

Demographic, developmental and psychosocial predictors of the development of anxiety in adults with ADHD

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Abstract The purpose of this research was to investigate potential demographic, developmental and psychosocial predictors of anxiety in the context of ADHD. Participants included 267 adults with a diagnosis of ADHD (168 males:99 females) and an age range of 18–70 years ($M = 31$ years; $SD = 10.03$ years). A background interview, parent questionnaire and rating scales were used to gather participant information. Correlations, independent t tests and one-way analysis of variances were used to identify variables associated with anxiety, and a stepwise multiple regression was used to identify potential predictors of anxiety. Variables associated with anxiety included childhood aggression, employment status, difficulties making friends, number of children and caffeine intake. Childhood aggression and caffeine intake were the potential predictors. Clinicians should be aware of these potential predictors of anxiety in the context of ADHD in order to minimise the likelihood of the development or maintenance of comorbid anxiety. Future research is needed in order to draw any conclusions on cause and effect.

Keywords Adult ADHD · Comorbidity · Anxiety · Predictors · Risk factors

Introduction

Although ADHD was previously conceived to be a childhood disorder with symptoms diminishing throughout adolescence, it is of current understanding that ADHD persists in adulthood for the majority of affected children (Guldborg-Kjaer et al. 2013). ADHD persistence rates from childhood to adulthood are reaching 78 % (Biederman et al. 2010). The prevalence of ADHD in adulthood is suggested to be between 2.9 and 4.7 % (Adler et al. 2008; Faraone and Biederman 2005; Kessler et al. 2006).

ADHD is a disorder which is rarely seen in isolation. Overall, 86.7 % of individuals with ADHD have lifetime comorbid disorders, the vast majority of which have more than two comorbid disorders (Torgersen et al. 2006). Up to 47.1 % of adults with ADHD suffer from anxiety disorders (Kessler et al. 2006). Furthermore, there are many individuals with ADHD who suffer from anxiety but do not meet the clinical diagnostic criteria meaning that their anxiety cannot be categorised or treated (Young and Bramham 2007). Moreover, anxiety in individuals with ADHD appears to increase in severity with age (Bramham et al. 2012).

Individuals with ADHD are likely to experience a significant amount of adversity throughout their lives due to their condition, which may predispose them to the development of anxiety. For instance, negative past experiences in childhood (e.g. academic under-attainment) can lead to a low self-esteem, lack of confidence and an ‘anticipatory anxiety’ regarding events that they previously failed at or were disappointed with (Young and Bramham 2007). Although anxiety levels may fluctuate from childhood to adulthood, they tend to become more intense by adulthood. In turn, the presence of anxiety disorders in individuals with ADHD can lead to poorer outcomes, such as poor life

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satisfaction (Gudjonsson et al. 2009) or reduced responses to ADHD medication such as stimulants (Tannock et al. 1995). It is therefore important to identify the presence of anxiety at an early stage so that preventative action can be implemented.

There are many factors that have been seen to influence the development of anxiety in a general population of individuals including gender (Bekker and van Mens-Verhulst 2007), age (Hinz et al. 2004), birth weight (Elgen et al. 2013), eating problems in infancy (Pauli-Pott et al. 2013), aggression in youth (Seah and Ang 2008), being unemployed (Herbig et al. 2013), relationship status (Leach et al. 2013), caffeine intake (Kendler et al. 2006), alcohol (Crum et al. 2013), smoking (Mojtabai and Crum 2013) and drugs (Wu et al. 2010). However, little is known about how these variables impact on anxiety levels for individuals with ADHD specifically.

Research investigating the development of anxiety in individuals with ADHD is lacking. As noted above, there is an abundance of research suggesting that many individuals with ADHD experience anxiety, and it is not so clear why some individuals with ADHD experience greater levels of anxiety throughout their life than others. Potential predictors of the development of anxiety need to be identified so that the adverse effects of the comorbid disorder can be minimised. This piece of exploratory research will assess a number of variables that may impact on anxiety with an initial aim of establishing variables associated with anxiety in individuals with ADHD. These variables can be divided into three categories for the purpose of investigation: basic demographics, developmental history and psychosocial factors. Once these variables have been determined, the secondary aim is to establish specific predictors of anxiety for adults with ADHD.

Methods

Participants

Participants included 267 adults with a diagnosis of ADHD (168 males:99 females) with an age range of 18–70 years.

Table 1 Sample characteristics for all adults with ADHD

Characteristic	<i>n</i>	<i>M</i> (<i>SD</i>)
Mean age in years	267 (18–70 years)	31 (10.03)
Mean anxiety score ^a	267	12.78 (4.48)
Mean inattentive symptoms ^b	267	7.30 (2.12)
Mean hyperactive/impulsive symptoms ^c	267	6.40 (2.34)

^a Scores were attained from the HADS; scores above 11 out of 21 indicate ‘probable cases’ of anxiety

^b Scores were attained from the symptom checklist of DSM-IV inattentive symptoms; scores above 6 out of 9 indicate the presence of ADHD

^c Scores were attained from the symptom checklist of DSM-IV hyperactive/impulsive symptoms; scores above 6 out of 9 indicate the presence of ADHD

Participants were asked to withdraw from non-stimulant medication for the purpose of the assessment. Participants were asked whether they received previous treatment for ADHD, with 36 % reporting having been on medication. However, further details about exact regimes were unknown. The Conners’ Adult ADHD Diagnostic Interview for DSM-IV (CAADID; Epstein et al. 1999) was the instrument used by a consultant psychiatrist to guide the diagnosis of ADHD, and the Hospital Anxiety and Depression Scale (Zigmond and Snaith 1983) was used to assess levels of anxiety (see Table 1 for sample characteristics).

Data for participants were collected during their diagnoses of ADHD. Although the sample size consisted of 267 participants, data for all of these participants were not available across all variables. Over time, the data being collected from clinical participants consisted of different measures and background questionnaires. For this reason, sample sizes are smaller in some analyses compared to others, as some data may not have been collected from participants regarding the variables used in that specific analysis. As the level of anxiety is a key variable in all analyses, participant data were kept wherever a total score for anxiety was available. The number of participants (*n*) is stated across all analyses.

Ethical approval

Participants gave informed consent for the archiving of their data, and the Research Ethical Committee at King’s College London granted ethical approval. The UCD Office of Research granted ethical approval for the use of the archival data for the purpose of this research in March 2014.

Measures

CAADID (Epstein et al. 1999)

This measure documents participant information including: gender; age; relatives with ADHD; relatives with other

psychiatric diagnosis; age when diagnosed with ADHD; treatment of ADHD; number of previous jobs; time spent in jobs; employment status; occupational classification; difficulties making friends; relationship status; number of children; cups of tea/coffee drunk per day; number of cigarettes smoked per day; units of alcohol drunk per week; cannabis use; amphetamines use; ecstasy use and cocaine use.

Parent report was used to answer some questions relating to birth weight; infant sleeping problems; infant eating problems and childhood aggression.

Hospital Anxiety and Depression Scale (HADS; Zigmond and Snaith 1983)

HADS (Zigmond and Snaith 1983) was used to assess the current anxiety and depression levels of the participants. Included in the scale are 14 items divided into two subscales: seven items measure anxiety symptoms and seven alternate items measure depression symptoms. Each item is rated on a four-point scale and scored between 0 and 3 with a possible total of 21 for each subscale. In a systematic literature review of 747 papers, Bjelland et al. (2002) found that the concurrent validity of HADS ranged from good to very good. They also assessed the convergent validity of HADS with other commonly used self-report scales for anxiety (e.g. Clinical Anxiety Scale, State Trait Anxiety Inventory and the Symptom Checklist-90 anxiety subscales) using correlational analysis and found medium to strong correlations ($r = 0.49\text{--}0.78$). The authors concluded that HADS has the same properties when applied to samples from the general population, general practice and psychiatric patients. Within an ADHD context, previous research found that the subscales of the HADS had good internal consistency with an alpha value of 0.840 for the anxiety subscale and an alpha value of 0.707 for the depression subscale (Grogan and Bramham 2014).

Procedure

Statistical analyses

The software used for statistical analysis was Statistical Package for the Social Sciences (SPSS Inc. 2009). A series of Pearson product-moment correlations, independent t tests and one-way analysis of variances (ANOVAs) were used to assess how certain variables are associated with levels of anxiety. Any significant variables at a level of $p < 0.05$ were deemed to be associated with anxiety. These associated variables were then entered into a stepwise multiple regression to analyse possible predictors of anxiety for adults with ADHD. As this research was exploratory in nature, adjustments for multiple comparisons were

not made as any alterations may be too stringent, increasing the risk of a Type II error.

It has been previously suggested that the number of participants included in a sample using multiple regression analysis be the number of predictors plus 104; or the number of predictors multiplied by 8, plus 50 (Tabachnick and Fidell 2007). The number of participants in the present research ($N = 267$) exceeds the former ($N = 109$) and the latter ($N = 90$) suggested values.

Results

A series of correlations, t tests and ANOVAs were used in the analysis to assess how certain variables influence levels of anxiety. Variables were categorised and analysed under three headings: basic demographics (Table 2), developmental history (Table 3) and psychosocial factors (Table 4).

Internal consistency of HADS

The internal consistency of the anxiety subscale of the HADS is needed. The Cronbach's alpha for the seven items on the anxiety subscale of the HADS was 0.832, which is considered 'good' internal consistency.

Basic demographics

Gender and age were the two demographic factors that were explored (see Table 2). There were no significant gender differences in terms of anxiety levels, and age did not impact on levels of anxiety among the sample.

Developmental history

Birth weight, sleeping problems in infancy, eating problems in infancy, aggression in childhood, relatives with ADHD, relatives with other psychiatric disorders, previous ADHD diagnosis, age when diagnosed with ADHD and previous treatment for ADHD were the domains of developmental factors that were explored (see Table 3). Aggression in childhood was the only variable in this category that was found to be associated with the development of anxiety. Results showed that individuals with childhood aggression had significantly higher levels of anxiety in adulthood than individuals who did not have childhood aggressiveness.

Psychosocial factors

The psychosocial factors that were assessed included information on previous jobs, longest time spent in

Table 2 Demographic factors tested and levels of anxiety

Variables	Response	<i>n</i>	<i>M</i>	SD	Statistic	<i>p</i>
Gender	Male	168	12.64	4.538	$t = -0.629$	0.530
	Female	99	13.00	4.387		
Age	In years	267	12.78	4.477	$r = 0.103$	0.092
Age (by groups)	18–20 years	41	11.66	4.948	$F = 1.224$	0.301
	21–30 years	101	12.68	4.207		
	31–40 years	81	13.00	4.607		
	41–50 years	34	13.88	4.663		
	51–70 years	10	12.70	2.791		

Table 3 Developmental factors tested and levels of anxiety

Variables	Response	<i>n</i>	<i>M</i>	SD	Statistic	<i>p</i>
Birth weight	In pounds	121	11.85	4.440	$r = -0.082$	0.371
Sleeping problems in infancy	Yes	61	12.11	4.906	$t = -0.060$	0.952
	No	75	12.16	3.891		
Eating problems in infancy	Yes	34	12.00	4.156	$t = -0.057$	0.955
	No	102	12.05	4.446		
Aggression in childhood	Yes	62	13.85	4.020	$t = 4.022$	0.000***
	No	87	11.18	3.978		
Relative with ADHD	Yes	52	12.56	4.505	$t = 0.789$	0.431
	No	96	11.98	4.119		
Relative with other psychiatric disorder	Yes	83	12.30	4.081	$t = 0.674$	0.501
	No	62	11.82	4.419		
Previous ADHD diagnosis	Yes	66	12.32	4.308	$t = 0.315$	0.753
	No	84	12.10	4.292		
Age when diagnosed with ADHD	In years	63	12.44	4.165	$r = 0.104$	0.418
Previous ADHD treatment	Yes	60	12.08	4.248	$t = -0.168$	0.867
	No	88	12.20	4.371		

* $p < 0.05$ level; ** $p < 0.01$ level; *** $p < 0.001$ level

previous jobs, employment status, occupational classification, difficulties making friends, relationship status, number of children, caffeine intake, cigarettes smoked, alcohol consumption, cannabis use, amphetamine use, ecstasy use and cocaine use (see Table 4). There were three psychosocial factors that were found to be associated with the development of anxiety: employment status; difficulties making friends and caffeine intake. There was a significant difference in anxiety levels between the three employment groups. The results of a post hoc least significant difference test indicated that both working and non-working participants had significantly higher levels of anxiety than students ($p = 0.006$ and $p = 0.000$, respectively). There were no differences in anxiety levels between the participants who were working and who were not working. Results showed that adults who had difficulties with making friends had significantly greater levels of anxiety than adults who did not have difficulties with making

friends. There was a significant positive relationship between caffeine intake and anxiety levels.

Predictors of anxiety in adults with ADHD

Demographic, developmental and psychosocial variables that were associated with the development of anxiety were entered into a stepwise multiple regression model. However, employment status was not entered as it was not a dichotic variable, which is necessary for regression analysis. We chose not to create a dummy variable as the rule of thumb is that there should be at least 15 % of the sample in each level of a dummy variable. Because students represent <15 % of the employment status variable, we did not create a dummy variable as there would be a risk of overfitting in our regression (Babyak 2004). Variables entered included childhood aggression, difficulties making friends, number of children and caffeine intake. Data were available for 136 participants across these four variables.

Table 4 Psychosocial factors tested and levels of anxiety

Variables	Response	<i>n</i>	<i>M</i>	SD	Statistic	<i>p</i>
Previous jobs	Number of previous jobs	118	12.37	4.210	$r = 0.082$	0.380
Longest time spent in previous jobs	In months	132	12.20	4.166	$r = -0.020$	0.823
Employment status	Working	79	12.03	4.172	$F = 6.499$	0.002**
	Not working	54	13.09	3.808		
	Student	16	8.94	4.266		
Occupational classification	Professional	12	11.50	3.656	$F = 0.179$	0.837
	Skilled	43	12.21	3.732		
	Unskilled	61	12.26	4.385		
Difficulties making	Yes	90	12.73	4.077	$t = 2.228$	0.027*
Friends	No	55	11.13	4.422		
Relationship status	Single	52	12.08	4.702	$F = 0.792$	0.500
	Partner, not living with	48	11.98	4.245		
	Partner, living with	18	13.50	2.479		
	Married	30	11.60	4.368		
Children	Number of children	150	12.14	4.251	$r = 0.181$	0.027*
Tea/coffee	Cups per day	141	11.99	4.284	$r = 0.198$	0.018*
Cigarettes smoked	Amount per day	149	12.11	4.253	$r = 0.065$	0.428
Alcohol consumption	Units per week	142	12.28	4.216	$r = 0.092$	0.278
User of cannabis	Yes	58	12.91	3.854	$t = 1.659$	0.099
	No	92	11.73	4.499		
User of amphetamines	Yes	21	13.14	3.568	$t = 1.103$	0.272
	No	129	12.03	4.386		
User of ecstasy	Yes	17	12.65	3.334	$t = 0.469$	0.640
	No	133	12.13	4.401		
User of cocaine	Yes	24	13.25	3.467	$t = 1.329$	0.186
	No	126	11.98	4.409		

* $p < 0.05$ level; ** $p < 0.01$ level; *** $p < 0.001$ level

Table 5 Predictors of anxiety

Variable	<i>t</i>	Sig.	<i>B</i>	β
Childhood aggression	-3.585	0.000**	-2.494	-0.291
Caffeine intake	2.352	0.020*	0.193	0.191

* $p < 0.05$ level; ** $p < 0.01$ level; *** $p < 0.001$ level

Stepwise multiple regression analysis was used to test if these variables significantly predicted participants' ratings of anxiety. The most significant model included two variables: childhood aggression and caffeine intake; $F(2, 133) = 10.04$, $p = 0.000$, $R^2 = 0.131$ (adjusted $R^2 = 0.118$; see Table 5). Childhood aggression and caffeine intake were positively significant to the prediction. Aggressive behaviour at school during childhood and greater amounts of caffeine intake are predictive of higher levels of current anxiety in adults with ADHD. The effect size of this R^2 value according to Cohen's F^2 is 0.151 which is a medium effect size (Cohen 1992).

Discussion

Summary of results

The aim of this study was to provide information on variables associated with anxiety as well as potential predictors of anxiety in the context of ADHD. Results found that variables associated with the development of anxiety included childhood aggression, employment status, difficulties making friends, number of children and caffeine intake. Childhood aggression, difficulties making friends, number of children and caffeine intake were entered into a stepwise multiple regression with the best fitting model producing childhood aggression and caffeine intake as predictors of anxiety in adults with ADHD. The effect size of the R^2 value according to Cohen's F^2 is 0.151 which is a medium effect size (Cohen 1992) and therefore has limited predictive value in a clinical setting. The following paragraphs will discuss childhood aggression and caffeine intake in terms of their relationship with anxiety and

ADHD. The association of anxiety with employment status, difficulties making friends and number of children will then be discussed, followed by a discussion on limitations and a conclusion section.

Childhood aggression as a potential predictor of anxiety in adults with ADHD

Results showed that childhood aggression was the most significant predictor of the development of anxiety for adults with ADHD. Many children with ADHD have been found to be reactively aggressive, responding in an angry, emotionally dysregulated way to perceived offences or frustrations (Bennett et al. 2004; Vitaro et al. 2002). Many researchers (e.g. Barkley 2015; Harty et al. 2009) suggest that emotional dysregulation is at the core of ADHD, alongside the symptoms of inattention and hyperactivity/impulsivity. This emotional dysregulation is characterised by an inability to inhibit emotions, in particular frustration, impatience, anger and aggression (Barkley 2015).

Reactive aggression has also been found to be associated with internalising problems such as anxiety and is used as a defence mechanism to deal with ambiguous social cues (Seah and Ang 2008; Vitaro et al. 2002). It is not surprising then that reactive aggression is associated with peer rejection and poor communication with parents, problems also experienced by children with ADHD (Erhardt and Hinshaw 1994; Ghanizadeh and Shams 2007). Moreover, there appears to be a link between ADHD, aggression and anxiety whereby all three characteristics might go hand-in-hand in forming a sub-group of individuals with ADHD. For example, research by Biederman et al. (2012) showed that severity scores on the anxiety/depression, aggression and attention scales (AAA) of the Child behaviour Checklist (CBCL) can distinguish between two groups of children with ADHD experiencing elevated emotional regulation deficits and severe emotional regulation deficits, with different outcomes for both groups.

Research investigating the psychopathology associated with emotional dysregulation in adolescents showed that emotional dysregulation is a risk factor for both anxiety and aggressive behaviour but that psychopathology was not associated with increases in emotional dysregulation (McLaughlin et al. 2011). This suggests a causal relationship whereby emotional dysregulation is a predictor of psychopathology rather than a consequence (McLaughlin et al. 2011). Moreover, due to the temporal sequencing of these life situations, it is plausible to suggest that childhood aggression leads to anxiety for adults with ADHD rather than the reverse.

As mentioned above, reactive aggression is linked with certain social problems such as peer rejection and communication difficulties with parents. Childhood emotional

regulation has been found to be predictive of future social functionality (Denham et al. 2003), which is an interesting overlap in terms of another variable that will be discussed below, difficulties making friends.

Caffeine intake as a potential predictor of anxiety in adults with ADHD

Caffeine is consumed daily by most individuals; however, for some people caffeine intake is excessive, resulting in negative consequences. Caffeine intoxication and caffeine withdrawal are categorised as ‘caffeine-related disorder’ in the DSM-V (APA 2013) with symptoms of each mirroring symptoms of anxiety (e.g. ‘nervousness’; ‘restlessness’; ‘difficulty concentrating’). Much of the research on caffeine’s effects on anxiety dates back to the 1980s and 1990s with a general consensus across the literature that only very high doses of caffeine intake result in symptoms of anxiety (Sicard et al. 1996).

Research suggests that individuals with ADHD are more likely than individuals without ADHD to consume caffeine (Walker et al. 2010). A potential reason for this is that many ADHD individuals consume caffeine to self-medicate. Almost four decades ago, research conducted by Schnackenberg (1973) suggested caffeine as a substitute for methylphenidate or dextroamphetamine in treating children with ADHD. Even more recently, researchers have suggested that a combination of caffeine and stimulants might produce better functioning in children with ADHD than either caffeine or stimulant treatment alone (Leon 2000). However, a more recent review on past literature has led to the conclusion that the detrimental effects of caffeine (e.g. insomnia, loss of appetite and of course anxiety) result in the superiority of methylphenidate and atomoxetine treatments over caffeine (Carlson et al. 2007).

The relationship between ADHD, caffeine and anxiety can be explained by the adenosine A2A receptor (ADORA2A) gene. Dopaminergic dysfunction in the frontal cortex and striatum is repeatedly found to be a cause of ADHD (Tripp and Wickens 2009). Adenosine receptors have the potential to alter dopaminergic release. Specifically certain polymorphisms of the ADORA2A gene have been found to be linked to ADHD traits (Molero et al. 2013). A recent study conducted by Pandolfo et al. (2013) on spontaneously hypertensive rats (SHRs)—the most widely accepted animal model of ADHD displaying similar alterations of dopamine in the frontocortico-striatal circuits—showed that this gene receptor is present in frontocortical nerve terminals and has increased density in these rats. Chronic caffeine treatment restored normal density and activity of dopamine transporters in the frontal cortex through its action on the A2A receptor. Although caffeine was able to improve attention, it was less effective

at reducing anxious-related behaviour in spontaneously hypertensive rats (Pandolfo et al. 2013). Moreover, it has been reported that moderate-to-high caffeine intake can cause certain polymorphisms on the adenosine A2A receptor gene that results in increased anxiety (Gajewska et al. 2013). This would lead to a general conclusion that although caffeine as a means for treatment may alleviate symptoms of ADHD, it may worsen the symptoms of anxiety.

Other variables associated with anxiety in adults with ADHD

Employment status, difficulties making friends and number of children are the final three variables to be discussed with respect to their association with anxiety. It is possible that these variables might be risk factors for the development of anxiety. However, due to the lack of knowledge on temporal sequencing of events, a conclusion on cause and effect is beyond the scope of this research. The relationship between these variables and anxiety will be discussed below.

Employment status

There were significant differences found between working individuals and students, and not working individuals and students, whereby the students had lower levels of anxiety than both working and non-working individuals. There was no significant difference between working and non-working individuals. Perhaps students had significantly lower levels of anxiety by being involved in education, which promotes mental health by enhancing positive well-being and resisting mental health problems (Weare 2007). Mental health services are widespread among students, and mental distress among students is predictive of higher levels of knowledge and use of these services (Yorgason et al. 2008).

On the other hand, individuals who are employed and certainly individuals who are unemployed may not receive the same level of support as students in education. Moreover, students with ADHD have the benefit of availing of disability services at college, whereas there are usually no such supports for people with ADHD in the workplace. This could explain the development of mental health issues such as anxiety for employed and unemployed individuals with ADHD.

Difficulties making friends

Results showed that individuals with ADHD who have difficulties making friends reported higher levels of anxiety in adulthood. There is ample research to suggest that

ADHD individuals are a poorly socialised group of people who have poor social skills (Young and Gudjonsson 2006), have difficulties with making friends (Litner 2003) and form friendships that tend to be superficial and short-lived (Litner 2003). Barkley (1990) estimated that up to 60 % of children with ADHD suffer social rejection in their peer groups. At an older age, college students with ADHD were more frequently described with negative than positive adjectives (Chew et al. 2009). In turn, many children with ADHD can be coaxed into forming inappropriate and unnatural friendships as a form of acceptance and as a way of fitting into peer groups (Litner 2003).

Individuals with anxiety suffer from a long line of social impairments including social withdrawal, lower levels of social acceptance and more negative peer interactions (Biggs et al. 2012), which make it difficult for them to make new friends. In terms of a causal relationship, it can be argued that difficulties making friends might be a predictor of anxiety in the context of ADHD. There is research to suggest that individuals with ADHD suffer from social anxiety; however, the reverse was not found whereby individuals with social phobia were not so likely to suffer from ADHD (Mörtberg et al. 2012). There may also be a further explanation through autism spectrum disorder (ASD) traits, another common comorbidity in ADHD, which is also associated with high levels of anxiety (White et al. 2009). ASD may underpin both social difficulties and anxiety difficulties in individuals with ADHD. Moreover, the link between ADHD, aggressive behaviour, social difficulties and anxiety might also be explained by emotional dysregulation in individuals with ADHD, as mentioned above.

Number of children

Results found that number of children was positively related to levels of anxiety. Family life for any household can be very stressful, particularly for the parents. Both major life stresses and even minor daily hassles have been found to impact negatively on parents, children and families (Crnic and Greenberg 1990). There is no empirical research assessing the relationship between anxiety levels and number of children in a family. However, it is quite probable that additional children in any given family will most likely result in additional stress and anxiety for many reasons including sibling arguments, excess mess in the household, financial difficulties among other problems. Furthermore, as ADHD is highly heritable, there is a likelihood that children of ADHD adults will also have the disorder. Parenting a child with ADHD can further increase parental stress and anxiety due to the disorganisation and forgetfulness that surround the disorder (Theule et al. 2013).

Limitations

One major limitation of the study was that a formal diagnosis of anxiety disorders could not be established for any participant due to the use of archival data. Only symptoms of anxiety were measured using the HADS, with moderate correlations being observed between anxiety symptoms and Barkley total symptoms ($r = 0.346$; $p = <0.001$). This relationship evident between anxiety and ADHD symptoms may be due to (1) comorbidity between ADHD and anxiety disorders or (2) double counting of similar symptoms on the HADS and ADHD self-report scales (e.g. 'I feel restless as if I have to be on the move' and 'was "on the go" or acted as if "driven by a motor"'). Without a formal diagnosis of anxiety, findings on comorbidity are inconclusive. However, as outlined in the method section, HADS has good convergent validity with other measures of anxiety, suggesting that this limitation might exist for all self-report measures of anxiety and not just the HADS. This highlights the need for a new, improved measure of anxiety in the context of ADHD.

A further limitation is that cause and effect of predictors cannot be confidently determined due to the use of cross-sectional data. It is possible that childhood aggression might be a true predictor of the development of anxiety because of the temporal sequencing of events (i.e. the aggression in childhood came before the anxiety in adulthood). Further research is needed to assess the timing of the other variables associated with anxiety. Employment status was not entered into the regression as it was not a dichotic variable, which is necessary for regression analysis. Further research is needed to assess whether employment status can predict levels of anxiety in adults with ADHD.

Although research is mixed in terms of the effects of stimulant medication on symptoms of anxiety, there is evidence to suggest that methylphenidate might increase levels of anxiety and also evidence to suggest the contrary (Epstein et al. 2014). The exact details of the medication regimes of the sample were unknown; however, future research should take medication status into account when assessing levels of anxiety in an adult ADHD sample. Information on caffeine intake in the present study was restricted to tea and coffee only. Further research is needed to assess whether caffeine present in soft drinks and food sources influences anxiety levels further to that of caffeine present in tea and coffee. Also, the impact of the combination of stimulant medication and caffeine should be examined further. Data were not corrected for multiple comparisons, so the possibility of Type I errors is increased.

Two findings that did not appear to agree with previous literature were that there was no significant association found for gender or age with levels of anxiety. There were more male participants than female in the present study.

Perhaps if the participants were balanced in terms of gender, a significant gender difference may have been found. Our finding that there were no specific gender differences in terms of anxiety for adults with ADHD contradicts literature, which suggests that internalising disorders are more prevalent in a female population than the male population who often present with externalising comorbid disorders (e.g. OCD), particularly for ADHD individuals (Skogli et al. 2013). Another surprising finding was that there was no relationship between age and anxiety symptoms. Research suggests that anxiety increases with age in a general population (Hinz et al. 2004). However, almost 70 % of the sample in this study was under the age of 35 years. Perhaps a more evenly distributed age range would show a significant relationship between levels of anxiety and age.

Conclusions

It can be concluded that childhood aggression, and higher caffeine intake are possible predictors of the development of anxiety for adults with ADHD. Clinicians working with both children and adults with ADHD should be aware of these factors associated with anxiety as early intervention may help to improve outcomes in ADHD and prevent future comorbid anxiety in the context of ADHD. Future research that takes account of the mentioned limitations is warranted in order to fully understand why anxiety develops in some adults with ADHD and not in others.

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