	37
Bad	3	22
IR (n = 65)		
Good	4	47
Bad	2	12
Nail biting (n = 66)		
Yes	2	26
No	4	34

ADHD = attention deficit–hyperactivity disorder; CIU = compulsive Internet use; IR = Interpersonal relationship; M = mean; non-CIU = noncompulsive Internet use; SD = standard deviation; SP = school performance.

* Indicates $p < 0.05$.

Table 2 Symptom severity (subtype and comorbidity) and child behavior problems in ADHD with compulsive Internet use and ADHD with noncompulsive Internet use

		CIU	Non-CIU
Subtype (62)	Combined	5	26
	Inattentive	3	28
	Yes	7	35
Comorbidity (n = 66)	No	2	20
CBCL			
		15.38 ± 5.49	12.41 ± 7.5
Aggression		6.08 ± 4.28	6.32 ± 5.04
Anxiety/depression		10.40 ± 2.67	9.28 ± 3.83
Attention problem		6.27 ± 2.99	4.60 ± 3.39
Delinquency		4.10 ± 2.08	5.08 ± 3.23
Social problem		2.90 ± 3.73	2.01 ± 2.43
Somatic complaint		2.90 ± 1.66	2.54 ± 1.72
Thought problem		5.60 ± 2.80	4.98 ± 2.71
Withdrawal		14.58 ± 9.35	13.31 ± 8.31
Internalization		21.65 ± 7.82	17.01 ± 10.07
Externalization			

ADHD = attention deficit–hyperactivity disorder; CBCL = Child Behavior Check List; CIU = compulsive Internet use; non-CIU = noncompulsive Internet use.

3.3. Environmental family characteristics

No significant difference was noted between the family risks of ADHD adolescents with CIU and the NCIU group (Tables 4 and 5). A correlation matrix of ASRS, CBCL, CIAS, and SCL-90 was used to test associations among participants in the study (data not shown). We found that many significant correlations existed, regardless of the total score or the time construction surface score.

3.4. Associated risk factors among CIU

A statistical significant correlation with “plays computer games more than one hour every day” was discovered on further analysis using a stepwise regression to detect multiple coefficient correlations between the core Internet addiction score (i.e., sum of compulsion + withdrawal and tolerance) ($\beta = 7.266, p = 0.031$), IA-related problems (i.e., sum of interpersonal and health problems + time management problems) ($\beta = 0.299, p = 0.020$), and Internet abnormal use tendency (i.e., sum of compulsion + withdrawal and tolerance and interpersonal and health problems + time management problems) ($\beta = 0.279, p = 0.031$). In addition, IA-core symptoms (sum of compulsion + withdrawal + tolerance) was primarily correlated with ADHD children’s withdrawal tendency from CBCL data

Table 3 Media exposure of adolescents with ADHD with compulsive Internet use and ADHD with noncompulsive Internet use

	Duration (h)	CIU	Non-CIU
(1) Internet	None	3	30
	≥1	1	8
	<1	2	13
(2) Watching television	None	0	13
	≥1	2	29
	<1	4	13
(3) Computer game*	None	0	31
	≥1	2	7
	<1	4	13
(4) Internet computer game*	None	1	31
	≥1	2	6
	<1	3	12
(1) + (2) + (3) + (4)	Non	0	7
	≥1	4	26
	<1	2	13

ADHD = attention deficit–hyperactivity disorder; CIU = compulsive internet use; non-CIU = noncompulsive internet use.

*Indicates $p < 0.05$.

Table 4 Family characteristics of ADHD with compulsive Internet use and ADHD with noncompulsive Internet use

		CIU	
		Yes	No
Father's age		27.00 ± 21.95	38.75 ± 11.53
Mother's age		39.00 ± 5.83	38.80 ± 14.61
Socio-economic status (n = 78)	III	10	67
	II	0	1
Understanding of ADHD (n = 66)	Yes	4	50
	No	2	10
Marital status (n = 60)	Satisfied	4	48
	None	1	7
Attending parenting training therapy (n = 63)	Yes	2	21
	No	3	16
	Some	1	20
Stimulant adherence (n = 67)	Good	6	51
	Bad	0	10
Stimulant response (n = 60)	Good	3	47
	Bad	2	8
Impression toward parent (n = 53)	Good	4	48
	Bad	0	1
Compliance (n = 52)	Good	2	43
	Bad	1	6

ADHD = attention deficit–hyperactivity disorder; CIU = compulsive internet use; non-CIU = noncompulsive internet use.

(beta = 0.088; $p = 0.044$) and with father's age (beta = -0.024 ; $p = 0.047$).

4. Discussion

These preliminary results exploring the potential risk factors (i.e., overall psychopathology, family characteristics) of adolescents with ADHD and abnormal Internet use in an outpatient setting identified 12.8% of individuals among ADHD adolescents who fulfilled the criteria for an Internet addiction problem. The present results indicated that ADHD adolescents addicted to Internet were taller, in early adolescence (junior high or senior high school age), and often were characterized by a withdrawal tendency, compared to adolescents with ADHD without a CIU problem. To sum up, our results suggest that having a younger father was the most significant parental risk factor for developing Internet addiction in youths with ADHD. Addiction core symptoms and related problem were correlated with how much time an adolescent was exposed to media.

Table 5 Parental ADHD and parental symptoms in ADHD with compulsive Internet use and ADHD with noncompulsive Internet use

	CIU	Non-CIU
	M ± SD (N = 10)	M ± SD (N = 68)
ASRS-inattentive	20.20 ± 5.63	18.97 ± 6.59
ASRS-hyperactivity/impulsivity	19.80 ± 7.94	17.76 ± 6.26
ASRS-total	40.00 ± 12.93	36.73 ± 12.03
Somatization	7.00 ± 6.80	6.88 ± 7.32
Interpersonal sensitivity	7.30 ± 7.35	4.76 ± 4.76
Obsessive-compulsive	10.22 ± 8.33	7.70 ± 6.07
Depression	10.60 ± 8.86	8.37 ± 8.48
Anxiety	5.78 ± 6.92	4.23 ± 5.13
Hostility	4.70 ± 2.98	3.91 ± 3.93
Phobic anxiety	2.80 ± 3.88	1.62 ± 2.36
Paranoid ideation	4.70 ± 3.59	2.98 ± 2.99
Psychoticism	4.60 ± 3.92	3.08 ± 3.62
Total score	62.20 ± 48.21	46.62 ± 41.65
Positive symptom total	39.90 ± 22.73	30.34 ± 20.70
PSDI	1.40 ± 0.39	1.37 ± 0.44
Global severity index	0.69 ± 0.54	0.52 ± 0.46

ADHD = attention deficit–hyperactivity disorder; ASRS = ADHD Self-rating Scale; CIU = compulsive internet use; M = mean; non-CIU = noncompulsive internet use; PSDI = Positive Symptom Distress Index; SD = standard deviation.

Adolescents with ADHD who spent more than 1 hour a day playing computer games were especially at risk for developing Internet addiction.

A recent Turkish study has indicated that the severity of ADHD symptoms could predict the severity of abnormal Internet use.²⁶ However, in the present study, we found no relationship between the children's ADHD symptom severity risks (e.g., male sex, combined subtype, comorbidity problem) and abnormal Internet use. However, a sex proportion difference in other Internet addiction screening studies has been discussed (e.g., male: female ratio of 4.8:1 in China²⁷ and 3.8:1 in the United States²⁸). This study also evaluated the difference in stimulant response or compliance between the two groups. However, we did not notice that Internet-addicted adolescents had poor stimulant response. Our results cannot confirm the report of Petersen et al,¹¹ which suggests that severe Internet problem in symptomatic adolescents is because of insufficient stimulant treatment.

Our findings are inconsistent with a previous screening study demonstrating that hostility, depression, aggression, and social phobia are common characteristics among college students with abnormal Internet use. However, we found withdrawal characteristics among early adolescents of an outpatient psychiatric service after we ruled out all ADHD risks about the adolescent itself. This finding is interestingly in line with the general description of Internet-dependent adolescents living a “sedentary lifestyle”. It is expected that addicted youths live more sedentary and appear less impulsive or outgoing. Hence, in this study they appear as more withdrawn, compared with youths with ADHD without CIU. However, this study result cannot distinguish whether withdrawal is a character trait before or after Internet addiction among these adolescents because this study's design was cross-sectional and examined their behavior problem. However, if an early adolescent is living sedentarily or withdraws from life under the mask of Internet addiction, this may be a tremendous hindrance on his or her development in social interactions. Therefore, the child and adolescent psychiatrist should be aware that possibly 12.8% of youths with ADHD in an outpatient service concurrently having abnormal Internet use. It involves essentially asking how much of their time is spent on playing games to rule out whether they live a sedentary lifestyle, which needs to be addressed during clinical practice.

Parents permitting their children to spend more time playing computer games may lead to abnormal Internet use.¹² Our stepwise regression analysis corroborates previous studies on video games and Internet addiction. Our finding is congruent with early reports^{12,29} that indicate if parents permit their children to spend more time specifically playing computer games, then the core symptom (sum of compulsion + withdrawal + tolerance) and related problem (sum of interpersonal and health problems + time management problems) of Internet addiction would be followed while we ruled out all other types of risks of playing on the computer. Such association between symptoms of abnormal Internet use and playing games is in line with Bioulac's study that indicated the vulnerability of developing abnormal Internet use is especially associated with playing computer games.²⁹

From the background family member analysis, we found that the father's age of these addicted children is 11 years younger than children in the nonaddicted group. Our interpretation of this finding is that younger fathers can identify an overuse computer problem because they themselves grew up in days of “playing computer as popular activity” in the past 30 years.

It has been suggested BMI should be considered together with body weight or body height; in the present study we have discussed metabolic problems in adolescents with ADHD.³⁰ The BMI is likely to increase because these children live a sedentary lifestyle

without exercise.¹² We did not find such association; we noticed instead the Internet-addicted early adolescents with ADHD are only taller in height. We would like to suggest that if addicted youths overplay computer games and show addiction-related symptoms (sum of interpersonal and health problems + time management problems) and sometimes forget to eat a regular meal, they will become only taller but have no increasing BMI problem. Further study would be needed on metabolic problems of addicted youths in the future.

Limitations of this study design were its small sample size, which was clinically based, convenient sampling, and the involvement of only one general hospital. Some demographic data, which included simple “yes” or “no” responses, may decrease the reliability of the questionnaire. This study is based on a convenient sample and lacks data on refusal to participate in the study or whether the sample is reflective of the general population. Another drawback of this method is more than 78 families reported complete data and were examined. The authors admit that we underestimated the difficulty on collecting data on Internet addiction, and the 78 families used in this study proved to be a challenge because many parents of addicted ADHD adolescents refused to face the addiction issue. The limited sample size in this study may result in a type II error, and we are unable to provide further interpretation. However, our data may begin to fill the special need for many recently addicted adolescents with ADHD.

We suggest that child and adolescent psychiatric experts in Taiwan should diagnose CIU among adolescents with ADHD, be conscious of a vicious invisible cycle that starts with a withdrawal tendency among a youth with ADHD that leads to a sedentary lifestyle, and further progresses into spending increasing amounts of time playing computer games, which eventually leads to addiction. Further cooperation with parents to devise a culturally appropriate study or ADHD parenting counseling guidelines toward Internet addiction toward early adolescents with ADHD is emergently needed.

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