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Original Article

Boredom proneness and its correlation with Internet addiction and Internet activities in adolescents with attention-deficit/hyperactivity disorder

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Abstract This study examined the associations of boredom proneness with Internet addiction and activities as well as the moderators for such associations in adolescents with attention-deficit/hyperactivity disorder (ADHD). In total, 300 adolescents with ADHD participated in this study. Their Internet addiction, the scores for lack of external and internal stimulation on the Boredom Proneness Scale-short form (BPS-SF), ADHD, parental characteristics, and the types of Internet activities were examined. The associations of boredom proneness with Internet addiction and Internet activities and the moderators of the associations were examined using logistic regression analyses. Higher scores for lack of external stimulation on the BPS-SF were significantly associated with a higher risk of Internet addiction. Maternal occupational socio-economic status moderated the association of lack of external stimulation with Internet addiction. Higher scores for lack of external stimulation were significantly associated with a high tendency to engage in online gaming, whereas higher scores for lack of internal stimulation were significantly associated with a low tendency to engage in online studies. Lack of external stimulation on the BPS-SF should be considered a target in prevention and intervention programs for Internet addiction among adolescents with ADHD.

Conflicts of interest: All authors declare no conflicts of interests.

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Introduction

Internet addiction has substantial adverse effects on physical and mental health and interpersonal relationships; it also diminishes the academic performance of adolescents [1]. Attention-deficit/hyperactivity disorder (ADHD) is the most common psychiatric disorder among adolescents with Internet addiction [2]. The risk of Internet addiction was significantly associated with the severity of ADHD symptoms among adolescents in community [3]. A prospective community study also indicated that ADHD predicts the occurrence of Internet addiction in adolescents during a 2-year follow-up period [4]. The results of previous studies support the observation that Internet addiction warrants early prevention in adolescents with ADHD.

Boredom proneness is one of the possible etiologies responsible for the high risk of Internet addiction among individuals with ADHD [5]. Mikulas and Vodanovich [6] defined boredom as "a state of relatively low arousal and dissatisfaction, which is attributed to an inadequately stimulating environment." Perkins and Hill [7] expounded boredom as "cognitive changes in the direction of less differentiated and more homogeneous construing give rise to a state of subjective monotony which induces, or perhaps even represents, the state." Boredom has been found to be significantly associated with problems of negative affect, behavior, interpersonal relationships, and occupations [8]. In addition, boredom has been identified as one of common causes of addictive substance use [9]. Boredom is one of the common triggers of intensive Internet use [10], and it is significantly associated with Internet addiction [11] and Internet-related functional impairment [12] in university students. High boredom proneness is also one of the risk factors for online gambling in young adults [13].

High boredom proneness has been considered one of the core symptoms in individuals with ADHD, which usually results in impaired academic function and difficulties in interpersonal relationships [14]. Adults with high boredom proneness performed poorly on measures of sustained attention and exhibited increased symptoms of ADHD [15]. Given that Internet use can provide rapid responses, immediate rewards, and multiple windows with different activities, which may reduce the feeling of boredom, the hypothesis that high boredom proneness is significantly associated with the risk of Internet addiction among adolescents with ADHD is reasonable [5]. However, several issues regarding the association between boredom proneness and Internet addiction in adolescents with ADHD warrant further study. First, a previous study reported that leisure boredom increases the probability of Internet addiction in adolescents [16]. However, the relationship between general boredom proneness and Internet addiction in adolescents with a clinical diagnosis of ADHD has not been examined. Second, boredom proneness consists of various factors. For example, the Boredom Proneness Scale-short form (BPS-SF) [17] is the commonly used instrument for measuring general boredom proneness. The BPS-SF consists of two overall factors, namely lacks of internal stimulation and external stimulation [10]. The relationships between various components of boredom proneness and Internet addiction have not been examined. Third, adolescents may use the Internet for many types of online activities. Various Internet activities have different characteristics and provide different types of pleasure. Whether boredom proneness has various relationships with different types of Internet activities requires further study. Fourth, sex [18], age [19], parental socioeconomic status (SES) [19], and severity of ADHD symptoms [18] are significantly associated with Internet addiction in individuals with ADHD. Meanwhile, sex and age moderated the relationships of residential background and social activities with Internet addiction in adolescents [20]. Regarding boredom proneness, a previous study on psychiatric inpatient population found that boredom proneness was not associated with age or gender [21], whereas another study on community population found that boredom is more prevalent among men, youths, the unmarried, and those of lower income [22]. However, whether these factors moderate the association between boredom proneness and Internet addiction and activities in adolescents with ADHD requires further study.

This study examined the associations between boredom proneness and Internet addiction and activities as well as the moderating effects of demographic, parental, and ADHD characteristics on these associations in adolescents with ADHD. We have three hypotheses. First, the scores for the lack of internal stimulation and external stimulation on the BPS-SF measuring boredom proneness are significantly associated with the risk of Internet addiction in adolescents with ADHD. Second, boredom proneness has various relationships with different types of Internet activities. Third, due to the scarcity of previous studies, we hypothesized that the demographic, parental, and ADHD characteristics moderate the association between boredom proneness and Internet addiction and activities in adolescents with ADHD.

Methods

Participants

The participants for this study were recruited from the child and adolescent psychiatric outpatient clinics of two medical centers in Kaohsiung, Taiwan. Adolescents aged between 11 and 18 years, who had received a diagnosis of ADHD according to the diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5) [23], were consecutively invited to participate in this study between August 2013 and July 2015. ADHD was diagnosed on the basis of multiple data sources including (i) an interview with a child psychiatrist; (ii) clinical observation of the participant's behavior; and (iii) a history provided by the parents and the short version of the Swanson, Nolan, and Pelham, Version IV Scale-Chinese version (SNAP-IV) [24]. Adolescents with intellectual disabilities, schizophrenia, bipolar disorder, autistic disorder, difficulties in communication, or any cognitive deficits that adversely affected their ability to understand the study purpose or complete the questionnaires were excluded. A total of 333 adolescents with the diagnosis of ADHD were enrolled for this study. Among them, 300 (90.0%) agreed to participate in this study and were interviewed by research assistants using a research questionnaire. Of the 33 adolescents who refused to join this study, 19 and 14 refused on the basis of their parents' and their own opinions, respectively. The

Institutional Review Boards of Kaohsiung Medical University and Chang Gung Memorial Hospital, Kaohsiung Medical Center, approved the study.

Measures

Boredom proneness

The present study applied the BPS-SF [17] to measure the participants' trait susceptibility to boredom. The BPS-SF is a self-report questionnaire consisting of 12 items rated on a 7-point Likert scale. The BPS-SF is composed of two subscales: internal stimulation (6 items; e.g., "I find it easy to entertain myself.") and external stimulation (6 items; e.g., "Unless I am doing something exciting, even dangerous, I feel half-dead and dull.") [17]. The internal stimulation subscale indicates boredom due to one's inability to generate interesting activities, whereas the external stimulation subscale indicates the perception of low environmental stimulation. After the scores of the items on the internal stimulation subscale are transformed, higher total scores on the two BPS-BF subscales indicate higher levels of lack of internal stimulation and external stimulation. We translated the English version of the BPS-SF to Chinese by using standard forward-, backward-, and pretest-step methods. The internal consistency (Cronbach's α) values of the internal stimulation and external stimulation subscales of the BPS-SF in the present study were .71 and .74, respectively.

Internet addiction and activities

We used the Chen Internet Addiction Scale (CIAS) to assess the severity of the participants' Internet addiction levels over 1 month prior to the study. The CIAS contains 26 items to be rated on a 4-point Likert scale with scaled scores ranging from 26 to 104 [25]. A high total score indicates severe Internet addiction. The internal reliability (Cronbach's α) of the CIAS in the present study was .94. The 63/64 cutoff point has the highest diagnostic accuracy, sensitivity, and specificity for Internet addiction [26]. We also questioned whether the participants engaged in the four most common Internet activities among adolescents in Taiwan, namely online gaming, online chatting, watching movies online, and online studying [27].

Parental factors

The present study examined the marital status of each participant's parents (married and living together vs. divorced or separated). The participants' parental occupational SES was assessed using the Close-Ended Questionnaire of the Occupational Survey (CEQ-OS) [28], which classifies paternal and maternal occupational SES into five levels; a high level indicates a high occupational SES. The reliability and validity of the CEQ-OS have been proven to be acceptable, and the CEQ-OS has frequently been used in studies on children and adolescents in Taiwan [28]. In the present study, levels I, II, and III of the CEQ-OS were classified as low occupational SES, whereas levels IV and V were classified as high occupational SES.

ADHD characteristics

The short version of the SNAP-IV-Chinese version was used to rate the core ADHD subscales of inattention and hyperactivity/impulsivity of the participants during the 1-month period prior to the study [24]. Each of the items was rated on a 4-point Likert scale from 0 (*not at all*) to 3 (*very much*). The Cronbach's α values of the inattention and hyperactivity/impulsivity subscales in the present study were .80 and .89, respectively. The high total scores on the subscales indicated severe ADHD symptoms. The presentations of ADHD specified by the participants, including predominantly inattentive, predominantly hyperactive/impulsive, or combined presentations, were determined by child psychiatrists on the basis of the diagnostic criteria in the DSM-5 [23]. The child psychiatrists also recorded whether the participants received medication for ADHD at the time of the study.

Procedure

The research assistants conducted interviews using the BPS, CIAS, and questionnaire for Internet activities to collect data from the adolescent participants. Adolescents' parents completed the SNAP-IV under the direction of the research assistants.

Statistical analysis

Data analysis was performed using SPSS 20.0 (SPSS Inc., Chicago, IL, USA). The associations between boredom proneness and Internet addiction and engagement in Internet activities were examined using logistic regression analysis to control the confounding effects of the demographic and ADHD characteristics and family factors. P value, odds ratios (ORs) and 95% confidence intervals (CIs) were used to present the significance. A two-tailed p value of less than .05 was considered statistically significant.

We also used the criteria proposed by Baron and Kenny [29] to examine the moderators for the associations between boredom proneness and Internet addiction and activities. According to the criteria, moderation occurred when the interaction term between the predictors (boredom proneness) and the hypothesized moderators was significantly associated with the dependent variable (Internet addiction and activities) after the main effects of both the predictors and hypothesized moderator variables were controlled for. In this study, if boredom proneness and possible moderators were significantly associated with Internet addiction and activities in the logistic regression analysis, the interactions (boredom proneness $\times$ possible moderators) were further selected for logistic regression analyses to examine their moderating effects.

Results

The participants' demographic, parental, and ADHD characteristics, Internet addiction and activities, and boredom proneness are presented in Table 1. Of the participants, 259 (86.3%) were boys and 41 (13.7%) were girls. The mean age was 12.8 years (standard deviation [SD] = 1.8 years). In total, 213 (71.0%), 71 (23.7%), and 16 (5.3%) participants were identified as having combined, predominantly inattentive, and predominantly hyperactive/impulsive presentations, respectively. In total, 42 (14.0%) participants

Table 1 Demographic characteristics, ADHD and Internet usage characteristic, and the levels of boredom proneness (N = 300).

	n (%)	Mean (SD)	Range
Sex			
Girls	41 (13.7)		
Boys	259 (86.3)		
Age (years)		12.8 (1.8)	10—18
Parental marriage status			
0: married and live together	231 (77.0)		
1: divorced or separated	69 (23.0)		
Paternal occupational socioeconomic status			
0: high	125 (41.7)		
1: low	175 (58.3)		
Maternal occupational socioeconomic status			
0: high	94 (31.3)		
1: low	206 (68.7)		
ADHD symptoms on the SNAP-IV			
Inattention		12.7 (5.8)	0—27
Hyperactivity/impulsivity		8.8 (6.0)	0—27
Receiving medication for ADHD	254 (84.7)		
Severity of Internet addiction on the CIAS		47.7 (14.1)	25—95
Having Internet addiction	42 (14.0)		
Internet activities			
Online gaming	264 (88.0)		
Online chatting	212 (70.7)		
Online watching movie	248 (82.7)		
Online studying	100 (33.3)		
Boredom proneness on the BPS-SF			
Lack of internal stimulation		24.6 (7.0)	6—42
Lack of external stimulation		18.3 (7.5)	6—42

ADHD: attention-deficit/hyperactivity disorder; BPS-SF: Boredom Proneness Scale-Short Form; CIAS: Chen Internet Addiction Scale; SNAP-IV: Swanson, Nolan, and Pelham, Version IV Scale.

were classified as having Internet addiction. The percentages of participants who engaged in online gaming, online chatting, online movie watching, and online studying were 88.0%, 70.7%, 82.7%, and 33.3%, respectively. The mean scores on the internal stimulation and external stimulation subscales of the BPS were 24.6 (SD = 7.0) and 18.3 (SD = 7.5), respectively.

The results obtained from examining the associations between boredom proneness and Internet addiction are listed in Table 2. The results indicate that after the effects of other factors were controlled for, a higher score for lack of external stimulation on the BPS-SF was significantly associated with a higher risk of Internet addiction (OR = 1.103, 95% CI: 1.049—1.159).

Table 2 Associated factors of Internet addiction: logistic regression analysis.

	Internet addiction			
	Wals χ^2	*p*	OR	95% CI of OR
Sex	.397	.529	.727	.270—1.960
Age	.196	.658	1.045	.859—1.273
Broken parental marriage status	1.650	.199	.534	.205—1.391
Low paternal occupational socioeconomic status	2.286	.131	1.898	.827—4.357
Low maternal occupational socioeconomic status	5.711	.017	3.672	1.264—10.670
Inattention on the SNAP-IV	1.460	.227	1.050	.970—1.138
Hyperactivity/impulsivity on the SNAP-IV	.000	.988	.999	.925—1.080
Receiving medication for ADHD	1.275	.259	.599	.246—1.458
Lack of internal stimulation on the BPS-SF	.607	.436	1.022	.967—1.081
Lack of external stimulation on the BPS-SF	14.853	.000	1.103	1.049—1.159

ADHD: Attention-deficit/hyperactivity disorder; BPS-SF: Boredom Proneness Scale-Short Form; SES: socioeconomic status; SNAP-IV: Swanson, Nolan, and Pelham, Version IV Scale.

Because of the significant association between low maternal occupational SES and Internet addiction (OR = 3.672, 95% CI: 1.264–10.670), the interaction between low maternal occupational SES and lack of external stimulation was included in the logistic regression analysis. The result indicated that the interaction between maternal occupational SES and lack of external stimulation was significantly associated with Internet addiction (OR = 1.252, 95% CI: 1.070–1.464), indicating that maternal occupational SES moderated the association between lack of external stimulation and Internet addiction. The results of further examination revealed that a significant association between lack of external stimulation and Internet addiction was observed only in participants with low maternal occupational SES (OR = 1.149, 95% CI: 1.082–1.221) but not in participants with high maternal occupational SES (OR = .923, 95% CI: .786–1.082).

The results of examining the association between boredom proneness and engagement in Internet activities are presented in Table 3. The results indicate that higher scores for lack of external stimulation on the BPS-SF were significantly associated with a high tendency to engage in online gaming (OR = 1.109, 95% CI: 1.043–1.180); however, the higher scores were not significantly associated with online chatting (OR = .994, 95% CI: .957–1.032), online movie watching (OR = 1.003, 95% CI: .961–1.047), or online studying (OR = 1.028, 95% CI: .993–1.064).

Because of a significant association between sex and engagement in online gaming (OR = 4.991, 95% CI: 2.075–12.009), the interaction between sex and lack of external stimulation was included in the logistic regression analysis. However, the interaction between sex and lack of external stimulation was not significantly associated with engagement in online gaming (OR = .982, 95% CI: .859–1.123), thereby indicating that sex did not moderate the association between lack of external stimulation and engagement in online gaming.

Higher scores for lack of internal stimulation on the BPS-SF were significantly associated with a low tendency to engage in online studying (OR = .962, 95% CI: .926-.999); however higher scores were not significantly associated with online gaming (OR = 1.006, 95% CI: .952–1.064), online chatting (OR = .980, 95% CI: .941–1.020), or online movie watching (OR = .994, 95% CI: .949–1.040).

Because of a significant association of age (OR = 1.164, 95% CI: 1.009–1.342) and low maternal occupational SES (OR = 2.141, 95% CI: 1.169–3.920) with engagement in online studying, the interaction of age and low maternal occupational SES with internal stimulation was included in the logistic regression analysis. However, neither the interaction between age and internal stimulation (OR = .993, 95% CI: .972–1.014) nor that between low maternal occupational SES and internal stimulation (OR = .974, 95% CI: .895–1.060) was significantly associated with engagement in online studying, thereby indicating that neither age nor low maternal occupational SES moderated the association between the lack of internal stimulation and engagement in online studying.

Table 3 Table 2 Associated factors of Internet activities: logistic regression analysis.

	Online gaming				Online chatting			
	Wals χ^2	*p*	OR	95% CI of OR	Wals χ^2	*p*	OR	95% CI of OR
Sex	12.883	<.001	4.991	2.075–12.009	.009	.923	.961	.428–2.157
Age	.863	.353	.906	.736–1.116	29.574	.000	1.763	1.437–2.162
Broken parental marriage status	.067	.796	1.130	.446–2.866	.017	.896	1.044	.551–1.978
Low paternal occupational SES	.143	.705	.852	.371–1.957	.337	.562	.840	.465–1.515
Low maternal occupational SES	.912	.339	.639	.255–1.601	.322	.570	.836	.451–1.550
Inattention	1.135	.287	.956	.880–1.039	.028	.867	1.005	.944–1.070
Hyperactivity/impulsivity	.200	.654	1.019	.938–1.107	1.024	.312	.970	.913–1.029
Receiving medication for ADHD	1.917	.166	.386	.100–1.486	.005	.946	.972	.431–2.193
Lack of internal stimulation on the BPS-SF	.051	.822	1.006	.952–1.064	1.007	.316	.980	.941–1.020
Lack of external stimulation on the BPS-SF	10.831	.001	1.109	1.043–1.180	.113	.737	.994	.957–1.032
	Online watching movie				Online studying			
	Wals χ^2	*p*	OR	95% CI of OR	Wals χ^2	*p*	OR	95% CI of OR
Sex	1.669	.196	.481	.159–1.460	.080	.778	.900	.434–1.869
Age	8.441	.004	1.368	1.107–1.689	4.350	.037	1.164	1.009–1.342
Broken parental marriage status	1.231	.267	1.561	.711–3.427	.519	.471	1.253	.678–2.317
Low paternal occupational SES	1.804	.179	.620	.308–1.246	.051	.821	.939	.541–1.627
Low maternal occupational SES	.063	.801	1.095	.540–2.220	6.084	.014	2.141	1.169–3.920
Inattention	.051	.821	.992	.922–1.066	.159	.690	1.012	.956–1.071
Hyperactivity/impulsivity	.002	.967	1.001	.935–1.073	1.756	.185	.963	.910–1.018
Receiving medication for ADHD	.359	.549	1.309	.543–3.157	.160	.689	1.159	.563–2.387
Lack of internal stimulation on the BPS-SF	.077	.781	.994	.949–1.040	4.005	.045	.962	.926–.999
Lack of external stimulation on the BPS-SF	.020	.887	1.003	.961–1.047	2.373	.123	1.028	.993–1.064

ADHD: Attention-deficit/hyperactivity disorder; BPS-SF: Boredom Proneness Scale-Short Form; SES: socioeconomic status.

Discussion

The present study determined that higher scores for lack of external stimulation on the BPS-SF were significantly associated with a higher risk of Internet addiction. Maternal occupational SES moderated the association between lack of external stimulation and Internet addiction. Moreover, higher scores for lack of external stimulation on the BPS-SF were significantly associated with a high tendency to engage in online gaming, whereas higher scores for lack of internal stimulation on the BPS-SF were significantly associated with a low tendency to engage in online studying.

Although the cross-sectional research design of the present study limited the possibility of drawing a causal relationship between boredom proneness and Internet addiction and activities, we proposed several possible etiologies to account for the significant association between boredom proneness and Internet addiction and activities in adolescents with ADHD. First, boredom proneness and Internet addiction may have common biological mechanisms. A previous functional magnetic resonance imaging (fMRI) study on individuals playing a first-person shooter video game found that boredom was related to the activities of insula, amygdala, and bilateral ventromedial prefrontal cortex [30]. Another fMRI study found that boredom was related to the activities of insula and caudate nucleus [31]. Moreover, fMRI studies also found that inter-hemispheric insula [32], amygdala—insula [33], amygdala—frontal [33], and frontostriatal [32] functional connections were associated with Internet gaming disorder. Insula, amygdala, and bilateral ventromedial prefrontal cortex that are responsible for emotional regulation, impulse control and motivation are involving in both boredom proneness and Internet addiction.

Second, boredom proneness may contribute to the development of Internet addiction and a preference for some varieties of Internet activities in adolescents with ADHD. Lack of external stimulation on the BPS-SF indicates the perception of low environmental stimulation; specifically, the BPS-SF items on the external stimulation subscale reflect a need for variety and change [8]. ADHD adolescents with high scores for lack of external stimulation may have difficulties in experiencing interest from daily activities and pleasure from leisure time. Internet use can conveniently provide users with various activities and enjoyment with rapid response, which may reduce the feeling of boredom. When compared with other Internet activities, online gaming frequently provides adolescent users with feelings that are different from the usual experiences in their daily lives; hence, adolescents with ADHD with high scores for lack of external stimulation on the BPS-SF are attracted to engage in online gaming. Lack of internal stimulation indicates boredom due to one's inability to generate interesting activities; specifically, the BPS-SF items on the internal stimulation subscale refer to a perceived inability to generate sufficient stimulation for oneself [8]. Although the present study did not show a significant association between lack of internal stimulation on the BPS-SF and Internet addiction, higher scores for lack of internal stimulation were significantly associated with a low tendency to engage in online studying. Online studying has become a trend for modern learning. Although online studying involves more vivid and vigorous learning than does traditional studying in classrooms, adolescents with ADHD with high scores for lack of internal stimulation on the BPS-SF may still perceive an inability to generate sufficient stimulation for themselves to study.

Third, other factors such as psychopathology and personality characteristics may contribute to the significant association between boredom proneness and Internet addiction in adolescents with ADHD. For example, studies have indicated that boredom proneness is significantly associated with depression [34], anxiety [34], and hostility [35]. Moreover, depression and anxiety are significantly associated with Internet addiction in adolescents with ADHD [36]. Depression, social phobia, and hostility predict the occurrence of Internet addiction among adolescents in a 2-year follow-up [4]. Regarding personality characteristics, sensation seeking is not only one of the manifestations of boredom proneness but also significantly associated with Internet addiction in adolescents with ADHD [19]. Thus, further study is warranted to examine whether psychopathologies and personality characteristics contribute to the co-occurrence of boredom proneness and Internet addiction or mediate the significant association between boredom proneness and Internet addiction.

Fourth, Internet addiction may aggravate boredom proneness in adolescents with ADHD. The Internet provides adolescents with various activities, rapid responses, and immediate rewards, which are very different from the adolescents' experiences in real environments. Adolescents with ADHD may experience less boredom in online environments but may experience more severe boredom in the virtual world. However, the hypothesis requires further study.

The present study found that maternal occupational SES moderated the association between lack of external stimulation and Internet addiction. A significant association between lack of external stimulation and Internet addiction was found only in those with low maternal occupational SES and not in those with high maternal occupational SES. Studies have revealed that families with low SES were more likely to have a sedentary lifestyle than were those with high SES [37]. In most Taiwanese families, mothers typically manage their children's daily behaviors. The mothers' occupational SES may substantially influence their knowledge of computers and the Internet. Consequently, mothers with less knowledge of computers and the Internet have a low capacity for monitoring and controlling their adolescents' Internet use; thus, the risk of Internet addiction increases in adolescents with ADHD and causes high boredom proneness.

Several limitations in our investigation must be discussed. First, the cross-sectional design of this study limited our ability to conclude regarding the causal relationships between boredom proneness and Internet addiction. Second, the participants of the present study were recruited from clinical units. Additional studies are required to examine whether the results of the present study can be generalized to adolescents with ADHD who do not visit clinical units to receive treatment. Third, the present study did not examine how the associations between boredom proneness and Internet addiction develop. As mentioned, psychopathology and personality characteristics may contribute to the co-occurrence of boredom

proneness and Internet addiction; thus, the roles of psychopathology and personality characteristics in the association between boredom proneness and Internet addiction in adolescents with ADHD warrant further study. Fourth, no control group was recruited in the present study, and thus it is unclear whether high boredom proneness results in a higher risk of Internet addiction among adolescents with ADHD compared than those without ADHD. Fifth, the psychometrics of Chinese version of the BPS-SF warrants further examination.

Based on the results of the present study, we suggest that mental health and educational professionals should routinely evaluate boredom proneness in adolescents with ADHD. Furthermore, they should monitor the risk of Internet addiction in adolescents with ADHD with high scores for lack of external stimulation on the BPS-SF. Prevention and intervention programs for Internet addiction and overuse of Internet gaming must consider adolescents' boredom proneness and maternal occupational SES. Because that emotional regulation, impulse control and motivation are involving in both boredom proneness and Internet addiction, prevention and intervention programs should take these psychological characteristics into consideration. For example, research found that methylphenidate treatment can reduce the severity of problematic Internet faming in children with ADHD [38]. It is possible that methylphenidate may improve ADHD children's impulse control and then reduce Internet gaming. Moreover, early identification of children and adolescents with emotional dysregulation and providing cognitive-behavioral therapy for them may reduce the risk of developing Internet addiction among the ADHD youths with high boredom proneness. Shek and colleagues also developed an Internet addiction treatment program for Chinese adolescents in Honk Hong [39]. The program enhances adolescents' motivation to self-arrange their daily lives and invite the parents of adolescents to learn skills for communicating with adolescents to enhance their self-control. The model of adolescent-parent working together may result in the reduction of boredom feeling and then improve adolescents' Internet addiction.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.kjms.2018.01.016.