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The association of Internet addiction symptoms with anxiety, depression and self-esteem among adolescents with attention-deficit/hyperactivity disorder

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Abstract

Background: The aims of this study were to examine the associations of the severity of Internet addiction symptoms with various dimensions of anxiety (physical anxiety symptoms, harm avoidance, social anxiety, and separation/panic) and depression symptoms (depressed affect, somatic symptoms, interpersonal problems, and positive affect) and self-esteem among adolescents diagnosed with attention-deficit/hyperactivity disorder (ADHD) in Taiwan.

Method: A total of 287 adolescents aged between 11 and 18 years who had been diagnosed with ADHD participated in this study. Their severity of Internet addiction symptoms was assessed using the Chen Internet Addiction Scale. Anxiety and depression symptoms and self-esteem were assessed using the Taiwanese version of the Multidimensional Anxiety Scale for Children (MASC-T), the Center for Epidemiological Studies Depression Scale (CES-D), and the Rosenberg Self-Esteem Scale (RSES), respectively. The association between the severity of Internet addiction symptoms and anxiety and depression symptoms and self-esteem were examined using multiple regression analyses.

Results: The results indicated that higher physical symptoms and lower harm avoidance scores on the MASC-T, higher somatic discomfort/retarded activity scores on the CES-D, and lower self-esteem scores on the RSES were significantly associated with more severe Internet addiction symptoms.

Conclusions: Prevention and intervention programs for Internet addiction in adolescents with ADHD should take anxiety, depression, and self-esteem into consideration.

1. Introduction

Internet addiction can result in substantial adverse effects on the lives of adolescents, such as declines in physical and mental health, interpersonal relationships, and academic performance [1,2]. Attention-deficit/hyperactivity disorder (ADHD) is the most common psychiatric disorder among adolescents with Internet addiction who have been referred for psychiatric treatment [3]. A prospective community study also found that ADHD can predict the occurrence of Internet addiction 2 years later in adolescents [4]. Several biopsychosocial mechanisms might explain the coexistence of Internet addiction and ADHD. Firstly, Internet behavior is characterized by rapid response and immediate reward, which may provide immediate stimulation and reward for people with the core ADHD symptoms of "being easily bored" and "having an aversion for delayed reward" [5]. Meanwhile, people with ADHD tend to seek enhanced stimulation of the reward pathway [6]. Most Internet games, the major Internet activity for many adolescents, are designed to provide an incentive to "get to the next level," which instantaneously creates a salient reward for users with ADHD [7]. Adolescents with ADHD have abnormal brain activities associated with impaired inhibition [8], which may

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result in difficulty in controlling Internet use and hence increased vulnerability to Internet addiction. ADHD symptoms can also negatively influence interpersonal relationships in the real lives of adolescents, and thus, adolescents with ADHD may seek interpersonal relationships online instead of in the real world [5]. The association between ADHD and Internet addiction suggests that adolescents with ADHD should be an important target group of preventive scheduling for Internet addiction.

Other than ADHD, anxiety and depression are the two psychological symptoms that are prevalent in people with Internet addiction [5]. Some issues regarding the relationships of Internet addiction with anxiety and depression in adolescents with ADHD have not been examined in depth. First, both anxiety and depression are multi-dimensional and not single-dimensional psychological symptoms. Studies on children and adolescents found multiple dimensions of anxiety symptoms as measured by the Multidimensional Anxiety Scale for Children (MASC), including physical symptoms, harm avoidance, social anxiety, and separation/panic [9,10]. However, previous studies only examined the association between Internet addiction and social anxiety in adolescents. For example, research has found that social anxiety and shyness are significantly associated with Internet addiction [4,11] and Instant Messaging addiction among adolescents [12], respectively. Moreover, research on adolescents found multiple dimensions of depression symptoms as measured by the Center for Epidemiological Studies Depression Scale (CES-D), including affect (depressed and positive), somatic symptoms, and interpersonal problems [13]. However, previous studies have considered depression as a single-dimensional symptom and did not differentiate the various relationships of Internet addiction with different dimensions of depressive symptoms [4,11]. The relationships of Internet addiction with multiple dimensions of anxiety and depression need further study. Second, research has found that over one-third of adolescents with ADHD have comorbid anxiety disorders [14], and that generalized anxiety disorder but not social phobia is the most prevalent diagnosis co-occurring with ADHD in children and adolescents [15]. Meanwhile, between 5 and 40% of children and teens with ADHD meet the criteria for major depression [16]. Based on our research, however, no study has examined the relationships of Internet addiction with multiple dimensions of anxiety and depression in adolescents clinically diagnosed with ADHD.

Research has found that adolescents with lower self-esteem are more easily addicted to the Internet [17]. It has been hypothesized that the Internet provides adolescent players with activities in which they can feel confident, and they have positive self-esteem in the virtual world [17,18]. Furthermore, children diagnosed with ADHD report lower self-esteem in adolescence as compared with controls [19]. Multiple failures in school and family contests may drive adolescents with ADHD to experience a low perception of their competency as compared with their peers. It is reasonable to hypothesize that Internet addiction is significantly associated with low self-esteem in adolescents with ADHD. However, no study has examined this hypothesis.

The aims of this study were to examine the associations of the severity of Internet addiction symptoms with various dimensions of anxiety (physical anxiety symptoms, harm avoidance, social anxiety, and separation/panic) and depression symptoms (depressed affect, somatic symptoms, interpersonal problems, and positive affect) and self-esteem and the moderating effects of sex and age on the associations among adolescents with the clinical diagnosis of ADHD in Taiwan. Based on the results of previous studies [17,18], we hypothesized that the severity of Internet addiction symptoms is negatively associated with the level of self-esteem. Owing to a lack of previous studies, we temporally hypothesize that the severity of Internet addiction symptoms is positively associated with the severities of anxiety and depression symptoms and that the associations are various in term of different dimensions of anxiety and depression symptoms among adolescents with ADHD.

2. Methods

2.1. Participants

The participants were recruited from the child and adolescent psychiatric outpatient clinics of two medical centers in Kaohsiung, Taiwan. Adolescents aged between 11 and 18 years diagnosed with ADHD were consecutively invited to participate in this study between November 2012 and November 2013. Five child psychiatrists conducted a diagnostic interview with the adolescents and the parents to confirm the diagnosis of ADHD and subtypes according to the diagnostic criteria in the *Diagnostic and Statistical Manual of Mental Disorders-IV Text Revision* (*DSM-IV-TR*) [20]. If the adolescents visited the clinics not for the first time, their previous medical records and the results of the short version of the Swanson, Nolan, and Pelham Version IV Scale-Chinese version (SNAP-IV) [21,22] reported by the parents and teachers previously were also used as the references to support the diagnosis of ADHD and subtypes.

To make sure that the participants can understand the study purpose and complete the research questionnaires, adolescents who had the diagnosis of intellectual disability, whose current or previously recorded full intelligence quotient on any version of the Wechsler Intelligence Scale for Children or Wechsler Preschool and Primary Scale of Intelligence was 70 or below, or whose poor adaptive functioning indicated the possibility of intellectual disability were excluded from this study. Adolescents who had or might have the diagnosis of schizophrenia, bipolar disorder, or organic mental disorder based on the results of medical records, parents' reports, or clinicians' observation in interview room were also excluded. Although according to *DSM-IV-TR* autistic disorder should not be diagnosed with ADHD concurrently [20], this study only exclude those whose autistic disorder resulted in difficulty in communicating. Anyone who had cognitive, reading, or

hearing difficulties that might prevent the adolescents from understanding the study purpose and complete the research questionnaires were also excluded.

A total of 316 adolescents diagnosed with ADHD were invited to participate in this study. Among them, 287 (90.8%) agreed to participate and were interviewed by the research assistants based on the research questionnaire. Of the 29 adolescents who refused to join this study, 16 and 13 refused based on their parents' opinion and their personal opinion, respectively. Among the participants, 251 (87.5%) were boys and 36 (12.5%) were girls. The mean age was 13.1 years (SD = 2.0 years). Regarding the subtype, 222 (77.3%), 63 (22.0%), and 2 (0.7%) were combined, inattention, and hyperactivity/impulsivity subtypes, respectively. Regarding the treatment, 244 (85%) participants received medication for ADHD currently and 43 (15%) received cognitive–behavioral therapy (CBT) or counselling without medication. The Institutional Review Board of Kaohsiung Medical University and Chang Gung Memorial Hospital, Kaohsiung Medical Center, approved the study.

2.2. Measures

2.2.1. Internet addiction

We used the Chen Internet Addiction Scale (CIAS) to assess the participants' severity of Internet addiction symptoms in the month preceding the study. The CIAS contains 26 items ranked on a 4-point Likert scale with the scaled score ranging from 26 to 104 [23]. A higher total score indicates a more severe level of Internet addiction symptoms. The internal reliability (Cronbach's α) of the CIAS in this study was .94. Those whose total score was 64 or more were identified to have Internet addiction [24].

2.2.2. Anxiety symptoms

We used the Taiwanese version of the MASC (MASC-T) to evaluate adolescents' anxiety symptoms in the month preceding the study [10,25]. The MASC-T evaluates the level of anxiety symptoms in children and adolescents with 39 items answered on a 4-point Likert scale. The MASC-T is composed of four scales: physical anxiety symptoms, harm avoidance, social anxiety, and separation/panic. Higher scores on the scales indicate more severe anxiety symptoms. The psychometrics of the MASC-T were examined and the results proved that the MASC-T has satisfactory reliability and validity [10]. The Cronbach's α for the four scales in this study ranged from .72 to .81.

2.2.3. Depression symptoms

The Mandarin Chinese version [26] of the CES-D [27] comprises 20 four-point items that assess the frequency of depressive symptoms on a 4-point Likert scale in the month before the questionnaire is administered. The CES-D is composed of four scales: depressed affect, somatic symptoms, interpersonal problems, and positive affect [13], with higher scores indicating more severe depression. The Cronbach's α for the four scales in the present study ranged from .70 to .82.

2.2.4. Self-esteem

The Rosenberg Self-Esteem Scale (RSES) contains 10 four-point items that assess current self-esteem. This scale has high reliability and construct validity [28]. The scale yields a single overall score for self-esteem, with high scores indicating high levels of self-esteem. The scale was previously used to evaluate the level of self-esteem among Taiwanese adolescents [29]. The Cronbach's α in the present study was .86.

2.2.5. ADHD and oppositional symptoms

The parent-reported short version of the SNAP-IV [21,22] was used to assess the severity of ADHD and oppositional symptoms in the month preceding the study. The short version of the SNAP-IV-Chinese version is a 26-item rating instrument comprising the core *DSM-IV*-derived ADHD subscales of inattention, hyperactivity/impulsivity, and oppositional symptoms of oppositional defiant disorder [21,22]. Each item is rated on a 4-point Likert scale from 0 (*not at all*) to 3 (*very much*). The Cronbach's α of the three subscales in this study ranged from .86 to .91.

2.3. Procedure and statistical analysis

After obtaining the informed consents from the adolescents and their parents, research assistants performed interviews by using the research questionnaires to collect data from the adolescents. The adolescents' parents completed the SNAP-IV-Chinese version based on the directions of the research assistants. Data analysis was performed using SPSS 17.0 statistical software (SPSS Inc., Chicago, IL, USA). We firstly examined the correlations between anxiety symptoms, depression symptoms, and self-esteem. If there were significant correlations between them, we used hierarchical multiple regression analysis to examine their individual association with the severity of Internet addiction symptoms. In every regression model the effects of demographic characteristics and ADHD symptoms were controlling for. A two-tailed p value of less than .05 was considered statistically significant.

3. Results

The participants' demographic characteristics, ADHD subtypes, severities of Internet addiction symptoms, anxiety and depression symptoms, and the level of self-esteem and are shown in Table 1. The mean severity of Internet addiction symptoms on the CIAS was 47.1 (SD = 14.7). According to the cutoff of 63/64 for Internet addiction, 45 (15.7%) participants were classified to have Internet addiction.

The correlations between anxiety symptoms, depression symptoms, and self-esteem are shown in Table 2. The results indicated that some subscales of anxiety and depression symptoms were significantly correlated with each other. For example, the subscale of physical anxiety symptoms was significantly correlated with all subscales of depression symptoms on the CES-D. The subscale of social anxiety

Table 1
Demographic characteristics, severity of Internet addiction symptoms, ADHD, anxiety, depression symptoms, and level of self-esteem.

	n (%)	Mean (SD)
Age (years)		13.1 (2.0)
Sex		
Girls	36 (12.5)	
Boys	251 (87.5)	
ADHD subtypes		
Combined	222 (77.3)	
Inattention	63 (22.0)	
Hyperactivity/impulsivity	2 (0.7)	
Internet addiction symptoms on the CIAS		47.1 (14.7)
SNAP-IV		
Inattention		12.7 (5.4)
Hyperactivity/impulsivity		8.9 (5.8)
Oppositional		10.1 (5.8)
MASC-T		
Physical anxiety symptoms		6.4 (6.1)
Harm avoidance		12.7 (5.4)
Social anxiety		9.8 (6.9)
Separation/panic		7.5 (5.7)
CES-D		
Negative affect		3.1 (4.1)
Positive affect		6.9 (3.2)
Somatic discomfort/retarded activity		5.0 (3.9)
Interpersonal relation		1.2 (1.6)
Self-esteem on the RSES		20.2 (5.5)

ADHD: attention-deficit/hyperactivity disorder; CES-D: Center for Epidemiological Studies Depression Scale; CIAS: Chen Internet Addiction Scale; MASC-T: Taiwanese version of the Multidimensional Anxiety Scale for Children; RSES: Rosenberg Self-Esteem Scale; SNAP-IV: Swanson, Nolan, and Pelham, Version IV Scale.

symptoms was significantly correlated with all subscales of depression symptoms except for positive affect. Meanwhile, self-esteem was significantly correlated with physical anxiety symptoms, social anxiety symptoms, and all subscales of depression symptoms. Thus, we used hierarchical regression analysis to examine the individual associations of anxiety symptoms, depression symptoms, and self-esteem with Internet addiction symptoms in three regression models.

The results of multiple regression analysis are shown in Table 3. Anxiety symptoms on the MASC-T were added to model I by controlling for the effects of age, sex, and ADHD and oppositional symptoms ($F = 5.076$, $p < .001$). The results of model I indicated that more severe physical anxiety symptoms and lower harm avoidance on the MASC-T were significantly associated with more severe Internet addiction symptoms. Social anxiety and separation/panic were not significantly associated the severity of Internet addiction symptoms.

Depression symptoms on the CES-D were then added to model II ($F = 4.278$, $p < .001$). The results indicated that higher somatic discomfort/retarded activity was significantly associated with more severe Internet addiction symptoms. Negative and positive affect and interpersonal relation were not significantly associated the severity of Internet addiction symptoms.

Self-esteem on the RSES was added to model III ($F = 4.424$, $p < .001$). The results indicated that lower self-esteem was significantly associated with more severe Internet addiction symptoms.

4. Discussion

This study found that 15.7% of adolescents with ADHD were classified to have Internet addiction. Previous study in Taiwan using the CIAS and the same cutoff found that 10.8% of junior high school students at grade 7 [4] and 18.7% of adolescents aged between 12 and 18 in community [30] self-reported to have Internet addiction. The prevalence of Internet addiction in adolescents with ADHD seems not be significantly higher than that among Taiwanese adolescents in community. One of possible explanations for the results is that the participants with ADHD were recruited from clinical units. The severities of ADHD symptoms might be improved after receiving medication or CBT for ADHD. A previous study found that 8-week methylphenidate treatment could improve the severity of Internet video game play in children with ADHD [31]. Further study is

Table 2
Correlations between anxiety, depression, and self-esteem.

	1	2	3	4	5	6	7	8	9
1. Physical anxiety symptoms	–	.226**	.542**	.319**	.704**	−.235**	.706**	.541**	−.423**
2. Harm avoidance		–	.439**	.370**	.091	.266**	.160*	.082	.061
3. Social anxiety			–	.514**	.439**	−.032	.496**	.430**	−.321**
4. Separation/panic				–	.181*	.092	.239**	.094	−.088
5. Negative affect					–	−.265**	.729**	.659**	−.509**
6. Positive affect						–	−.271**	−.236**	.548**
7. Somatic discomfort/retarded activity							–	.516**	−.510**
8. Interpersonal relation								–	−.381**
9. Self-esteem									–

* $p < .01$.
** $p < .001$.

Table 3
The association of the severity of Internet addiction symptoms with demographic characteristics and psychological symptoms.

	Model I			Model II			Model III		
	Beta	*t*	*p*	Beta	*T*	*p*	Beta	*t*	*p*
Age	.133	2.127	.034	.148	2.352	.019	.150	2.401	.017
Sex	.086	1.505	.133	.077	1.363	.174	.074	1.315	.190
SNAP-IV									
Inattention	.080	1.145	.253	.064	0.915	.361	.054	0.787	.432
Hyperactivity/impulsivity	−.189	−2.398	.017	−.164	−2.074	.039	−.173	−2.208	.028
Oppositional	.057	0.753	.452	.060	0.792	.429	.068	0.906	.366
Anxiety on the MASC-T									
Physical anxiety symptoms	.191	2.813	.005	.104	1.148	.252	.111	1.234	.218
Harm avoidance	−.133	−2.075	.039	−.113	−1.700	.090	−.102	−1.544	.124
Social anxiety	.093	1.178	.240	.067	0.812	.418	.036	0.432	.666
Separation/panic	.089	1.227	.221	.093	1.292	.197	.096	1.341	.181
Depression on the CES-D									
Negative affect				−.095	−0.972	.332	−.135	−1.368	.172
Positive affect				−.063	−1.013	.312	.013	.191	.849
Somatic discomfort/retarded activity				.240	2.664	.008	.206	2.268	.024
Interpersonal relation				−.040	−0.520	.604	−.038	−.493	.623
Self-esteem on the RSES							−.178	−2.327	.021

CES-D: Center for Epidemiological Studies Depression Scale; MASC-T: Taiwanese version of the Multidimensional Anxiety Scale for Children; RSES: Rosenberg Self-Esteem Scale; SNAP-IV: Swanson, Nolan, and Pelham, Version IV Scale.

needed to examine the effects of methylphenidate and CBT on Internet addiction in adolescents with ADHD. Furthermore, parents might learn skills for managing adolescents' Internet-using behaviors from psychiatrists and psychologists in the clinical units. The prevalence and correlates of Internet addiction in adolescents with ADHD who have never visited clinical units need further study.

The present study found that more severe physical anxiety symptoms on the MASC-T were significantly associated with more severe Internet addiction symptoms in adolescents with ADHD. There are a number of possible explanations for the significant association between anxiety-related physical symptoms and Internet addiction symptoms in adolescents with ADHD. Firstly, stress from poor interpersonal relationships and academic performance in real life may make adolescents with ADHD experience a high level of physical anxiety symptoms, leading to their escape into the virtual world of the Internet concurrently. Secondly, physical anxiety symptoms may increase the difficulties for adolescents in terms of performing well to pursue achievements in the real world, and thus adolescents with physical anxiety symptoms may seek achievements online instead of in the real world. Thirdly, physical anxiety symptoms may be one of the withdrawal symptoms in adolescents with Internet addiction. Meanwhile, engagement in Internet activities may also result in physical anxiety symptoms, for example, encountering obstacles in getting to the next level in Internet gaming and waiting for others' responses via instant messaging.

Harm avoidance reflects variation in the brain's behavior inhibition system, and individuals with low harm avoidance are confident, optimistic, carefree, uninhibited, and energetic [32]. This study found that lower harm avoidance on the MASC-T was significantly associated with more severe Internet addiction symptoms in adolescents with ADHD. The results of this study on adolescents with ADHD were not in line with those of a previous study on a community population of adolescents, in which adolescents with Internet addiction reported a higher level of harm avoidance than those without Internet addiction [33]. Ko and colleagues hypothesized that as the Internet provides an anonymous virtual world, adolescents with high harm avoidance may perceive less responsibility and harm from it than they do from the real world, and may consequently become vulnerable to Internet addiction [34]. However, the hypothesis is not supported by the results of the present study on adolescents with ADHD. The results of this study indicate that adolescents with ADHD who have low harm avoidance may be uninhibited and ignore the potential harm resulting from Internet use, and then are vulnerable to Internet addiction. The significant associations of physical anxiety symptoms and harm avoidance with Internet addiction symptoms disappeared after depression symptoms were selected into regression model, indicating that depression symptoms had more significant association with Internet addiction symptoms than did anxiety symptoms. However, owing to the adverse effects of anxiety symptoms on adolescents' lives [35], anxiety symptoms and their association with Internet addiction symptoms should be monitored in adolescents with ADHD.

Furthermore, social anxiety was reported to be significantly associated with Internet addiction in a community population of adolescents [4,11]. It has been hypothesized that adolescents with social phobia may receive social support from Internet use and avoid stress caused by face-to-face interaction with others [5]. However, this study did not find a significant association between social anxiety

symptoms and Internet addiction symptoms in adolescents with ADHD. The results of this study suggest that in adolescents with ADHD, social anxiety plays a less significant role in the occurrence of Internet addiction as compared with other dimensions of anxiety symptoms.

Previous studies that considered depression as a single-dimensional symptom found a significant association between Internet addiction and depression among adolescents [4,11,34]. As the Internet provides adolescents with social support [36], pleasure of control [37], and a virtual world in which they can escape from emotional difficulty in the real world, it is reasonable to hypothesize that adolescents with ADHD who have a depressed mood and interpersonal relationship problems are more likely to use the Internet to alleviate their negative mood than their unaffected peers. However, the present study found that among depressive symptoms, somatic discomfort/retarded activity but not affect or interpersonal relationships was significantly associated with more severe Internet addiction symptoms in adolescents with ADHD. Adolescents with ADHD who have somatic discomfort or psychomotor retardation may have difficulties in and avoid participating in activities that require physical exertion in real life and turn their attention to Internet activities. Another possibility is that spending too much time and effort on Internet activities may have negative effects for adolescents in terms of developing physical strength for daily activities in real life, and thus deteriorate the severity of discomfort/retarded activity. Meanwhile, Internet addiction can reduce the duration of sleep and compromise the quality of sleep for adolescents [38], and insomnia and a short sleep duration may increase the risk of depression in adolescents [39,40]. The hypothesis that adolescents with ADHD who have a more severe depressed mood and interpersonal relationship problems have more severe Internet addiction symptoms is not supported by the results of the present study.

Consistent with previous studies [17,41], the present study found that lower self-esteem was significantly associated with more severe Internet addiction symptoms in adolescents with ADHD. It has been hypothesized that adolescents develop their self in the era of the Internet and role-playing fantasy games [42]. The Internet provides adolescent players with activities in which they can feel confident, and they have a positive self-esteem in the virtual world [17,18]. Adolescents with ADHD may encounter multiple failures in school and family contests, which may drive them to experience a low perception of their competency as compared with their peers [19]. Thus, the characteristics of the Internet may attract adolescents with ADHD and make them vulnerable to Internet addiction. However, adolescents with Internet addiction may have a virtual self-identity in the online world different from that in the real world. Low self-esteem in the real world may increase the risk of not only Internet addiction but also depression, suicidal ideation, delinquency, and adjustment problems [43].

This study found that lower parent-rated hyperactivity/impulsivity symptoms were associated with more severe Internet addiction symptoms, and that no significant association exists between parent-rated inattention symptoms and Internet addiction symptoms in the clinical sample of adolescents with ADHD. These results contradict those of previous community studies on elementary [44] and college students [45]. Based on our research, this study is the first to examine the relationship between parent-rated ADHD symptoms and Internet addiction in a clinical sample of adolescents with ADHD; further research is necessary to reexamine the derived results. It is possible that adolescents with ADHD are less hyperactive than they were as children. Adolescents with severe Internet addiction spend excessive time on the Internet, thus causing their hyperactivity/impulsivity symptoms to be less observable by their parents. The results of this study can remind clinicians and parents of adolescents to avoid ignoring the potential for Internet addiction among adolescents whose hyperactivity/impulsivity symptoms seem to be mild.

Several limitations in our investigation require attention. First, the cross-sectional research design of this study limited the ability to draw conclusions regarding the causal relationships between Internet addiction symptoms and psychological correlates. Second, the data regarding Internet addiction symptoms and psychological variables were provided by the adolescents. The problem of shared-method variance resulted from the sole information source and requires careful consideration. Third, all Internet use behaviors, anxiety, depression, and self-esteem are influenced by environmental factors such as family and peer interactions. This study did not take the influences of environmental factors on the association between Internet addiction symptoms and psychological variables into account. Finally, the participants were recruited from outpatient clinics of medical centers. The results of this study might not be generalized to adolescents with ADHD who have never visited the clinical units for treatment.

4.1. Implication

Although the cross-sectional research design limited the possibility to determine the causal relationships between Internet addiction symptoms and anxiety, depression, and self-esteem, the present study provided empirical evidence to increase our understanding of Internet addiction symptoms and its psychological correlates in adolescents with ADHD. Some dimensions of anxiety and depression symptoms that have been proposed to be significant correlates of Internet addiction symptoms in the community population of adolescents, such as social anxiety and negative affect, were not found to be significantly associated with the severity of Internet addiction in adolescents with ADHD. The results indicated that the psychological mechanisms of Internet addiction may not be the same between adolescents with ADHD and the general adolescent population. The

psychological mechanisms regarding anxiety and depression for developing Internet addiction in adolescents with ADHD need further study.

Our study results reminded clinicians, educational professionals, and parents of adolescents with ADHD that it is necessary to monitor the Internet use of adolescents with ADHD and those who exhibit these dimensions of anxiety and depression symptoms identified in this study. Meanwhile, Internet addiction may compromise adolescents' mental health, and thus adolescents with ADHD and Internet addiction may be at high risk of developing some dimensions of anxiety and depression symptoms. Prevention in terms of early detection and intervention in anxiety and depression symptoms is necessary. Self-esteem is a powerful motivational force for adolescents [40]. Empowering adolescents with ADHD to reduce the risk of Internet addiction should be an essential component of prevention and intervention programs.

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