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Research Article

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ASSOCIATIVE STUDY ON ADHD, ANXIETY, DEPRESSION, STRESS, AND EXCESS BODY WEIGHT IN ADOLESCENTS

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Abstract

Objective: This study aimed to verify the relationship between attention deficit hyperactivity disorder (ADHD), excess body weight, and other mental disorders, such as anxiety, stress, and depression. **Methods:** We performed a cross-sectional study to assess 271 adolescents (105 girls and 166 boys) with a mean age of14.5 years (SD = 2.35). Data collection for ADHD, anxiety, depression, and stress prevalence was performed through a Brazilian Portuguese validated version of the Child Behavior Checklist (*Inventário de Comportamentos da Infância e Adolescência*). Body mass index was calculated based on body weight and height. Values above 85% were classified as excess body weight. In order to verify the relationship among the mental disorders, we used Person's chi-square test due to the abnormal distribution of the sample. We applied the same method to verify the relationship between excess body weight and the above-mentioned disorders. **Results:** We observed a positive relationship between ADHD and the other disorders, with a p-value greater than 0.05, showing a high probability of association between ADHD and stress, anxiety, and depression. The results also revealed an association between being overweight and depression (residual variation = -2.2, p = 0.025), indicating that overweight adolescents were twice as likely to have depression (PR = 2.53). In relation to stress and anxiety, the values found were not statistically significant (p = 0.249 and p = 0.447, respectively). **Conclusions:** We concluded that ADHD increases the probability of anxiety disorders, depression, and stress, and that obesity increases the probability of a depressive condition.

Key Words: Associative study, anxiety, depression, obesity, adolescents.

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is characterized by inattention and/or hyperactivity-impulsivity, with at least some of the symptoms having emerged during childhood or adolescence. It has long been thought to be an exclusive childhood disorder, but it is known that ADHD persists in adult life in more than half of the affected individuals. Many patients will only be diagnosed in adulthood with an estimated prevalence of 4.4%.[1]

In general, children diagnosed with ADHD concurrently present other comorbidities, such as oppositional defiant disorder, conduct disorder, learning disabilities, depression, and others.[2]

More than 25% of children with ADHD have anxiety disorder as an associated comorbidity, and the occurrence increases by about one-third when it comes to adolescents with ADHD.[3]

Anxiety disorder has a major negative impact on quality of life.A study revealed that a three-month treatment course with methylphenidate reduced anxiety and compulsive symptoms. The therapy indicated an improvement in quality of life, as well as in the symptoms of impulsivity, hyperactivity, and inattention.[4]

ADHD can also be a contributor to being overweight and obesity, which are determined by multiple factors. This hypothesis shows the importance of its identification and treatment (CORTESE *et al*., 2013).[5]

The two main symptoms of ADHD, inattention and impulsivity, may increase the risk of obesity individually or in association, in part due to insufficient dopamine in the brain.

These hypotheses are supported by the mode of action of stimulant medications, which reduce appetite and impulsivity and increase synaptic dopamine availability by blocking its transport. Finally, patients with ADHD tend to have greater emotional lability than individuals without ADHD.[6] This characteristic makes them more likely to choose high-calorie foods to meet the negative affect.[7]

In a study carried out by Fliers *et al*. (2013), obesity was more prevalent in younger children.[8] This may be due to the gradual effect of ADHD on obesity.[9] When we compare the effects of obesity in both sexes, the results are higher in girls than in boys. Finally, the many comorbidities related to ADHD cited above establish a risk factor for increasing body mass.[10]

Recently, a meta-analysis performed by Nigg *et al*. (2016) concluded that there is no discernible relationship between ADHD and obesity in preadolescents and that in adolescents and adults, the association is greater in girls than in boys, as revealedby previous studies.[9]

Some symptoms of ADHD that may persist in adulthood include memory and organization problems, difficulty completing tasks, and emotional dysregulation. Consequently, many adults with ADHD develop concomitant depression and anxiety.[11] Thus, the early diagnosis of ADHD in children is key to avoiding complications and achieving a higher quality of life, as well as the evaluation and search for appropriate treatment programs for those patients who have already been diagnosed with the disorder. Identifying and treating the severity of anxiety symptoms in patients with ADHD and anxiety is crucial since these symptoms affect the prognosis of the disease.[12]

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Adolescents experience an increase in academic tasks, responsibilities, and commitments. This changing phase in their lives can lead to high levels of stress, which, in turn, in individuals with little resilience, can lead to a depressive state. Depression and stress levels are higher in adolescents with ADHD, especially in individuals who experience an event such as the loss of a close family member, financial difficulties, and/or school failure. These comorbidities directly affect academic performance and increase stress levels.[13]

We observed that individuals with ADHD present with other life-threatening problems that may persist in adulthood. These problems may be related to mental health (such as high levels of stress, anxiety, or even a depressive disorder) or physical health (such as excess body weight).

Based on this evidence, this study aimed to verify the relationship between ADHD and other mental disorders, such as anxiety, stress, and depression. We also aimed at verifying if these disorders are associated with excess body weight.

Keywords: Association; Mental Disorders; Overweight; Adolescents; Cross-sectional study.

MATERIALS METHODS

This is a cross-sectional epidemiological study nested in a cohort study.[14] The latter was carried out in the south of Brazil, assessing 271 ninth grade daytime students (elementary school) enrolled in the municipal school system in 2014. Inclusion criteria for participation in the study were 13-16 years of age, be able to practice physical activities, and agree to voluntarily participate in the study.

Our sample size was calculated according to the base number of the cohort study and consisted of 1,263 elementary school adolescents enrolled in the 9thgrade in municipal schools, based on the average prevalence presented in the literature (6% for individuals with ADHD). With a confidence interval of 99%, a statistical power of 80%, a standard error of 3%, a design effect of 2, and following a simple random sampling criteria based on the identification number of the previous study, we reached a sample of 268 adolescents. Considering possible refusals, we distributed 321 questionnaires and, of these, 271 adolescents accepted to participate in the survey. We used the statistical software OpenEpi version 2.31 to calculate the data.

Body mass index (BMI) was calculated based on body weight (measured with a scale accurate to 100gr) and height (measured with a stadiometer). Body mass index was obtained by dividing total body mass by height squared (BMI = weight/height^2). Obesity and overweight were defined according to the BMI sex- and age-specific cut-off points established by Conde & Monteiro (2006).[15]

The instrument used to identify ADHD, stress, anxiety, and depression symptoms was the "Child Behavior Checklist" (CBCL), which consists of a 113-item questionnaire, with 20 questions aimed at assessing the child's/adolescent's social competence, and 93 questions regarding the evaluation of their behavioral problems. Information is provided by parents. Students to be researched fit the 5-18 year age group. Therefore, we used a validated Brazilian Portuguese version of the questionnaire that includes adolescents(*Inventário de Comportamentos da Infância e Adolescência*).[16] Patients who present with symptoms at clinical levels, according to the criteria of the instrument itself, were classified as ADHD, stress, anxiety, and/or depression patients. For this study, we recorded all the cases that presented with symptoms classified as borderline and clinical according to the instrument.

Ethical aspects

In order to authorize participation in the study, parents or legal guardians of the students signed the informed consent form and alsoanswered the checklist for the participants. In relation to IMC verification, participants signed the study consent form from the previous study.[14]

This research was approved by the ethics committee of UFCSPA under the opinion n° 688.748/2014.

Data Processing and Analysis

The data were stored in a database formatted in EPIDATA and double entered. After checking consistency, we exported the data to SPSS (Statistical Package for Social Sciences), version 22.

In order to verify the relationship between ADHD and other disorders (stress, anxiety, and depression), we used Person's chi-square test due to the abnormal distribution of the sample. We applied the same method to verify the relationship between obesity and the above-mentioned disorders.

RESULTS

The sample totaled 271 participants, with a mean age of 14.5 years (SD = 2.35). We compared adolescents with and without ADHD to adolescents who presented with clinical symptoms of stress, anxiety, and depression, as shown in Table 1. We observed a positive association between ADHD and the other disorders, with a statistically significant p value (<0.05). The prevalence ratio points out that adolescents who have ADHD are at high likelihood of experiencing stress, anxiety, or depression.

Table 1 Relationship between ADHD and other disorders

ADHD		Stress	Anxiety	Depression
Yes	N	6	3	4
	%	60	30	40
	Residue	6.5	2.9	3.3
No	N	14	16	22
	%	5.3	6.1	8.4
	Residue	-6.5	-2.9	-3.3
Pearson's Chi-Square Test	P	0.000 *	0.004 *	0.001 *
	PR	26.57	6.59	7.27
	CI	6.72 – 105.08	1.55 – 27.92	1.90 – 27.73

*P <0.05 significance level; PR = Prevalence Ratio; CI = Confidence Interval

In order to verify a possible relationship between body weight issues and other psychological disorders, we also verified if there is a relationship between being overweight, stress, anxiety, depression, and ADHD, as presented in Table 2.

The results reveal a relationship between being overweight and depression (residual -2.2, p = 0.025); that is, overweight adolescents presented with more than double the prevalence for depression than those with ideal weight. Regarding stress, anxiety, and ADHD, the values found were not statistically significant (p = 0.249, p = 0.447, and p = 0.240, respectively), which means that no relationship was found between being overweight and stress, anxiety, or ADHD.

Table 2 Relationship between obesity and other mental disorders

Obesity		Stress	Anxiety	Depression	ADHD
Yes	N	7	6	11	4
	%	10.6	9.1	16.7	6.1
	Residue	1.2	0.8	2.2	1.4
No	N	13	13	15	6
	%	6.3	6.3	7.3	2.9
	Residue	-1.2	-0.8	-2.2	-1.4
Pearson's Chi-Square Test	P	0.249	0.447	0.025*	0.240
	PR	1.75	1.48	2.53	2.14
	CI	0.67 – 4.59	0.54 – 4.05	1.10 – 5.83	0.58 – 7.83

DISCUSSION

In this study, ADHD demonstrates a positive association with anxiety, corroborating the literature findings.[17] One of the most significant symptoms of ADHD is attention deficit, or difficulty in maintaining focus for longer periods. It is during adolescence that the individual enters the most complex school period, with more subjects and more responsibilities. It is also in this period that adolescents are more pressured in relation to which profession to choose, which university to attend, or what to make of their adult lives. These aspects contribute to the increase of anxiety and may cause an anxiolytic crisis that may result in academic and personal injury.[18,17]

Elia *et al*. (2008) investigated 342 children diagnosed with ADHD and found that generalized anxiety was among the disorders with the highest prevalence (15.2%).[19] Children diagosed with hyperactivity showed a prevalence of 22.2% and those diagnosed with attention deficit, 18.6%. Depression prevalence in children with ADHD was 21.6% of the sample, attention deficit 20.8%, and hyperactivity 19.4%.

The present study identified a positive relationship between ADHD and depression, with a p-value of 0.001. The prevalence of depressive disorders in adolescents has increased significantly. Yang *et al*. (2013) – in a study that aimed to verify the implications of ADHD, anxiety, and depression symptoms in the quality of life of adult individuals who had developed these symptoms in childhood – found that persistent symptoms of any of these disorders impair the quality of life in adulthood.[20] Strohmeier *et al*. (2016) evaluated adults with ADHD, anxiety, and depression symptoms and found that adults with ADHD have a strong positive correlation with cognition problems, which means that the effects of ADHD may bring future cognitive impairment.[21] Anxiety and depression, in turn, show no correlatation with cognitive disorders.

The relationship between anxiety, depression, and ADHD symptoms seems to be familial. Segnreich *et al*. (2015) found a strong relationship between mothers who presented with one of thesedisorders and their children presenting with ADHD symptoms.[22] In fathers, however, this influence was not significant. Mothers with attention deficit symptoms were correlated with their children's symptoms of inattention, hyperactivity, and anxiety,and mothers with anxiety symptoms were positively correlated with their children's inattention symptoms.The study concludes that the three disorders are correlated with familial aspects, mothers more than fathers, but does not assert genetic characteristics due to study limitations.

It is known that depressive disorders are often associated with anxious symptomatology and their causes or triggers are most often linked to stressful experiences. However, Dave *et al*. (2011) suggested that stressful events in patients with underlying anxiety disorders (such as superimposed acute stress and chronic anxiety)may induce immunological changes similar to those caused by inflammatory diseases.[23] This may explain the known relationship between stress and clinical adverse reactions, such as asthma exacerbations, autoimmune diseases, and acute cardiovascular events.

Another positive relationship found in that study was between ADHD and stress (with a significant p-value >0.0001). Stress can be caused by non-resilient behavioral reactions to certain life events. The individual's resilience is what will determine how to deal with stressful events. It is known that adolescents face several stressful factors, such as school exams, concerns about the future, lifestyle, difficulty in controlling weight, physical changes, among others.When stress cannot be managed, a depressive picture is often established, which brings a new problem and creates a vicious cycle that is difficult to break without a specific treatment.[24] Moksnes *et al*. (2010) assessed stress and the emotional state of adolescents, considering anxiety, depression, and self-esteem.[25] They found that girls have higher levels of stress, anxiety, and depression than boys, who presented with higher self-esteem scores. The study points to a strong inverse relationship among self-esteem and anxiety and depression. However, there is a paucity of studies examining ADHD and stress at any stage of life. Studies addressing this issue examined parents' or caregivers'levels of stress, but a study evaluating the association or the relationship between ADHD and stress in adolescents was not found.

Romeo (2013) conducted a review of the literature regarding the relationship between the developing brain of adolescents and stress.[26] The author concluded that adolescence is a period of significant neural maturation, mainly in the limbic and cortical regions, which increases sensitivity to stressor events. That would cause anxiety, depression, drug abuse, and schizophrenia, thus highlighting the importance of care and greater attention to symptoms and exacerbated reactions to stressful life events.

Although being overweight, obesity, or difficulty controlling weight are stressful factors, the present study showed no association between being overweight and stress. Anxiety is regularly reported by overweight people as a cause for abusive eating behaviors and other compulsive behaviors, thus leading to weight gain. However, anxiety showed no relationship with being overweight. On the other hand, the study revealed a positive relationship between depression and being overweight.[27]

The present study deals with ADHD, a much-studiedclinical problem but with difficult diagnosis.According to our data, the condition is positively associated with anxiety, depression, and stress. These results demonstrate how patients diagnosed with ADHD need special care and attention in their treatments to deal with behavioral reactions at school, social, and family environments.

Social and physical factors such as being overweight not only bring harm to the physical health of individuals (heart

problems, diabetes, among others), but may also affect their mental health.

Some studies point out that overweight adolescents are more likely to be the target of weight-related bullying in the school environment, which is a stressful event that causes anxiety and can lead to depressive symptoms.[14,28]

In this study, we found a positive relationship between depression and being overweight, with a p-value of 0.025, meaning that problems with body weight may also be associated with depressive disorders.

Marmorstein *et al*. (2014) pointed out the association of early depression in girls with future obesity as well as obesity in late adolescence with adult depression. However, they suggest that more studies need to be done to better elucidate the mechanism between the conditions, considering the differences between the sexes.[29] Roberts and Duong (2013) found no association between body weight and depression, but they suggest that cases involving depression and being overweight are more related to body image and body satisfaction than to body weight itself.[30] One of the limitations of that study is the reverse causality presented by transversal delineations. Another limitation is that memory bias may also have affectedthe scores on the CBCL answered by parents.

CONCLUSION

We conclude that anxiety, depression, and stress are positively associated with ADHD, indicating a greater probability that the individual with the disorder may develop other mental health problems. The second conclusion of this study is that being overweight was associated with depression, pointing to the relatiosnhip between physical and mental health.

More studies need to be done to verify the relationship between the disorders, to clarify if an individual who has depression, anxiety, or stress can have ADHD, and to check the causality between depression and obesity.

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