Loneliness accounts for the association between diagnosed Attention Deficit-Hyperactivity Disorder and symptoms of depression among adolescents

Abstract

Background: The heightened levels of peer relationship difficulties associated with Attention Deficient/Hyperactivity Disorder (ADHD) potentially predispose adolescents to feelings of loneliness and depressive symptoms. The current study explores whether feelings of loneliness mediate the effects of ADHD on depressive symptoms.

Method: Eighty-four adolescents (M*age* = 13.01 years, 75% Male) in Western Australian schools completed mental health and wellbeing surveys. Multivariate analysis of variance assessed whether adolescents with ADHD had greater loneliness and depressive symptoms, and mediation analysis explored whether loneliness mediated the relationship between ADHD and depressive symptoms.

Results: Adolescents with ADHD reported significantly greater depressive symptomatology and feelings of isolation and lower quality of friendships. Together, friendship and isolation related loneliness fully mediated the relationship between ADHD and depressive symptoms.

Conclusions: Loneliness is associated with depression in adolescents with ADHD and may be an important consideration when addressing symptoms of depression among young people diagnosed with ADHD.

Keywords: ADHD, adolescent mental health, friendships, isolation, depression.

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During adolescence, peer friendships become more complex and assume particular importance for emotional and physical wellbeing (Sigstad 2016). Having a sufficient number of friends to interact with in activities such as talking, having fun, and disclosing personal information is vitally important for adolescents' subjective wellbeing Newland et al. (2019). Having positive *quality* friendships is thought to add benefit above that of just having a friend Schmidt and Bagwell (2007), while the *absence* of friends can lead to feelings of loneliness, higher rates of morbidity and mortality (Holt-Lunstad et al. 2010), and long-term psychopathology (Prinstein et al. 2009). Approximately 80% of adolescents in general report feeling lonely at some time and up to 22% experience loneliness in a chronic form (Houghton et al. 2016; van Dulmen and Goossens 2013).

Friendship dynamics are especially salient in the secondary school setting because during this time, young people spend more time with their peers than at any other stage in the life course (Witkow and Fuligni 2010). However, the social difficulties that some adolescents experience significantly limits both the number and quality of friendships, and increases their risk of feeling lonely (Elmose and Lasgaard 2017; Lasgaard et al. 2010). Defined as the negative emotions that arise in response to a perceived discrepancy between the actual and desired or achieved quality and quantity of social relationships (Lasgaard et al. 2016; Maes et al. 2016; Roekel et al. 2016), loneliness is a complex construct that does not discriminate across the lifespan (Houghton et al. 2016). It even manifests among those surrounded by large numbers of others and/or with numerous contacts, followers, or friends on social media (Qualter et al. 2015).

The research is unequivocal that loneliness is strongly associated with a range of mental health problems (e.g., depression, anxiety, and suicidal ideation: Cacioppo et al. 2002;

Cacioppo et al. 2006; Heinrich and Gullone 2006), and is as strong a risk factor for broad based morbidity and mortality as smoking, obesity, sedentary lifestyle, and high blood pressure (Cacioppo et al. 2019). A trajectory of increasing loneliness during adolescence predicts self-harming and suicide ideation (Heinrich and Gullone 2006; Qualter et al. 2013), and more lethal suicide attempts (Gvion et al., 2014). Further, *f*MRI studies have shown that the neural activation from loneliness resembles the affective component of the physical pain response (Eisenberger, 2012) - in other words, it hurts to be lonely!

Within the context of ADHD, peer relationships are especially troubling given the social difficulties reported by young people who present with this condition. Adolescents with ADHD experience some of the highest levels of peer relationship difficulties (Antshel et al. 2009; Gardner and Gerdes 2015). They have fewer friends, are more frequently rejected by their peers, have poor peer interactions, fewer reciprocated peer friendships, and are frequently left out of activities at school compared to their non-ADHD peers (Normand et al. 2011). Recent studies have also found that adolescents with ADHD are more likely to perceive themselves as having fewer positive features and more negative features in regards to their friendships and are less satisfied about their peer networks, compared with non-ADHD peers (Grygiel et al. 2018). They are also 40% more likely to be a victim of bullying (Fridh et al. 2018).

These peer relationship difficulties likely arise from the core symptoms of ADHD, namely excessive impulsivity, hyperactivity, and inattention (American Academy of Pediatrics 2011; Lee et al. 2011). Beyond these core symptoms, a proclivity to be forceful, indelicate, uncompromising, disturbing, impatient, and neglectful of rules in organized activities (Capodieci et al. 2018) often elicits negative peer responses such as social rejection (Hoza 2007). Some researchers have asserted that the neural imbalance during adolescence in general (e.g., slower prefrontal cortex maturation and exaggerated subcortical limbic and reward

system activation: Dir et al. 2019; Rubia et al. 2019) is particularly marked for adolescents with ADHD (Banich et al. 2019; van Rooij et al. 2015) and this places them at significantly greater risk of social rejection and loneliness (Matthews et al 2015; Vannucci et al 2019).

In addition, adolescence is marked by the onset (and first appearance) of symptoms of a diverse array of adverse mental health (Patel et al. 2007), with depression being particularly prevalent (Merikangas et al. 2009). Loneliness is strongly associated with elevated depression throughout the life span (Eyre et al. 2019) and adolescents with ADHD have a five times greater risk of depression than those without ADHD (Jerrell et al. 2015). Cross-sectional studies have shown depression rates in young people with ADHD range from 9.3% to 40.7%, while longitudinal studies have reported that developing depression in ADHD occurs at a rate of 5.4%–8.9% (Grygiel et al. 2018). These elevated rates of depressive symptoms in those with ADHD result in increased rates of psychiatric hospital admission and negative life outcomes (Biederman et al. 2008).

A small body of work has investigated the links between loneliness and ADHD. Al-Yagon (2009) for example, presented self-report data, which suggests that Israeli children aged 8-12 years with comorbid ADHD and learning difficulties report significantly higher levels of loneliness. Among 6 to 13-year-old Italian children, Langher et al. (2009) also found that those with ADHD reported higher levels of loneliness than either their typically developing peers or peers without ADHD but with other special needs. In contrast, Heiman (2005) found no support for the existence of any difference in loneliness when comparing Israeli children aged 7-12 years diagnosed with ADHD to their non-ADHD peers. In what appears to be the most recent investigation, Elmose and Lasgaard (2017) compared 25 male adolescents from special education settings with a clinical diagnosis of ADHD with 199 adolescent boys from regular schools. Although more adolescents with ADHD reported difficulties in making friends, there were no differences apparent in loneliness.

A limitation of these studies, however, is their use of unidimensional measures of loneliness. A substantial body of evidence now shows loneliness is best represented as a multidimensional construct. That is, it varies in intensity and across causes and circumstances and where different social relationships give rise to different forms of loneliness (Dahlberg 2007; Goossens et al. 2009; Hawkley et al. 2012; Maes et al. 2016). As a multidimensional contsruct loneliness is composed of elements of isolation, quality of friendships, and positive and negative attitudes toward aloneness/solitude (Goossens et al. 2009; Houghton et al. 2014). To our knowledge, only one study has considered the multidimensional nature of loneliness among adolescents with ADHD. Houghton, Roost, Carroll and Brandtman (2015) found no significant differences on reported levels of isolation loneliness, friendship related loneliness, or on attitudes toward solitude when comparing 84 young people diagnosed with ADHD to 84 individually age and gender matched non-ADHD Community Comparisons.

In sum, very little is known about loneliness in adolescents with ADHD, yet adolescence is *the* peak period of risk for loneliness. Loneliness is also strongly associated with a constellation of mental health problems across the lifespan and studies involving children and adolescents with learning disabilities (Margalit and Al-Yagon 2002) and autism spectrum disorder (Lasgaard et al. 2010) suggest that the risk of loneliness is exacerbated by mental health disorders marked by social difficulties in adolescence. Adolescents with ADHD experience interpersonal difficulties and are at significantly greater risk of elevated levels of depression compared to their non-ADHD peers (Eyre et al. 2019; Stickley et al. 2019). To date, however only one study has examined multidimensional loneliness in adolescents with ADHD. Furthermore, no studies have examined the associations between ADHD, loneliness and symptoms of depression. Understanding the link between ADHD and depressive symptoms through its effect on loneliness may have implications in educational contexts where young people with ADHD most frequently meet and interact with their friends (Heiman 2005).

This study aimed to examine the patterns of association between ADHD diagnosis, the multiple components of loneliness and depressive symptoms. Specifically, we hypothesized that loneliness would mediate the relationship between an ADHD diagnosis and depressive symptoms.

Method

Participants and Settings

The sample consisted of 84 adolescents (males 74%, females 26%) recruited from Grades 5 to 12 (ages 10 to 18 years, *M* =13.4 years, *SD* = 2.0). Of these, 42 (31 males) were clinically diagnosed by a paediatrician or child psychiatrist as meeting DSM-IV-TR (American Psychiatric Association 2000) or DSM 5 (American Psychiatric Association 2013) criteria for ADHD and 42 were individually age and gender matched non-ADHD Community Comparisons with no diagnosed neurological deficits. Of the sample, 14 were aged 10-11 years, 29 were 12-13 years, 30 were 14-15 years, and 11 were 16-18 years.

The ADHD sample was recruited from one Western Australian statewide ADHD community organisation that provides assessment, counselling and evidence based educational services to children and adolescents diagnosed with ADHD (and their families). Children and adolescents who receive a diagnosis of ADHD from paediatricians or child psychiatrists are referred to this organization, which includes a range of experienced trained psychologists, educators, dieticians, and social workers. ADHD subtype information and comorbidity was not available for the current ADHD sample, but all participants were receiving concurrent pharmacotherapy at the time of the study.

The non-ADHD age (within six months) and gender matched community comparison group was recruited from one randomly selected government primary school and one government high school, both of which were located in the metropolitan area of Perth, the capital city of Western Australia. Both schools were located in low to middle socio-economic

status (SES) areas as indexed by their postal codes from the Socio-Economic Index for Areas (Australian Bureau of Statistics 2011). The non-ADHD community comparisons had no diagnosed neurological deficits and no identified problems based on the annual screening conducted by the schools, in accordance with criteria stipulated by the Education Department of Western Australia to identify students at risk of educational failure.

Instrumentation

The 24-item *Perth Aloneness Scale* (PALs; Houghton et al., 2014) uses a six-point Likert scale (1 = Never, 6 = Always) to measure four distinct aspects of loneliness: friendship related loneliness (i.e., having reliable, trustworthy supportive friends); isolation (i.e., having few friends or believing that there is no one around offering support); negative attitude to solitude (i.e., negative aspects of being alone such as time dragging, unhappiness, isolation); and positive attitude to solitude (i.e., positive aspects and benefits of being alone such as relaxing, happiness). Higher scores for friendship related loneliness indicates greater quality of friendships, while higher scores for isolation indicate higher levels of isolation. The scale has shown strong psychometric properties in prior research (Houghton et al. 2014; 2016), and each factor demonstrated acceptable-excellent internal consistency in the current study (friendship related loneliness; $\alpha = 0.91$, isolation; $\alpha = 0.83$, positive attitude to solitude; $\alpha = 0.81$, negative attitude to solitude; $\alpha = 0.74$).

The Children's Depression Inventory 2 (self-report short version; CDI:SR [S] 2; Kovacs, 2004) is a brief self-report assessment of cognitive, affective and behavioural symptoms of depression in children and adolescents aged 7-17 years. The CDI-2 comprises of 12 items, each with three separate sentence response options that describe participants' feelings and ideas over the past two weeks. Each item is measured on a 3-point Likert scale, with higher scores indicating poorer outcomes (e.g., 0 = I am sad once in a while, 1 = I am sad many times, 2 = I am sad all the time). The CDI-2 has demonstrated good reliability, and discriminant and

convergent validity in prior research (Kovacs, 2004). In the present study, the CDI-2 had good internal consistency (α = .86).

Procedure

Permission to conduct this research was obtained from the Human Research Ethics Committee of the administering institution, the State Department of Education, and Child and Adolescent Health Services. Permission was also granted by the publisher of the *CDI:SR [S] 2)* to administer the instrument online.

The parents of potential participants with ADHD at the community organisation were contacted via personalised letters of introduction and also through a presentation by the first author about the research at a monthly parents' coffee morning. Information sheets were sent to interested parents, which stressed that no identifying information was required and anonymity of responses was assured. An email address was also provided so that parents could contact the researchers should they have any questions. Consent forms were also included with the information sheet along with reply paid envelopes.

The recruitment of the non-ADHD community comparisons initially involved the principals of two randomly selected schools being contacted via telephone to ascertain their interest in participating in the research. Information sheets explaining the research, along with consent forms for parents, were subsequently delivered to both of the schools as they agreed to be involved. The information sheets were distributed to one randomly selected class in each of school grades 5 (10 years of age) to 12 (up to 18 years of age). These classes comprised students at similar age levels to the ADHD group.

In the ADHD and non-ADHD samples, all parents provided written consent, while adolescents gave verbal assent. An overall positive response of N = 144 (70%) was obtained and from these the matched sample (n = 42) was generated.

The PALs and CDI-2 were administered to participants via an online survey. All participants were provided with a unique 4-digit identification code which allowed them to log into the survey during the four weeks that it remained open. This unique code also ensured that all information provided was confidential. For the ADHD participants the survey was completed at home at a convenient time. For non-ADHD students, the survey was completed during regular school hours. School principals nominated one teacher to be responsible for liaising with the researchers and for administering the survey in the school setting. These teachers each received written instructions that ensured standardization of administration procedures. For the ADHD sample, the same written instructions were provided for the parents.

Analytical Approach

A one-way multivariate analysis of variance was conducted to assess differences between adolescents with and without a diagnosis of ADHD and mental health outcomes (i.e., loneliness, depressive symptoms), while controlling for sex and age, using SPSS version 22. To test the mediating role of loneliness between a diagnosis of ADHD and depressive symptoms, a mediation analysis was performed using Mplus Version 7 (Muthén and Muthén 2019), while controlling for demographic factors. Mediation was tested by using a path analysis fitted via maximum likelihood. A direct path was fitted between ADHD and loneliness, as well as two mediated paths, while controlling for age and sex. One of these paths was mediated by friendships and the other was mediated by loneliness. Model fit was tested using confirmatory factor analysis using the CFI, TLI and RMSEA.

Results

Group Comparisons

A multivariate analysis of variance assessed differences in loneliness and depressive symptoms according to an ADHD diagnosis, while controlling for age and sex. Two cases were excluded from the analyses due to missing data on demographic or PALs items. Results

revealed a multivariate main effect of outcomes based on a diagnosis of ADHD, $F(5, 74) = 2.92$, $p = 0.04$, $\eta^2 = 0.14$. Follow-up univariate F-tests identified significant effects of an ADHD diagnosis on depressive symptoms $F(1, 78) = 8.94$, $p = .005$, $\eta^2 = 0.10$, friendship-related loneliness, $F(1, 78) = 8.43$, $p = .005$, $\eta^2 = 0.10$, and isolation-loneliness, $F(1, 78) = 8.99$, $p = .003$, $\eta^2 = 0.10$. That is, adolescents with ADHD tended to have a higher number of depressive symptoms, lower friendship related loneliness scores (i.e., quality of friendships), and greater feelings of isolation.

Table 1 here

Assessing Relationships between Loneliness and Depressive Symptoms

A mediation analysis was conducted to assess the extent to which aspects of loneliness accounted for the relationship between ADHD diagnosis and depressive symptoms, while controlling for age, sex, and covariance between potential mediators (Figure 1). Given the main effects of friendship related loneliness and isolation in the multivariate analysis of variance, these two dimensions were included in the mediation analysis. Houghton et al. (2016) also reported a positive association between positive mental wellbeing and friendship related loneliness and a negative association for isolation. Indices used to assess the goodness of fit included: the root mean-square error of approximation (RMSEA: 0.05 or less indicates good fit, 0.08 or less indicates adequate fit), the χ^2 (non-significant values represent good fit), and Comparative Fit Index (CFI: above 0.95 indicates good fit, above 0.90 indicates adequate fit; Hu and Bentler 1999). Correlations between predictors and outcomes are presented in Table 2.

Table 2 here

The model showed excellent fit of the data, $\chi^2 (4, 84) = 1.74$, $p = 0.78$; TLI = 1.00; CFI =1.00; RMSEA = 0.00 (90% confidence interval = 0.00, 0.11), and accounted for 57% of variance in depressive symptoms. As can be seen in Figure 1, an ADHD diagnosis was significantly associated with higher depressive symptoms, B = 2.92, $\beta = 0.30$, $p < .001$ (path

c), greater isolation loneliness scores, B = 3.78, β = 0.32, $p < .001$ (path b^1), and lower friendship related loneliness scores, B = 4.43, β = -0.31, $p < .001$ (path a^1). Further, higher scores on friendship related loneliness were significantly associated with lower depressive symptoms, B = -.30, β = -0.43, $p < .001$ (path a^2), while higher isolation scores were associated with higher levels of depressive symptoms, B = 0.26, β = 0.31, $p < .001$ (path b^2). The direct effect of a diagnosis of ADHD on depressive symptoms was non-significant when taking into account relationships with friendship related loneliness and isolation, B = 0.64, β = 0.07, $p = .39$ (path c'). The total indirect effect of an ADHD diagnosis on depressive symptoms, through friendship related loneliness and isolation, was statistically significant, B = 2.29, β = 0.24, $p < .001$. This indicates that friendship related loneliness and isolation largely accounted for the association between ADHD and depressive symptoms.

Figure 1 here

Discussion

Fear of future loneliness was one of the major concerns cited by a large sample of 12 to 18 year olds (Lindfors et al. 2012), thereby demonstrating that young people in general recognise the potential impact loneliness can have on their lives. Predicted to reach epidemic proportions by 2030 (Holt-Lunstad et al. 2015), loneliness is particularly prevalent during adolescence and is strongly associated with elevated levels of depression. Young persons with ADHD experience some of the highest levels of peer relationship difficulties and are at significantly greater risk of depression compared to their non ADHD peers (Eyre et al. 2019; Stickley et al. 2019), therefore examining the associations between ADHD and symptoms of depression among adolescents with ADHD is important.

The present study found that adolescents with ADHD had higher levels of loneliness which supports the findings of Al-Yagon (2009) and Langher et al. (2009), though it is at odds with Heiman's (2005), Houghton et al.'s (2015) and Elmose and Lasgaard's (2017) findings.

Of the studies cited, with the exception of Houghton et al. (2015), all employed a unidimensional measure to produce a single total score that tapped "global sense of loneliness". Using a multidimensional measure of loneliness, the present study found significant differences between adolescents with and without ADHD on isolation loneliness and friendship-related loneliness, but not on attitudes toward loneliness. This is contrary to the findings from the earlier Houghton et al. (2015) study, even though the same multidimensional measure was utilised. It should be noted, however, that although the results in the Houghton et al. (2015) study did not reach statistical significance, the trends were in the same direction as those in the present study.

Previous research (Houghton, Hattie, Carroll, Wood, & Baffour, 2016) also found that adolescents attach significance to the behavioural dimensions of friendship related loneliness and isolation, rather than attitudes to being alone. Research is unequivocal, it is not the number of friends that is important because one can have many friends and still be lonely, yet have few friends and not be lonely (Fischer & Phillips 1979; Qualter & Munn, 2002). Rather, it is the *quality* of friends that matters, especially in adolescence (see Qualter et al., 2015).

Adolescence is a known sensitive developmental phase "characterised by dynamic brain development in which the interaction with the social environment shapes the capabilities an individual takes forward into adult life" (Patton et al. 2016). During this period, friendships provide numerous social and emotional benefits and place young people on positive developmental trajectories (Rose and Rudolph 2006) that strongly influence development (Bukowski et al. 2010). While having friends helps buffer against the negative effects of life experiences, where friendships are positive there is added benefit above that of just having a friend (Schmidt and Bagwell 2007). However, adolescents with ADHD experience some of the highest levels of interpersonal conflict (Mayes et al. 2000) and peer relationship difficulties (Becker et al. 2012; Gardner and Gerdes 2015) with some studies reporting that up to 50% of

young people with ADHD have significant problems in their social relationships (McQuade and Hoza 2008).

The finding that friendship-related loneliness (i.e., having quality friendships) and isolation loneliness in the present study fully mediated the association between ADHD and depressive symptoms is important. Adolescents without ADHD hold negative attributions about individuals with ADHD (Swords et al. 2011; Walker et al. 2008) because the impulsive, intrusive, hostile behaviour and lack of appropriate social skills so necessary to develop mutually satisfying friendships (Wehmeier et al. 2010) are often absent in those with ADHD.

There are important implications of both friendship related loneliness and isolation mediating the relationship between ADHD and depressive symptoms, as shown in our model. For example, in addition to adolescents with ADHD having higher levels of depressive symptoms if they have lower quality friendships, those adolescents with ADHD with higher levels of isolation were more likely to have higher levels of depressive symptoms. This was the case even for adolescents with ADHD who had similar levels of quality friendships. This is consistent with the added-stress model of loneliness (see Cacioppo et al., 2003; Cacioppo & Patrick, 2008), which illustrates the subjective and interpretative nature of loneliness. That is, lonely adolescents have a tendency to negatively interpret their social environment (Qualter et al., 2013) and interpret their relationships with peers through a negative lens (Lodder, Goossens, Scholte, Engels, & Verhagen, 2016). This suggests that even for adolescents with ADHD who have the same quality of friendships as their non-ADHD peers, feelings of isolation will still be greater due to their negative interpretation of these relationships. The way individuals experience, interpret, and behave in social situations demonstrates the subjective nature of loneliness, which functions as a maintaining mechanism of chronic loneliness (Qualter et al., 2015; Riva, Wesselmann, Wirth, Carter-Sowell, & Williams, 2014).

In addition, adolescents with ADHD interpret a best friend as someone who is “fun” and “mutually entertaining”, while their typically developing peers refer to a best friend as someone who provides emotional support and a sense of security. This seeming disconnect from the emotional aspects of social relationships (Da Fonseca et al. 2009) might contribute to the increased loneliness and internalizing symptoms (e.g., depression; Mrug et al. 2012) found in the present study and may have a crucial impact on the emotional functioning of those with ADHD.

The present findings are also important because adolescents with ADHD are at increased risk of victimization and research clearly shows that “victims” have poorer quality friendships and greater experiences of distress (La Greca and Harrison 2005), and are significantly more likely to present with depressive symptoms and express more negative affect (Bacchini et al. 2008; Taylor et al. 2010). Perceiving themselves as different (Normand et al. 2011; Humphrey et al. 2007) and as having features not conducive to friendships (Grygiel et al. 2018) leads adolescents with ADHD to be excluded (or exclude themselves) from social situations and frequently withdraw from school activities that may otherwise act to enhance their interpersonal skills (e.g., recess time, group lessons; Humphrey et al. 2007). This may also form a basis for the negative self-beliefs associated with depression and anxiety (Grills and Ollendick 2002).

To date, pharmacological treatments have been widely utilised with adolescents with ADHD. While these may reduce negative social behaviours, they will not contribute to an increase in positive social behaviours or a change in peer status in adolescents with ADHD (Jensen 1999). It is well established that the presence of at least one mutual friendship can function as a protective factor against peer rejection and victimization, and in turn lead to greater gains in peer acceptance in the long term (Bollmer et al. 2005). Thus, in addition to a focus on promoting positive aspects of friendships, the quality (rather than quantity) of

friendships and on encouraging conflict resolution must be taken into consideration. There is considerable evidence that adolescents reporting high levels of emotional vulnerability, such as those with ADHD, often automatically focus on and interpret everyday ambiguous information as negative or threatening. As a consequence of this interpretive bias, their perceptions become distorted and dysfunctional, giving rise to negative patterns of thinking that in turn lead to adverse mental health (Grafton and MacLeod 2014).

Limitations

Although this is one of the few studies to examine multidimensional loneliness and depressive symptoms in adolescents with ADHD, the results should be read with an understanding of the limitations of the current study. For example, the relatively small sample size, particularly in relation to females is a limitation. However, the higher proportion of males with ADHD in the current study reflects prevalence within general populations (Lawrence et al. 2016). Future research should seek to replicate the findings from the current study with a larger and more diverse sample of adolescents.

As this study was cross-sectional, it is not possible to make any inferences about temporal associations or causation. Future research using longitudinal designs is required to understand whether loneliness causes depression in adolescents with ADHD or vice versa. To date, however, there have been few longitudinal studies examining the wellbeing of adolescents with ADHD. Our understanding of the directionality of these associations would be enhanced by conducting longitudinal follow-up studies with adolescents with ADHD.

It should also be acknowledged that sole reliance on self-report (as in this study) can give rise to the issue of shared method variance (Marcoen et al. 1987). However, loneliness requires insight into the subjective dispositions that can be difficult to obtain from third parties (e.g., parents, teachers) and reliability of self-report inventories has been found to increase from childhood to adolescence for measuring constructs such as psychopathology, while the validity

of that from third parties decrease (Frick et al. 2009; Kamphaus and Frick 2005). Moreover, Baldwin and Dadds (2007) argued that parents and teachers have great difficulty perceiving the internal world of their children, and children often have difficulty reporting their internal states to their parents and teachers. Future research should implement the optimal strategy therefore when examining loneliness and ADHD and use two or more sources such as parents, educators or clinicians (Antshel et al. 2012).

Finally, future research should attempt to obtain ADHD subtype presentation and comorbidity information since this influences children's social interactions and difficulties (Hodgens et al. 2000). Indeed, comorbidity is the rule rather than the exception in ADHD (Tannock 1998) and this might make strong contributions to potential differences in loneliness. This information was not available for the present study.

Summary

In conclusion, the current study has addressed the shortage of studies examining loneliness in adolescents with ADHD. In doing so, it adds to the limited knowledge on this issue. In addition, this study has shed new light on how loneliness accounts for the association between Attention Deficit-Hyperactivity Disorder and symptoms of depression. Specifically, not only are adolescents with ADHD at risk of heightened feelings of loneliness, but these feelings may be a key in the development of depressive symptoms. Cacioppo and Cacioppo (2018) identified loneliness as being associated with a 26% increase in premature mortality, and as an emerging public health problem that is "often stigmatised, trivialised, or ignored" (p. 426). Adolescents with ADHD are at significantly heightened risk of loneliness and associated depression compared to their non-ADHD peers. Therefore, it is imperative that resources, including professional development are provided in educational and school psychological settings to address this growing problem.

Compliance with Ethical Standards

Conflict of Interest

The authors state that there is no conflict of interest.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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Table 1

Univariate associations between ADHD, depressive symptoms and loneliness.

Model	Mean square	F	*p*	Partial η^2	Power Estimate	Non-ADHD *Mean (SD)*	ADHD *Mean (SD)*
Depressive Symptoms	176.20	8.94	.00*	.10	.84	4.39 (4.03)	7.29 (5.43)
Friendship loneliness	401.81	8.61	.00*	.10	.83	28.17 (5.84)	23.76 (7.76)
Isolation loneliness	293.03	8.99	.00*	.10	.84	10.33 (4.26)	13.45 (6.71)
Positive attitudes	32.62	.90	.35	.01	.16	19.57 (5.04)	20.05 (6.88)
Negative attitudes	4.47	.12	.73	.00	.06	18.34 (5.96)	17.83 (6.32)

Table 2

Pearson correlations between depressive symptoms and loneliness.

		1.	2.	3.	4.	5.
1.	Depressive symptoms	1	-	-	-	-
2.	Friendship loneliness	-0.68***	1	-	-	-
3.	Isolation loneliness	0.67***	-0.69***	1	-	-
4.	Positive attitudes	0.34**	-0.04	0.16	1	-
5.	Negative attitudes	0.09	-0.11	0.20	-0.26*	1

Note. *$p < .05$, **$p < .01$, ***$p < .001$.

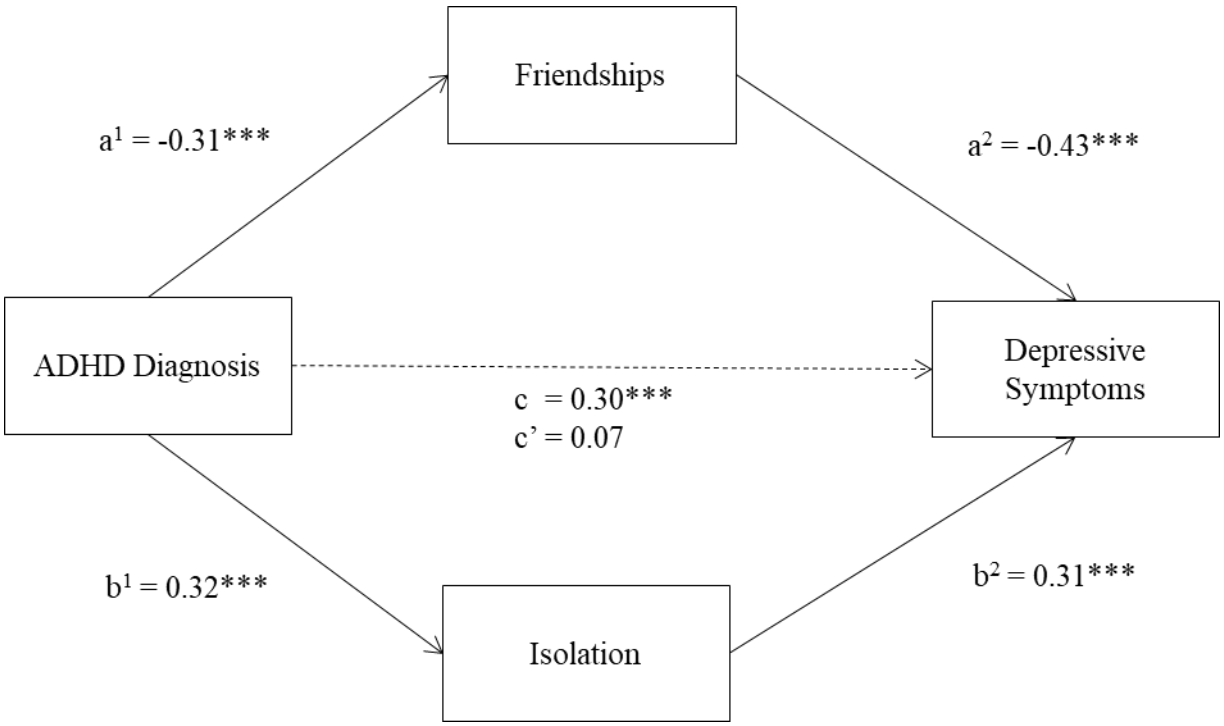

Figure 1. Mediation analysis assessing the relationship between ADHD, dimensions of loneliness, and depressive symptoms. All figures represent standardized coefficients. Dashed lines indicate non-significant direct effects. *** $p < 0.001$.