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Relationship of Risky Internet Use with Parental Depression and Anxiety in a Sample of Turkish Adolescents with Attention Deficit Hyperactivity Disorder

Dikkat Eksikliği Hiperaktivite Bozukluğu Olan Türk Ergen Örnekleminde Riskli İnternet Kullanımının Ebeveyn Depresyonu ve Anksiyetesi ile İlişkisi

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ABSTRACT

Parental mental health has a significant impact on adolescent well-being, including their engagement in problematic behaviors such as risky internet use. However, limited research has examined the association between parental mental health and risky internet use (RIU) in adolescents, particularly those with attention-deficit/hyperactivity disorder (ADHD). To address this gap, this study investigated the relations between parental depression and anxiety symptoms and RIU in adolescents with ADHD. A sample of 100 participants (mean age = 13.6 years; 27% female) diagnosed with ADHD was included. Parental depression and anxiety symptoms were assessed using the Beck Depression and Beck Anxiety Inventories, while adolescents' RIU was measured using Young's Internet Addiction Scale. Participants with scores exceeding 50 on the scale were classified as having RIU. After controlling for adolescent gender, parental education levels, and income, the results revealed that both parental depressive (β = 0.09) and anxiety symptoms (β = 0.06) significantly predicted an elevated risk of RIU in adolescents with ADHD. These findings highlight the substantial role of parental depression and anxiety as risk factors for RIU in this population. Understanding these associations can inform the development of targeted interventions to mitigate the impact of parental mental health on adolescent RIU and promote better outcomes for individuals with ADHD.

Keywords: Attention deficit/hyperactivity disorder, risky internet use, adolescence, parental depression, parental anxiety,

ÖZ

Ebeveynlerin ruh sağlığı ile ergenlerin ruh sağlığı ilişkilidir ve ebeveynler aşırı İnternet kullanımı dahil olmak üzere ergenlerin sorun oluşturan riskli davranışlarında rol oynayabilmektedir. Ebeveynlerin ruh sağlığı ile ergenlerdeki riskli internet kullanımı (RİK) arasındaki ilişkiyi, özellikle dikkat eksikliği/hiperaktivite bozukluğu (DEHB) olan ergenlerde araştıran az sayıda çalışma bulunmaktadır. Ebeveynlerin ruh sağlığı, ergenlerin iyi oluşunda önemli bir rol oynadığından, bu çalışma ebeveyn depresyonu ve kaygısı ile DEHB'li ergenlerde RİK arasındaki ilişkileri incelemiştir. Çalışmaya primer DEHB tanısı alan 11-17 yaşları arasında (Ort. = 13,6; %27 kadın) 100 katılımcı dahil edildi. Ebeveyn depresyonu ve anksiyete belirtileri Beck Depresyon ve Beck Anksiyete Envanterleri kullanılarak değerlendirilirken, ergenlerin RİK düzeyi Young'ın İnternet Bağımlılık Ölçeği ile ölçülmüştür. Ölçekte 50 puanı aşan katılımcılar RİK olarak sınıflandırılmıştır. Ergenlerin cinsiyeti, ebeveyn eğitim düzeyleri ve ailenin geliri kontrol edildikten sonra, ebeveynlerin depresyon (β = 0,09) ve anksiyete (β = 0,06) puanları, DEHB'li ergenlerin RİK puanları ile anlamlı derecede ilişkili saptandı. Bu bulgular, ebeveyn depresyonu ve anksiyetesinin RİK için risk faktörleri olabileceğini göstermektedir. Bu çalışma, ebeveyn ruh sağlığının ergenlerde RİK üzerindeki etkisini azaltmaya yönelik müdahalelerin geliştirilmesine ve DEHB'li ergenler için daha iyi sonuçların elde edilmesine katkıda bulunabilir.

Anahtar sözcükler: Dikkat eksikliği hiperaktivite bozukluğu, riskli internet kullanımı, ergenlik, ebeveyn depresyonu, ebeveyn kaygısı

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Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by symptoms of inattention, hyperactivity, and impulsivity (APA 2013). Prevalence rates of ADHD in children and adolescents range between 5.9% and 7.1% (Willcutt 2012). ADHD is known to be associated with significant impairments in academic, social, and family functioning, and it often co-occurs with other psychiatric conditions (AlZaben et al. 2018, Franke et al. 2018). Among the psychiatric comorbidities observed in individuals with ADHD, risky internet use has been identified as a noteworthy concern (Yoo et al. 2004, Yen et al. 2007a, Ko et al. 2012, Kahraman and Demirci 2018).

The proliferation of internet access, despite its numerous benefits, has brought forth adverse effects on the psychological, social, and familial well-being of adolescents (Lin and Tsai 2002, Kuss et al. 2014). The prevalence of problematic internet use among children and adolescents has been reported to be between 2% and 12% (Aboujaoude 2010). Terms such as pathological internet use, problematic internet use, excessive internet use, virtual addiction, and internet addiction have been used to describe problem behaviors associated with internet use (Shaw and Black 2008). While internet addiction is not officially recognized as a standalone disorder in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), the diagnosis of internet gaming disorder is included (American Psychiatric Association 2013).

In this study, "risky ınternet use (RIU)" refers to a pattern of internet use characterized by persistent, repetitive, and elevated preoccupation, compulsive behaviors, emotional changes, behavioral problems, and significant impact on various aspects of life (Young 2004). It involves excessive preoccupation, prolonged usage for satisfaction, irritability during abstinence, and deterioration in social and familial relationships (Young 2004). Previous research focusing on adolescents has demonstrated significant associations between RIU and ADHD (Yoo et al. 2004, Ha et al. 2006, Yen et al. 2007a, 2009; Bernardi and Pallanti 2009). RIU has been found to be related to elevated impulsivity, which is a core feature of ADHD (Zhang et al. 2015, APA 2013). Individuals with ADHD are more prone to impulsive actions and engage in sensation-seeking activities (Graziano et al. 2015). The internet provides a vast array of such activities. Furthermore, studies have indicated that individuals with ADHD exhibit abnormal brain activity associated with impaired inhibitory control (Rubia et al. 2005), a tendency to become easily bored, and a preference for immediate rewards rather than delayed ones (Castellanos and Tannock 2002). Additionally, the release of striatal dopamine during video game playing can enhance focus and performance, potentially facilitating increased internet use (Koepp et al. 1998). Adolescents with ADHD also exhibit motivational deficits, including a quick adjustment to repeated positive reinforcement and diminished response to punishment (Castellanos and Tannock 2002, Berger et al. 2007), which may make them more susceptible to developing RIU (Ko et al. 2012).

Parenting has been identified as a crucial factor influencing adolescents' internet use, as primary caregivers have the ability to shape the family environment and participate in the prevention of problematic and risky behaviors (Miller and Plant 2010). Numerous studies have demonstrated significant relations between parenting styles, parental attitudes, family relationships, and RIU in adolescents (Yen et al. 2007b, Park et al. 2008, Xiuqin et al. 2010, Xu et al. 2014, Ko et al. 2015). Limited research has explored the link between parental mental health and RIU in adolescents (Choi et al. 2018, Lam 2015, 2020). Depressed parents tend to have more negative interactions, pay less attention to their children's needs, and have lower-quality relationships compared to non-depressed mothers (Chi and Hinshaw 2002, Olsson and Hwang 2001, Burke 2003). This lack of monitoring and poor relationship quality may contribute to RIU in adolescents with ADHD, who already require additional parental support. Anxious parents may engage in overcontrolling behaviors and rely on corporal punishment rather than supportive strategies (Rapee 1997). Adolescents with ADHD, experiencing distress from intrusive parenting, may be more inclined to use the internet as a means of coping with negative moods (Lam 2015, Wong et al. 2019).

Given the significant influence of parental mental health on adolescent well-being (Acri and Hoagwood 2015), it is crucial to enhance our understanding of the role of parental mental health in relation to RIU in adolescents with ADHD. This knowledge is vital for the development and enhancement of interventions targeting the prevention and treatment of RIU. Building upon previous research, the present study aims to investigate the association between parental depressive and anxiety symptoms and RIU in adolescents with ADHD, employing a well-evaluated RIU group in comparison to an age-matched comparison group. Based on existing literature, we hypothesize that higher levels of parental depression and anxiety will be positively associated with an increased risk of RIU in adolescents with ADHD.

Method

Sample

The study included a sample of 100 adolescents aged 11-18, along with their primary caregivers. The majority of the adolescent participants were male (73%), and the mean age was 13.6 years (SD = 1.9). Most of the adolescents had no prior diagnosis of any psychiatric disorder (88%). The mean age of the mothers was 40.4 years, and the fathers' mean age was 44.5 years. The educational background of the mothers was primarily illiterate or primary school level (41%), while the fathers' education level was mostly secondary school or high school (56%). The majority of the mothers were housewives (66%), and the fathers were self-employed (54%). Most of the caregivers were married (91%) and had 2-3 children living in the household (75%). Regarding the household monthly income, the majority reported an income of more than 6000 Turkish lira (41%). A detailed description of the participant demographics is provided in Table 1.

Table 1. Demographic characteristics.

	NRIU Group (n=50)	**RIU Group (n=50)**	**Total (n=100)**
Adolescent Characteristics			
Gender			
Male	35 (70%)	38 (76%)	73 (73%)
Female	15 (30%)	12 (24%)	27 (27%)
Age (in years) Mean (SD)	13.7 (1.9)	13.5 (2.1)	13.6 (1.9)
Family Characteristics			
Mother age (in years) Mean (SD)	41 (4.8)	39.7 (5.1)	40.4 (4.9)
Mother Education			
Illiterate or primary school	21 (42%)	20 (40%)	41 (41%)
Secondary school or high school	18 (36%)	20 (40%)	38 (38%)
University or higher education	11 (22%)	10 (20%)	21 (21%)
Mother Employment			
Housewife	38 (76%)	28 (56%)	66 (66%)
Self-employed	6 (12%)	15 (30%)	21 (21%)
Civil servant	4 (8%)	2 (4%)	6 (6%)
Worker	2 (4%)	5 (10%)	7 (7%)
Father age (in years) Mean (SD)	45.3 (4.9)	43.7 (7.9)	44.5 (6.6)
Father Education			
Illiterate or primary school	11 (22%)	13 (26%)	24 (24%)
Secondary school or high school	26 (52%)	30 (60%)	56 (56%)
University or higher education	13 (26%)	7 (14%)	20 (20%)
Father Employment			
Unemployed	0 (0%)	1 (2%)	1 (1%)
Self-employed	26 (52%)	28 (56%)	54 (54%)
Civil servant	11 (22%)	6 (12%)	17 (17 %)
Worker	13 (26%)	15 (30%)	28 (28%)
Household Income (monthly)			
0-2800	1 (2%)	5 (10%)	6 (6%)
2800-4000	13 (26%)	12 (24%)	25 (25%)
4000-6000	17 (34%)	11 (22%)	28 (28%)
6000+	19 (38%)	22 (44%)	41 (41%)
Family Structure			
Married	47 (94%)	44 (88%)	91 (91%)
Divorced	3 (6%)	5 (10%)	8 (8%)
Death	(0%)	1 (2%)	1 (1%)
Number of children in home			
0-1	4 (8%)	10 (20%)	14 (14%)
2-3	39 (78%)	36 (72%)	75 (75%)
4-5	7 (14%)	4 (8%)	11 (11%)
Anyone at home other than the family			
No	40 (80%)	44 (88%)	84 (84%)
Yes	10 (20%)	6 (12%)	16 (16%)

NRIU: Non-Risky Internet Use; RIU: Risky Internet Use

Procedure

The participants in this study were adolescents who had been diagnosed with ADHD and were receiving treatment at the Child and Adolescent Psychiatry Outpatient Clinic of Bezmialem Vakıf University Hospital between July 2021 and June 2022. Inclusion criteria for the study included being between the ages of 11 and 18 and meeting the DSM-5 criteria for a diagnosis of ADHD as assessed by a child psychiatrist, either for the first time or having been drug-free for at least six months. The diagnosis of ADHD was confirmed using the semi-structured interview criteria from the Schedule for Affective Disorders and Schizophrenia for School-Age Children Present and Lifetime Version (K-SADS-PL-DSM-5-T) (Unal et al. 2019).

Adolescents who met the criteria for ADHD were invited to participate in the study, along with their parents who were provided with detailed information about the study and invited to take part. The sample size for the study was determined to be 126 individuals based on previous research, aiming to achieve a statistical power of 80% at a significance level of α: 0.05 and a 95% confidence level, with the intention of detecting a significant difference of 4 units between the means (44±10.6, 48±8). A total of 126 eligible parent-child dyads were invited to participate; however, consent was obtained from only 100 dyads, as 26 of them did not provide consent.

Parents of adolescents diagnosed with ADHD were asked to complete several assessment measures. These included the Conners Parent Rating Scale-Revised Short, which assesses the ADHD symptoms of their adolescents, the Parent-Child Internet Addiction Test, which evaluates risky Internet use, and the Beck Depression Inventory and Beck Anxiety Inventory scales, which measure the parents' own symptoms of anxiety and depression.

The case group consisted of adolescents diagnosed with ADHD who scored 50 or higher on the Young Internet Addiction Scale (IAS). The control group was defined as adolescents diagnosed with ADHD who scored less than 50 on the IAS. Exclusion criteria included receiving any medication or psychotherapeutic treatment for ADHD, having bipolar disorder, experiencing an acute psychotic episode or manic/hypomanic episode, having intellectual disability, being illiterate, having a diagnosis of autism, or being unwilling to participate in the study. Participation was voluntary with written informed consent obtained from both adolescents and their parents.

The study followed the approved research protocol (IRB Protocol: 26.07.2021-24597) and was conducted at the Child and Adolescent Psychiatry Outpatient Clinic of Bezmialem Vakıf University Hospital. Qualified a child psychiatrist administered the procedures, ensuring adherence to standardized practices and overseeing data collection in accordance with established protocols and guidelines. The study adhered to the ethical guidelines approved by the ethics committee of the Bezmialem Vakıf University Faculty of Medicine, ensuring credibility and reliability.

Measures

Schedule for Affective Disorders and Schizophrenia for School-Age Children Present and Lifetime Version-Turkish (K-SADS-PL-DSM-5-T)

The K-SADS-PL is a semi-structured diagnostic interview used to assess current and past episodes of psychopathology in children and adolescents based on DSM-5 criteria (Kaufman et al. 2016). The Turkish version of K-SADS-PL has well-established psychometric properties (Unal et al. 2019).

Conners Parent Rating Scale-Revised Short (CPRS-RS)

The CPRS-RS consists of 27 items measuring ADHD symptoms in children over the past month (Conners 1997). Items are scored on a Likert scale ranging from 0 to 3, with higher scores indicating more problems. The Turkish version of CPRS-RS demonstrated satisfactory psychometric properties (Kaner et al. 2013). The Cronbach's α for this study was 0.89.

Young Internet Addiction Scale (IAS)

The IAS is a self-report measure assessing preoccupation, compulsive use, behavioral problems, emotional changes, and impact on life related to internet use (Young 2009). It consists of 20 items rated on a Likert scale from 1 to 5. The Turkish version of IAS has well-documented psychometric properties (Boysan et al. 2017). The Cronbach's α for this study was 0.95. We defined the 'risky internet use' (RIK) group as IAS ≥ 50 (n = 50) and the 'non-risky internet use (NRIU)' group as IAS < 49 (n = 50).

Parent-Child Internet Addiction Test (PCIAT-20)

The PCIAT-20 is a measure designed to evaluate children for internet addiction (Young 2009). The Turkish version of PCIAT-20 has well-established psychometric properties (Eşgi 2014). It is a six-point Likert-type scale, and scores range from 0 to 5. Children are classified as Internet addicted if their score is above 80, with limited symptoms if their score is between 79 and 50, and with average symptoms if their score is below 49. The Cronbach's α for this study was 0.96.

Beck Depression Inventory (BDI)

The BDI is a self-report questionnaire assessing the severity of depression in both normal and psychiatric populations (Beck et al. 1961). It consists of 21 items rated on a four-point scale. The Turkish version of the BDI has good psychometric properties (Hisli 1988, 1989). The Cronbach's α for this study was 0.90.

Beck Anxiety Inventory (BAI)

The BAI is a 21-item self-report inventory measuring anxiety severity over one week in psychiatric populations (Beck et al. 1993). It includes physical, cognitive, and mixed symptom items. The Turkish version of the BAI has good psychometric properties (Ulusoy et al. 1998). The Cronbach's α for this study was 0.91.

Statistical Analysis

Descriptive statistics were used to summarize the sociodemographic characteristics of the participants, including age, gender, mothers' education level, fathers' education level, and income level. Chi-square tests and t-tests were conducted to examine any significant differences between the groups based on these characteristics. Next, correlation analyses were performed to explore the associations between study variables. Furthermore, a t-test analysis was conducted to compare the levels of parents' depressive and anxiety symptoms separately between the RIU and the NRIU groups. Binary logistic regression analysis was then performed to determine whether parents' depressive or anxiety symptoms was associated with RIU in adolescents with ADHD. Odds ratios (OR) and 95% confidence intervals (CI) were calculated to quantify the relationship. Gender, maternal education, paternal education, and household income were controlled for based on the existing literature and theoretical associations with the variables of interest (Bakken et al. 2009, Choi et al. 2018, Ko et al. 2008, Lam et al. 2009). Finally, additional binary logistic regression analyses were conducted with parent-report RIU as the dependent variable to verify the consistency of the previous findings regarding the significance of parent depressive and anxiety symptoms in predicting adolescent RIU. The convergence of parent-adolescent perceptions of RIU was also examined.

Results

A total of 100 adolescents with ADHD participated in the study, with a mean age of 13.6 years (SD = 2.2), ranging from 11 to 17 years. Among the participants, 27% (N = 27) were female. There were no significant differences between the groups with risky internet use (RIU) and non-RIU regarding gender ($\chi2(1) = 0.20$, $p = 0.65$), age ($t(97) = 0.46$, $p = 0.64$), mothers' education level ($\chi2(4) = 6.16$, $p = 0.18$), fathers' education level ($\chi2(4) = 3.43$, $p = 0.48$), or income level ($\chi2(3) = 3.21$, $p = 0.36$).

Table 2. Comparison of the mean values of parent depression and parent anxiety.

	NRIU Group (n=50)	RIU Group (n=50)	Total (n=100)	p-value
Parent Depression	7.5 (6.7) [0, 34]	12.6 (9.5) [0, 44]	10.1 (8.6) [0, 44]	0.003
Parent Anxiety	9.26 (8.37) [0, 34]	14.6 (11.3) [0, 52]	11.9 (10.3) [0, 52]	0.009

NRIU: Non-Risky Internet Use; RIU: Risky Internet Use

Parent-reported RIU showed a moderate association with parent-reported ADHD symptoms in adolescents ($r(98) = 0.39$, $p < 0.001$). Additionally, there were significant positive correlations between parents' depressive symptoms ($r(98) = 0.31$, $p = .002$) and anxiety symptoms ($r(98) = 0.30$, $p = 0.002$) with parent-reported RIU in adolescents.

A significant t-test analysis revealed that parents in the RIU group had significantly higher levels of depressive symptoms ($M = 12.6$, $SD = 9.5$) compared to the NRIU group ($M = 7.5$, $SD = 6.7$), $t(88) = -0.31$, $p = 0.03$. Subsequently, a binary logistic regression analysis was conducted with adolescent RIU group as the dependent variable, controlling for gender, maternal education, paternal education, and household income. The results

indicated that parents' depressive symptoms were a significant predictor of RIU in adolescents with ADHD (B = 0.09, p = 0.00). Compared to the NRIU group, parents were more likely to report depressive symptoms (OR = 1.09, 95% CI: 1.03-1.17). This suggests that for every one-unit increase in parents' depressive symptoms, the odds of having RIU (versus not having RIU) increased by 1.09 in adolescents diagnosed with ADHD. Furthermore, parents' depressive symptoms accounted for 10% of the adjusted explained variance (Table 3).

Table 3. Logistic regression analysis for parent depression to compare adolescents in the NRIU and RIU groups.

	Estimate	Std. Error	z-value	p-value	OR	2.5 %	97.5 %
Gender	-0.40	0.49	-0.82	0.41	0.66	0.24	1.74
Maternal Education	0.50	0.59	0.84	0.40	1.64	0.51	5.42
Paternal Education	-0.81	0.60	-1.33	0.18	0.44	0.12	1.41
Household Income	0.11	0.25	0.45	0.65	1.12	0.67	1.85
Parent Depression	0.09	0.03	2.85	p<0.01	1.09	1.03	1.17

NRIU: Non-Risky Internet Use; RIU: Risky Internet Use

A significant t-test analysis indicated that parents in the RIU group exhibited significantly higher levels of anxiety symptoms (M = 14.6, SD = 11.3) compared to the NRIU group (M = 9.3, SD = 8.3), t(90) = -2.69, p = 0.09. Subsequently, a binary logistic regression analysis was conducted with the adolescent RIU group as the dependent variable, while controlling for gender, maternal education, paternal education, and household income. The results revealed that parents' anxiety symptoms were a significant predictor of RIU in adolescents with ADHD (B = 0.06, p = 0.01). Parents were more likely to report anxiety symptoms compared to the NRIU group (OR = 1.06, 95% CI: 1.01-1.11). Therefore, for each one-unit increase in parents' anxiety symptoms, the odds of having RIU (versus not having RIU) increased by a factor of 1.06 in adolescents diagnosed with ADHD. Additionally, parents' anxiety symptoms accounted for 10% of the adjusted explained variance (Table 4).

Table 4. Logistic regression analysis for parent anxiety to compare adolescents in the NRIU and RIU groups.

	Estimate	Std. Error	z-value	p-value	OR	2.5 %	97.5 %
Gender	-0.17	0.48	-0.36	0.72	0.84	0.32	2.15
Maternal Education	0.41	0.59	0.69	0.49	1.50	0.47	4.94
Paternal Education	-0.77	0.59	-1.29	0.20	0.46	0.13	1.44
Household Income	0.05	0.25	0.19	0.85	1.04	0.64	1.72
Parent Anxiety	0.06	0.02	2.43	0.01	1.06	1.01	1.11

NRIU: Non-Risky Internet Use; RIU: Risky Internet Use

We further assessed the reliability of the findings through parent-adolescent reports. Our analysis revealed a strong positive association between parent and adolescent reports of adolescent RIU, indicating a high level of agreement (r(98) = 0.90, p < 0.001). To strengthen the evidence, we conducted additional analyses using parent-reported RIU as the dependent variable. The results consistently showed that both parent depressive symptoms (B = 0.03, p = 0.00) and parent anxiety symptoms (B = 0.02, p = 0.01) significantly predicted adolescent RIU based on both parent and adolescent reports. These findings provide robust evidence for the role of parental depressive and anxiety symptoms in predicting adolescent RIU. Moreover, this multi-informant study highlights the convergence of parent-adolescent perceptions regarding RIU and offers insights into its developmental aspects.

Discussion

The present study aimed to investigate the association between parental mental health and risky internet use (RIU) symptoms in Turkish adolescents with ADHD. Previous research examining the relationship between RIU and parental psychopathology in adolescents with ADHD is limited (Wong et al. 2019, Lam 2015, 2020, Sahanapriya et al. 2021). Our findings confirmed our hypothesis that higher levels of parental depressive symptoms and anxiety were significant predictors of greater RIU in adolescents with ADHD. Importantly, these associations remained significant even after controlling for sociodemographic factors such as income and parental education levels. The results obtained from both self-report and parent-report methods demonstrated consistent associations between parental anxiety and depressive symptoms and adolescent RIU.

It is essential to explore the mechanisms underlying this relationship. Previous studies have shown that mothers with depression tend to exhibit poor interactions and provide less attention to their children compared to non-depressed mothers (Lovejoy et al. 2000; Olsson and Hwang 2001, Burke 2003, Sohr-Preston and Scaramella 2006). Adolescents with a depressed mother may perceive their relationship as emotionally distant and cold, leading them to seek alternative sources of social support, such as excessive internet use, to alleviate their

emotional distress (Lovejoy et al. 2000, Park et al. 2008, Willoughby 2008). This may be particularly challenging for adolescents with ADHD, who require additional parental support to manage their ADHD symptoms and regulate their internet use.

Furthermore, anxious parents may exhibit over-controlling behaviors and excessive involvement in their children's lives. When combined with ADHD, these anxious parents may use more hostile parenting practices, such as frequent disapproval and criticism, in response to their children's behavioral challenges (Kashdan et al. 2004). These negative parenting behaviors, characterized by a lack of warmth, acceptance, positive affect, and support, may contribute to poorer parent-child relationship quality and subsequently drive excessive internet use in the child (Nickerson and Nagle 2005, Willoughby 2008). Therefore, parents with high levels of depressive and anxiety symptoms are associated with negative parenting behaviors that may facilitate increased internet use among adolescents with ADHD.

Additionally, high maternal anxiety levels may contribute to greater internet use in adolescents with ADHD by influencing their own anxiety levels. Continued exposure to anxious behaviors of parents, such as being nervous, restless, or having a sense of impending danger, may increase the risk of stress or anxiety development in children (Pereira et al. 2014). Studies have shown that mothers' anxious behaviors are associated with a higher likelihood of similar behaviors and cognitions in their children (Burstein and Ginsburg 2010; Pereira et al. 2014). Consequently, adolescents may turn to internet use as a means to avoid or alleviate their anxiety symptoms (Cho et al. 2013).

Moreover, it is important to recognize that the relationship between parental mental health and adolescent RIU problems may also be bidirectional (Wong et al. 2019). While parents have an influence on adolescent mental health (Acri and Hoagwood 2015), even skilled parents can encounter challenges in managing their children's difficult behaviors. The hyperactive, inattentive, and impulsive behaviors associated with ADHD can lead to dysfunction in various areas of adolescents' lives (Barkley et al. 2006, Bussing et al. 2010), including difficulties in parent-child communication, which further increases the parental caregiving burden (Margari et al. 2013). This excessive caregiving responsibility, surpassing normal developmental stages, can impact parents' emotional well-being and have adverse effects on their social, family, and professional lives, as well as their mental health. The increased caregiving burden, daily hardships, stress, and disappointment can directly influence parents' quality of life (Raina et al. 2015) and may contribute to the development of depressive symptoms (Segenreich et al. 2009, Margari et al. 2013) and anxiety (Steinhausen et al. 2013). These factors may further exacerbate parental mental health difficulties and potentially contribute to the emergence of RIU in adolescents with ADHD.

Indeed, the relationship between parental anxiety and depression and RIU in adolescents with ADHD is likely to be complex and influenced by both environmental and genetic factors. Shared environmental effects, such as family dysfunction and conflict, can impact both parental mental health and high levels of internet use in adolescents with ADHD (Ko et al. 2015). Genetic transmission of depressive disorder (Lee et al. 2008, Gámez-Guadix 2014) may also play a role in explaining the heightened risk of RIU in adolescents with ADHD, who may turn to the internet as a coping mechanism for emotional distress or personal problems (Gámez-Guadix 2014).

Our findings revealed no gender effect regarding RIU in adolescents with ADHD, which is consistent with previous studies that have also reported no gender differences in some forms of RIU (Dufour et al. 2016, Sahanapriya et al. 2021, Trumello et al. 2021). However, these results differ from studies suggesting that RIU is more common in either female adolescents (Ballarotto et al. 2018) or male adolescents (Ko et al. 2008, Bakken et al. 2009, Lam et al. 2009), indicating that gender might be a risk factor for RIU. The contradictory findings suggest the presence of other gender-related factors that may contribute to RIU. While gender was not the primary focus of this study, it is essential to address these findings in future research to gain a more comprehensive understanding.

Furthermore, our results demonstrated no significant effects of mother's or father's educational level on RIU in adolescents with ADHD, aligning with previous studies (Lam 2015). However, there is evidence suggesting an association between maternal depression and children's RIU, particularly among mothers with higher educational attainment (Choi et al. 2018). Moreover, household income did not show any impact on RIU in adolescents with ADHD. These findings suggest that socioeconomic factors did not significantly influence RIU in this particular sample. Additionally, the absence of variation in RIU among adolescents with ADHD based on socioeconomic factors helps rule out the possibility that parental mental health differences are solely attributable to socioeconomic differences. Instead, the results imply that differences in parental mental health for adolescents' RIU are primarily driven by variations in RIU itself rather than socioeconomic factors.

Several limitations of this study should be acknowledged. Firstly, the sample was limited to patients and their parents who sought outpatient care at a specific medical school, potentially limiting the generalizability of the findings. Secondly, the study relied on self-report measures of RIU from both adolescents and parents, which may introduce recall bias, although self-reports have been considered valid indicators in previous research (Lam 2015, 2020, Choi et al. 2018). Additionally, the cross-sectional design of the study precludes the establishment of causality between parental mental health and RIU in adolescents with ADHD, as both measures were assessed simultaneously. Therefore, these findings should be interpreted with caution. Furthermore, given the limited body of research in this area (Lam 2015, 2020, Choi et al. 2018), it remains challenging to draw definitive conclusions regarding the associations between parental mental health and RIU in adolescents with ADHD. Future longitudinal studies will provide valuable insights into the causal nature and temporal sequence of these relationships, informing clinical practice and improving the management of RIU in adolescents with ADHD.

Another consideration is that while the present study benefited from ADHD diagnosis based on a structured diagnostic interview conducted by a child psychiatrist, and RIU symptoms were assessed through both adolescent and parent reports, information on historical mental health diagnoses was solely based on self-report from the patients and not confirmed through diagnostic interviews. Undiagnosed psychiatric disorders, including depression, anxiety, and substance use disorders, among participants could potentially influence the levels of depression and anxiety reported by their parents. Additionally, since measures of adolescents' concurrent depressive and anxiety symptoms were not collected, it is important to acknowledge that the results do not rule out the possibility of low or mild depressive symptoms influencing aspects of RIU.

Furthermore, while the study controlled for important demographic covariates such as adolescent gender, household income, and maternal and paternal education levels, there may be other confounding factors, such as stressful life events, that could be causally related to the severity of internet use and may contribute to the observed findings. Lastly, it is worth noting that the proportion of mothers in the study was significantly higher (91%) compared to fathers (9%). Although one study suggests that RIU is negatively related to maternal care but not paternal care (Trumello et al. 2021), future research should explore the effect of paternal mental health on reporting behavior, considering the co-occurrence of mental health problems in married couples (Merikangas and Brunetto 1996).

Conclusion

This study provides evidence of a significant association between the severity of RIU in adolescents with ADHD and their parents' levels of anxiety and depression. Importantly, this research contributes to the limited empirical evidence available outside of Western societies, offering insights from a different cultural context and household structure. The coexistence of RIU and ADHD, along with its relationship with parental mental health, highlights the critical role of parental factors in the risk of developing RIU. These findings emphasize that adolescent RIU is not solely attributed to their own mental health but is also influenced by their parents' mental well-being. Consequently, future studies should prioritize the development of protocols for clinicians to routinely screen parents of adolescents with ADHD and RIU, as well as the implementation of intervention strategies targeting the family system alongside RIU treatment in adolescents. By considering the broader family context, interventions can be tailored to address the complex interplay between parental mental health and adolescent RIU, ultimately improving outcomes for affected individuals.

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