

## Social skills deficits and their association with Internet addiction and activities in adolescents with attention-deficit/hyperactivity disorder

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*Background and aims:* The aims of this study were to examine the association between social skills deficits and Internet addiction and activities in adolescents with attention-deficit/hyperactivity disorder (ADHD) as well as the moderators for this association. *Methods:* A total of 300 adolescents, aged between 11 and 18 years, who had been diagnosed with ADHD participated in this study. Their Internet addiction levels, social skills deficits, ADHD, parental characteristics, and comorbidities were assessed. The various Internet activities that the participants engaged in were also examined. *Results:* The associations between social skills deficits and Internet addiction and activities and the moderators of these associations were examined using logistic regression analyses. Social skills deficits were significantly associated with an increased risk of Internet addiction after adjustment for the effects of other factors [odds ratio (OR) = 1.049, 95% confidence interval (CI) = 1.030–1.070]. Social skills deficits were also significantly associated with Internet gaming and watching movies. The maternal occupational socioeconomic levels of the participants moderated the association between social skills deficits and Internet addiction. *Conclusions:* Social skills deficits should be considered targets in prevention and intervention programs for treating Internet addiction among adolescents with ADHD.

**Keywords:** attention-deficit/hyperactivity disorder, Internet addiction, social skills deficits, comorbidity

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### INTRODUCTION

#### *Internet addiction in attention-deficit/hyperactivity disorder (ADHD)*

Internet addiction has substantial adverse effects on the physical and mental health, interpersonal relationships, and academic performance levels of adolescents (Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000; Young, 1996). Previous cross-sectional and prospective studies have found that adolescents diagnosed with ADHD are at a higher risk of Internet addiction than those without ADHD. Furthermore, previous cross-sectional community studies have revealed significant associations between Internet addiction and ADHD symptoms in adolescents (Cao, Su, Liu, & Gao, 2007; Yen, Ko, Yen, Wu, & Yang, 2007). Moreover, these studies have revealed that ADHD is the most common psychiatric disorder among adolescents with Internet addiction (Bozkurt, Coskun, Ayaydin, Adak, & Zoroglu, 2013). A prospective community study also revealed that ADHD predicted the occurrence of Internet addiction in adolescents during a 2-year follow-up (Ko, Yen, Chen, Yeh, & Yen, 2009). The results of previous studies have indicated that

adolescents with ADHD have an increased risk of Internet addiction and warrant early prevention.

#### *Social skills deficits*

Social skills deficits have received considerable attention in studies on the social correlates of Internet addiction in adolescents. Social skills entail the ability to interact with others in interactive situations and majorly affect the life-adjustment, academic performance, and occupational development of an individual (Argyle, 1983). Research revealed that Internet use is associated with poor social skills as assessed by the identification of emotions, shown in pictures of facial expressions and as interpreted from the descriptions

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of social episodes (Engelberg & Sjöberg, 2004). Online-chatting users, who are socially fearful, may use the Internet as a form of low-risk social approach and an opportunity to rehearse social behavior and communication skills to enable them to improve their face-to-face interactions in social environments (Campbell, Cumming, & Hughes, 2006). However, research revealed that social phobia can predict the occurrence of Internet addiction in adolescents during the 2-year follow-up (Ko et al., 2009). By contrast, heavy Internet users have been reported to have numerous social contacts because of the use of the Internet but reduced face-to-face contacts (Bergmark, Bergmark, & Findahl, 2011), which may compromise their social skills in the virtual world.

### Research issues

Several issues regarding the association of social skills deficits with Internet addiction require further investigation. First, children with ADHD face difficulties in sharing, supporting, responding to social cues, and perspective-taking and are more self-focused while negotiating (Cordier, Bundy, Hocking, & Einfeld, 2010; Normand et al., 2011). These inappropriate social behaviors may evoke adverse sentiments in peers toward individuals with ADHD and result in peer isolation and rejection (Humphreys, Galán, Tottenham, & Lee, 2016). The adverse influence of ADHD on social relationships may persist into adolescence and early adulthood (Sacchetti & Lefler, 2014). Given that Internet use can provide social support (Wangberg et al., 2008), we may reasonably hypothesize that social skills deficits are significantly associated with the risk of Internet addiction in adolescents with ADHD. However, no study has examined the association between social skills deficits and Internet addiction in a group of adolescents clinically diagnosed with ADHD. Furthermore, adolescents may use the Internet to perform various online activities. Internet activities differ in their characteristics and the types of recreation they offer. To determine whether social skills deficits are associated with different types of Internet activities, further studies are required. Moreover, sex (Yen, Yen, Chen, Tang, & Ko, 2009), severity of ADHD symptoms (Yen et al., 2009), parental socioeconomic status (SES) (Chou, Liu, Yang, Yen, & Hu, 2015), depression (Yen, Chou, Liu, Yang, & Hu, 2014), and anxiety (Yen et al., 2014) are significantly associated with Internet addiction in individuals with ADHD; however, whether these factors moderate the association between social skills deficits and Internet addiction and activities in adolescents with ADHD requires further study.

### Aims of this study

This study focused on examining the association between social skills deficits and Internet addiction and activities as well as the moderating effects of demographic, parental, and ADHD characteristics and comorbidity on this association in adolescents with ADHD. We have three hypotheses. First, the adolescents with ADHD and Internet addiction have higher social skills deficits than do those without Internet addiction. Second, social skills deficits are associated with different types of Internet activities. Third, because of the lack of previous studies, we hypothesize that demographic, parental,

and ADHD characteristics and comorbidities moderate the association between social skills deficits and Internet addiction and activities in adolescents with ADHD.

## METHODS

### Participants

The participants of 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 been diagnosed with ADHD according to the diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders fifth edition (DSM-5) (American Psychiatric Association, 2013), 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 (a) an interview with a child psychiatrist; (b) clinical observation of the participant's behavior; and (c) a history provided by the parents and the short version of Swanson, Nolan, and Pelham, Version IV Scale – Chinese version (SNAP-IV) (Gau et al., 2008; Swanson et al., 2001). 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 the 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.

### Measures

*Social skills deficits.* The present study applied the parent-reported Social Skills and Behaviors Checklist for Children and Adolescents (SSBCA-C) to measure the participants' social skills deficits (Meng, 2004). The SSBCA-C was developed on the basis of the theory of social skills in school-age children and adolescents proposed by Stephens (1978) and Gresham (1986). The 43-item SSBCA-C assessed the participants' social skills in the dimensions of self-performance, interpersonal relationships, and occupational behaviors over 1 month prior to the study. Parents rated each item for the social skills of adolescents on a 5-point Likert scale from 1 (*never*) to 5 (*always*). The reliability and validity of the SSBCA-C have been proven to be acceptable, and the SSBCA-C has been frequently used in studies on children and adolescents in Taiwan (Meng, 2004). The Cronbach's  $\alpha$  of the SSBCA-C in the present study was .84. A high total score indicated severe social skills deficits.

*Internet addiction and activities.* We used the Chen Internet Addiction Scale (CIAS) to assess the severity of the participants' self-reported Internet addiction levels over 1 month prior to the study. The CIAS contained 26 items to be rated on a 4-point Likert scale with scaled score ranging from 26 to 104 (Chen, Weng, Su, Wu, & Yang, 2003). A high total score indicated severe Internet addiction. The

internal reliability (Cronbach's  $\alpha$ ) of the CIAS in the present study was .94. According to the diagnostic criteria of Internet addiction (Ko, Yen, Chen, Chen, & Yen, 2005a), the 63/64 cut-off point has the highest diagnostic accuracy, sensitivity, and specificity for Internet addiction (Ko et al., 2005). We also questioned the adolescents regarding the types of Internet activities in which they engaged, such as online gaming, online chatting, instant messaging (e.g., MSN), writing e-mails, bulletin board systems (BBS), watching movies, watching news, searching for information, online shopping, online study, online gambling, and viewing depictions of sex intended for adults on the web (Lin et al., 2014). The Internet activities reported by more than 5% of the participants were selected for analysis.

**ADHD characteristics.** The short version of SNAP-IV-Chinese version, a 26-item rating instrument including the core ADHD subscales of inattention and hyperactivity/impulsivity and oppositional symptoms of oppositional defiant disorder, was used to rate the parent-reported ADHD characteristics of the participants during the 1-month period prior to the study (Gau et al., 2008; Swanson et al., 2001). Each of the 26 items was rated on a 4-point Likert scale from 0 (*not at all*) to 3 (*very much*). The Cronbach's  $\alpha$  of these three subscales in the present study ranged from .80 to .89. High total scores on the subscales indicated severe ADHD and oppositional symptoms. The presentations of ADHD specified by the participants, including combined, predominantly inattentive, and predominantly hyperactive or impulsive presentations, were determined by child psychiatrists according to the diagnostic criteria in the DSM-5 (American Psychiatric Association, 2013). The child psychiatrists also recorded whether the participants received medication for ADHD at the time of the study.

**Parental factors.** The present study examined the marital status of each participant's parents (married and living together vs. divorced or separated). Participants' parental occupational SES assessed using the Close-Ended Questionnaire of the Occupational Survey (CEQ-OS, Hwang, 2005), which classifies paternal and maternal occupational SES into five levels, such that 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 (Hwang, 2005). In the present study, levels I, II, and III of the CEQ-OS were classified as low occupational SESs, and levels IV and V were classified as high occupational SESs.

**Psychiatric comorbidity.** Two child psychiatrists assessed the clinical diagnoses of depressive disorders, anxiety disorders, and autism spectrum disorders (ASDs) on the DSM-5 on the basis of clinical interviews and chart reviews. Participants who were diagnosed with any ASDs, low intelligence (the full-scale intelligence quotient determined by the Wechsler Intelligence Scale for Children 4th Edition–Chinese version below 70), or difficulties in communication were excluded from this study.

#### Procedure

Because the adolescents recruited into this study have the diagnosis of ADHD, it is possible that adolescents may misunderstand the contents of the questionnaires due to

inattention. To ensure adolescents' comprehension, research assistants conducted interviews using the CIAS for the severities of Internet addiction and the questionnaire for Internet activities to collect data from the adolescents. The parents of the adolescents completed the SSBICA-C and SNAP-IV questionnaires under the direction of the research assistants.

#### Statistical analysis

Data analyses were performed using SPSS 20.0 statistical software (SPSS Inc., Chicago, IL, USA). We used a two-step statistical analysis method to examine the association between social skills deficits and Internet addiction. In the first step, we compared demographic and ADHD characteristics, family factors, comorbidities, and social skills deficits between participants with and without Internet addiction using the *t* and chi-square tests. A two-tailed *p* value of less than .05 was considered statistically significant. The significant variables in the first step were further selected for the second step of logistic regression analysis to examine their correlation with Internet addiction and activities. The odds ratio (OR) and 95% confidence interval (CI) were used to indicate significance. We also used the criteria proposed by Baron and Kenny (1986) to examine the moderators for the association between social skills deficits and Internet addiction and activities. According to the criteria, moderation occurred when the interaction term between the predictors (social skills deficits) and the hypothesized moderators was significantly associated with the dependent variable (Internet addiction and activities) after controlling for the main effects of both the predictors and hypothesized moderator variables. In this study, if social skills deficits and possible moderators were significantly associated with Internet addiction and activities in logistic regression analysis, the interactions (social skills deficits  $\times$  possible moderators) were further selected for logistic regression analyses to examine their moderating effects.

#### Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Boards of Kaohsiung Medical University and Chang Gung Memorial Hospital, Kaohsiung Medical Center approved the study. All participants were informed about the study. All adolescents and their parents provided informed consent.

## RESULTS

The demographic, parental, and ADHD characteristics, comorbidities, Internet addiction and activities, and social skills deficits of the participants are listed in Table 1. Among the participants, 259 (86.3%) were male and 41 (13.7%) were female. The mean age was 12.8 years [standard deviation (SD) = 1.8 years]. A total of 42 (14.0%) participants had Internet addiction.

The results of comparing demographic, parental, and ADHD characteristics, comorbidity, and social skills

Table 1. Demographic, parental, and ADHD characteristics, comorbidities, Internet addiction and activities, and social skills deficits of the participants (N = 300)

	n (%)	Mean (SD)	Range
Age (years)		12.8 (1.8)	11–18
Sex			
Girls	41 (13.7)		
Boys	259 (86.3)		
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 specified presentations			
Combined	213 (71.0)		
Predominantly inattentive	71 (23.7)		
Predominantly hyperactive/impulsive	16 (5.3)		
ADHD symptoms on the SNAP-IV			
Inattention		12.7 (5.8)	0–27
Hyperactivity/impulsivity		8.8 (6.0)	0–27
Oppositional		9.8 (5.7)	0–24
Receiving medication for ADHD	254 (84.7)		
Comorbidity			
Depressive or anxiety disorders	40 (13.3)		
Autism spectrum disorders	34 (11.3)		
Having Internet addiction	42 (14.0)		
Internet activities			
Online gaming	264 (88.0)		
Online chatting	212 (70.7)		
Instant messaging	105 (35.0)		
Writing e-mail	66 (22.0)		
BBS	47 (15.7)		
Watching movie	248 (82.7)		
Watching news	119 (39.7)		
Searching information	237 (79.0)		
Visiting pornographic website	26 (8.7)		
Online shopping	39 (13.0)		
Online gambling	9 (3.0)		
Online studying	100 (33.3)		
Social skills deficits		106.6 (22.9)	52–185

Note. ADHD = attention-deficit/hyperactivity disorder; BBS = bulletin board systems; SNAP-IV = Swanson, Nolan, and Pelham, Version IV Scale.

deficits between participants with and without Internet addiction are presented in Table 2. The results indicated that participants with Internet addiction had more severe social skills deficits and inattention and oppositional symptoms than those without Internet addiction. Furthermore, participants with Internet addiction were more likely to have low a maternal occupational SES and were less likely to receive medication for ADHD than those without Internet addiction.

The significant factors of Internet addiction were further selected for logistic regression model analyses to examine their associations with Internet addiction, and the results are presented in Table 3. The results of Model I indicated that a low maternal occupational SES and social skills deficits were significantly associated with Internet addiction. The

interactive variable of low maternal occupational SES and social skills deficits was further selected for Model II. The results indicated that the interactive variables of low maternal occupational SES and social skills deficits were significantly associated with Internet addiction; thus, maternal occupational SES had a moderating effect on the association between social skills deficits and Internet addiction. Further logistic regression analysis revealed that a significant association between social skills deficits and Internet addiction was found in participants with a low maternal occupational SES (OR = 1.059, 95% CI = 1.036–1.083) but not in those with a high maternal occupational SES (OR = 1.001, 95% CI = 0.954–1.050).

The associations between social skills deficits and Internet activities were initially examined using the *t* test. The

Table 2. Comparisons of demographic, parental, and ADHD characteristics, comorbidities, and social skills deficits between participants with and without Internet addiction

	Have Internet addiction (n = 42)	No Internet addiction (n = 258)	t or $\chi^2$	p value
Age (years), mean (SD)	13.2 (1.9)	12.8 (1.8)	-1.338	.182
Sex, n (%)				
Girls	7 (16.7)	34 (13.2)	0.373	.542
Boys	35 (83.3)	224 (86.8)		
Broken parental marriage status, n (%)	7 (16.7)	62 (24.0)	1.106	.293
Low paternal occupational SES, n (%)	30 (71.4)	145 (56.2)	3.446	.063
Low maternal occupational SES, n (%)	37 (88.1)	169 (65.5)	8.568	.003
ADHD subtypes, n (%)				
Combined	30 (71.4)	183 (70.9)	0.931	.628
Inattention	11 (26.2)	60 (23.3)		
Hyperactivity/impulsivity	1 (2.4)	15 (5.8)		
ADHD symptoms, mean (SD)				
Inattention	14.3 (6.0)	12.4 (5.8)	-2.031	.043
Hyperactivity/impulsivity	9.6 (7.2)	8.7 (5.8)	-0.947	.345
Oppositional	12.0 (6.1)	9.5 (5.6)	-2.636	.009
Receiving medication for ADHD, n (%)	31 (73.8)	223 (86.4)	4.434	.035
Comorbidity, n (%)				
Depressive or anxiety disorders	5 (11.9)	35 (13.6)	0.086	.769
Autism spectrum disorders	5 (11.9)	29 (11.2)	0.016	.900
Social skills deficits, mean (SD)	126.5 (20.8)	103.3 (21.6)	-6.482	<.001

Note. ADHD = attention-deficit/hyperactivity disorder; SES = socioeconomic status.

Table 3. Correlates of Internet addiction and moderators for the association between social skills and Internet addiction

	Model I		Model II	
	OR	95% CI of OR	OR	95% CI of OR
Low maternal occupational SES	4.349	1.555–12.165	0.012	0.000–2.617
Inattention symptoms	1.005	0.935–1.080	1.010	0.939–1.087
Oppositional symptoms	1.021	0.947–1.100	1.022	0.947–1.102
Receiving medication for ADHD	0.526	0.223–1.244	0.513	0.213–1.237
Social skills deficits	1.049	1.030–1.070	1.007	0.966–1.051
Low maternal occupational SES × social skills deficits			1.051	1.003–1.102

Note. ADHD = attention-deficit/hyperactivity disorder; CI = confidence interval; OR = odds ratio; SES = socioeconomic status.

Table 4. Association of social skills deficits with Internet activities

	Online gaming		BBS		Watching movie	
	OR	95% CI of OR	OR	95% CI of OR	OR	95% CI of OR
Low maternal occupational SES	0.594	0.256–1.381	0.746	0.383–1.454	0.988	0.513–1.902
Inattention symptoms	0.949	0.882–1.021	1.070	1.002–1.142	0.989	0.928–1.054
Oppositional symptoms	1.039	0.963–1.121	0.952	0.889–1.018	0.996	0.934–1.062
Receiving medication for ADHD	0.522	0.151–1.813	0.571	0.261–1.247	1.117	0.480–2.595
Social skills deficits	1.023	1.005–1.040	1.014	0.999–1.029	1.016	1.002–1.031

Note. ADHD = attention-deficit/hyperactivity disorder; BBS = bulletin board systems; CI = confidence interval; OR = odds ratio; SES = socioeconomic status.

results indicated that participants who engaged in online gaming ( $p = .007$ ), BBS ( $p = .033$ ), and watching movies ( $p = .026$ ) had more severe social skills deficits than those who did not participate in these Internet activities. The associations between social skills deficits and these three Internet activities were further examined using a logistic

regression model, and the results are presented in Table 4. The results, after adjustment for the effects of other factors, indicated that social skills deficits were significantly associated with online gaming and watching movies but not with BBS usage. However, maternal occupational SES was not significantly associated with online gaming or watching

movies, indicating that maternal occupational SES did not moderate the association between social skills deficits and online gaming and watching movies.

## DISCUSSION

In the present study, adolescents with ADHD and Internet addiction were found to have more severe social skills deficits than those without Internet addiction. Social skills deficits were also significantly associated with Internet gaming and watching movies. Maternal occupational SES moderated the association between social skills deficits and Internet addiction. Adolescent behaviors result from multi-system interactions (Lerner & Castellino, 2002). Two decades ago, Young, Pistner, O'Mara, and Buchanan (1999) proposed that addiction to cyber relationships is one of the major subtypes of Internet addiction (Young et al., 1999). The present study further provides evidence of the significant association between social skills deficits and Internet addiction.

### *Possible mechanisms underlying the association between social skills deficits and Internet addiction*

Although the cross-sectional study design limits the possibility of determining the causal relationships between social skills deficits and Internet addiction in adolescents with ADHD, several possible mechanisms may account for the relationships between social skills deficits and Internet addiction in adolescents with ADHD. First, social skills deficits contribute to the development of Internet addiction in adolescents with ADHD. Social skills deficits in ADHD partially result from social cognitive difficulties, including low empathy (Marton, Wiener, Rogers, Moore, & Tannock, 2009) and poor theory of mind performance (Uekermann et al., 2010). The Internet creates opportunities to engage anonymously in many activities without face-to-face social interaction; thus, social cognitive difficulties cause less failure in Internet activities. Some Internet activities, such as watching movies, can be performed by the user without interaction with others. Research revealed that lower empathy was associated with increased problematic Internet use in China and Germany (Melchers, Li, Chen, Zhang, & Montag, 2015). Moreover, individuals with ADHD show deficits in self-evaluation, self-monitoring, and the interpretation of affect in social situations (Hoza, 2007; Humphreys et al., 2016). Individuals with ADHD may experience reduced distress when using the Internet; during Internet sessions, they may experience reduced concern regarding appropriate responses to social cues. Even in the Internet activities, such as multiplayer online games, adolescents with ADHD and social skills deficits can behave according to set modes and have fewer difficulties in social interaction when playing online games than they typically have in face-to-face social situations.

Second, the ADHD-related characteristics accompanying social skills deficits increase the risk of Internet addiction in adolescents with ADHD. For instance, one typical characteristic of ADHD, emotional dysregulation, can aggravate social skills deficits in ADHD patients (Bunford, Evans,

Becker, & Langberg, 2015) and further increase Internet use. Emotional dysfunction may also make individuals with ADHD demonstrate immediate emotional reactivity to emotionally charged events and fewer anticipatory emotions toward future events because of a reduced capacity for forethought (Barkley, 1997). The individuals with emotional dysregulation may prefer to participate in Internet activities, such as the first-person shooter games, to release their emotion reasonably without concern regarding the comments of others. The core symptoms of ADHD, including inattention, hyperactivity, and impulsivity may also limit the social learning of individuals and make them highly aversive to peers (Hoza, 2007). However, the present study revealed that after adjustment for the effects of ADHD symptoms and receiving medication for ADHD, social skills deficits are independently associated with Internet addiction.

Third, Internet addiction reduces the opportunity for face-to-face contact between the adolescents and others. The adolescents need to practice social skills continuously and modify their behavior based on feedback from others (Bergmark et al., 2011). Preoccupation with Internet use may limit the adolescents' opportunities to practice social skills and rectify social skills deficits.

### *Moderators for the association between social skills deficits and Internet addiction*

This study revealed that the significant association between social skills deficits and Internet addiction occurred only in participants with a low maternal occupational SES but not in those with a high maternal occupational SES. Research has revealed that low SES families were more likely to have a sedentary lifestyle than were high SES families (Varo et al., 2003). In most of Taiwanese families, mothers are typically obligated to 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 reduced capacity for monitoring and controlling their adolescents' Internet use; thus, the risk of Internet addiction increases in adolescents with ADHD and social skills deficits.

Research has found that 20–50% of children with ADHD have significant ASD characteristics even meet criteria for ASD (Carpenter, Loo, Yang, Dang, & Smalley, 2009; Hattori et al., 2006). Research revealed that youth with combined ADHD and ASD have higher social interaction impairment than those with ADHD only (Salley, Gabrielli, Smith, & Braun, 2015). However, the present study did not found the moderating effect of comorbid ASD on the association between social skills deficits and Internet addiction in adolescents with ADHD. Research has found that executive functioning impairment is significantly associated with Internet addiction (Ko et al., 2014) and deficits in adaptive communication skills (Clark, Prior, & Kinsella, 2002), whereas comorbid ASD did not increase the severity of executive functioning impairments in those with ADHD (Neely, Green, Sciberras, Hazell, & Anderson, 2016; Tye et al., 2014, 2016). Therefore, lack of addictive impacts of comorbid ASD on executive functioning impairments in those with ADHD may partially account for the result of the

present study that comorbid ASD did not moderate the association between social skills deficits and Internet addiction in adolescents with ADHD.

Depression and anxiety were significantly associated with poor social functioning in adolescents with ADHD (Becker, Langberg, Evans, Girio-Herrera, & Vaughn, 2015). Adolescents with significant ADHD symptoms had more severe social anxiety symptoms than did those without significant ADHD symptoms (Liu, Yang, Ko, Yen, & Yen, 2014). Moreover, social anxiety was lower during face-to-face interaction than during offline interaction (Yen et al., 2012). We may reasonably hypothesize that depression and anxiety moderate the association between social skills deficits and Internet addiction in adolescents with ADHD. However, the results of the present study did not support this hypothesis. Moreover, research found that the association between attention deficit and Internet addiction was more significant among female college students than in male students (Yen et al., 2009). The present study, however, did not find the moderating effect of sex on the association between social skills deficits and Internet addiction in adolescents with ADHD. The very low number of girls in the addiction group ( $n = 7$ ) limited the possibility to make the conclusion. Research revealed that boys have more severe Internet addiction than girls, as well as that there are differences in the goals to play online games between boys and girls (Ko, Yen, Chen, Chen, & Yen, 2005b). The moderating effect of sex on the association between social skills deficits and Internet addiction in adolescents with ADHD warrants further study.

#### Study limitations

Several limitations in our investigation require attention. First, the cross-sectional research design of this study limited our ability to draw conclusions regarding the causal relationships between social skills deficits and Internet addiction. Second, the present study did not examine how the associations between social skills deficits and Internet addiction develop. Third, the participants of the present study were recruited from clinical units. Further studies are needed 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. Fourth, although the present study examined the moderating effects of demographic, parental, and ADHD characteristics and comorbidities, the present study did not examine the moderating effects of some other factors. For example, conduct disorder is one of the most prevalent comorbidities and has negative impacts on outcome in adolescents with ADHD (Biederman et al., 2008). Only two participants had the diagnosis of conduct disorder in the present study, which limited the possibility to examine the moderating effect of conduct disorder on the association between social skills deficits and Internet addiction in adolescents with ADHD.

#### CONCLUSIONS

Both social skills deficits and Internet addiction can have profoundly adverse influences on an adolescent's

development. The significant association between social skills deficits and Internet addiction found in the present study indicates that both social skills deficits and Internet addiction require early prevention and intervention in adolescents with ADHD. Regarding social deficits in ADHD, a meta-analysis found that cognitive-behavioral therapy (CBT) can improve the social competence of individuals with ADHD (Battagliese et al., 2015). However, most previous studies have focused on children with ADHD but not on adolescents with ADHD. Whether CBT can enhance social skills and reduce the risk of Internet addiction among adolescents with ADHD warrants further study. By contrast, prevention and intervention for Internet addiction in adolescents with ADHD is needed to reduce the possibility of social skills deficits. Although a previous study indicated that methylphenidate reduces the severity of Internet video game play addiction in children with ADHD (Han et al., 2009), multimodal, nonpharmacological intervention consisting of CBT, motivational interviewing, reality training, and family management skills training is the main strategy for treating Internet addiction (King, Delfabbro, Griffiths, & Gradisar, 2011). The present study found that maternal occupational SES moderates the association between social skills deficits and Internet addiction in adolescents with ADHD, and thus prevention and intervention strategies must consider maternal occupational SES.

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*Conflict of interest:* The authors declare that they have no conflict of interest.

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