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Original Research Article

BODY MASS INDEX IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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Abstract

Background: Children with ADHD tend to have weight dysregulation, more so towards the heavier side of body mass index which can be attributed to a in children with ADHD. **Materials and Methods:** This case-control study was conducted in the Department of Psychiatry, Pt. B.D. Sharma, PGIMS, Rohtak with 30 children with ADHD in case group and 30 typically developing children as control group. Children were then assessed for eating behavior patterns using child eating behaviour questionnaire. **Result:** Higher rates of obesity and overweight, lower rates of underweight were found statistically significant in ADHD group. **Conclusion:** Our findings suggested that children with ADHD could have higher prevalence of obesity and overweight.

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is the most common neurodevelopmental disorder of childhood and common among school going children.[1] Relationship between weight dysregulation and ADHD has generated an interest in the area over recent years. Executive functioning and self-regulation are dysregulated in ADHD and obesity which can lead to body weight dysregulation.[2] It has also been reported that persons with ADHD show higher than average body mass index (BMI) standard deviation scores, and have significantly higher percentage of body fat and abdominal circumference when compared to controls.[3] Seymour et al found a significant overlap of neural circuitry between these two conditions along with functional abnormalities found in reward, response inhibition, emotional processing, and regulation.[4] Dorsolateral prefrontal cortex activity is reduced in patients with obesity in response to food stimuli and postprandial state due to less impulse control via deregulated inhibitory mechanisms impacting eating patterns and food choice.[5-] Patients with reported ADHD symptoms are found to have increased hedonic eating patterns and more likely to have higher BMIs. Abnormal reward centre responses, availability of dopamine and norepinephrine in presynaptic neurons and related alterations in impulse control/ executive functioning are the common shared pathways for obesity and ADHD.

Curtin et al reported that obesity/overweight was quite co-mmon in children and adolescent with ADHD.[8-11] Philips et al compared adolescents with or without neurodevelopmental disorder with respect to their BMI status. The frequency of overweight was similar across all the groups with or without DD. Prevalence of both obesity and underweight were higher among adolescents with DD than without DD. Rates of obesity were higher among adolescents with all DD types, including ADHD.[12]

Various cross sectional studies one epidemiological survey, one longitudinal study had indicated that children with ADHD can have weight dysregulation, more so towards the heavier side of body mass index.[11-17] However, this evidence is from Western European subcontinent and to the best of our knowledge not much work has been done about the prevalence of obesity and overweight issues in Indian children with diagnosis of ADHD. Also the relation of weight and, type and severity of ADHD remain unexplored. Keeping in view the above, this study was planned to find association between BMI, type and severity of ADHD in children with ADHD.

MATERIALS AND METHODS

Study Procedure

This case control study was conducted in the child and Adolescent Guidance Clinic, Department of Psychiatry, Pt. B.D Sharma, PGIMS, Rohtak. A total of 30 children aged 6 to 11 years diagnosed with ADHD as per DSM 5 criteria were selected through purposive sampling between April 2021 to July 2022. Only drug naïve children were included to case group. Children with cerebral palsy, physical handicap, intellectual disability, chronic physical illness and ones with prescribed dietary control were excluded from the study.

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Thirty typically developing children matched for age, gender and family income constituted the control group. The exclusion criteria for this group was the same as for case group. Assent from children and consent from parents was duly taken and it was ensured that participating parent(s) was not actively suffering from any mental illness at the time of interview.

Tools: The study was conducted after getting the ethical clearance from the institutional ethical committee part from various tools, socio-demographic and clinical details of each participants following three scales were applied.

Vanderbilt ADHD Parent Rating Scale (VADPRS)[15] assess the disruptive problems associated with ADHD, it comprises of 47 items covering all the 18 criteria for ADHD which are rated on 4-point scale with responses as never, occasionally, often and very often. The VADPRS has two components: symptom assessment and impairment of performance at home, in school, and in social settings.

Conner's Parent 10-item abbreviated index [17] is an abbreviated version of the Conner's Parent Rating Scale (CPRS). Parents rate their child's symptoms from 0 to 3(0= not at all present, 1=just a little present, 2=pretty much present, 3=very much present), which yields a range of possible total scores between 0 and 30.

Physical assessment: Body weight was measured using a doctor's clinical scale with subjects clad in regular casual attire and being bare-foot.

Height of children was measured using a wall-mounted chart, the subjects being bare-feet, and feet kept together and the head kept level with a horizontal Frankfurt plane (below an imaginary line from the lower border of the eye orbit to the auditory meatus).

BMI was calculated by dividing child's weight by the square of the height.

RESULTS

The data was analysed using SPSS v23 (IBM corp). The statistical significance of different test was calculated at $p<0.05$. Descriptive analysis was used to calculate means, standard deviation and frequencies of the variables. For categorical variables percentages were calculated. Chi-square statistics was used to compare categorical variables. Fisher's Exact Test was used to determine significant association between two categorical variables.

The mean age of case group as a whole was 8.17 ± 2.21 years while the mean age of control group was 8.16 ± 2.17 years with an age range of 6-11 years. There was no significant difference between the groups in terms of age ($p=0.870$). There was a male preponderance i.e. 83.3% of the subjects were male.

[Table 1] shows the comparison of mean height, mean weight and mean BMI in the study groups. There was no statistically significant difference between the groups in terms of height and weight. However, statistically significant higher BMI was observed in case group as compared to control group. We further classified based on BMI scores, there were significantly more overweight and obese children in ADHD group than in the control group ($p<0.05$) [Table 1]. No statistical significant difference was observed between case and control groups in terms of neighbourhoods and independent variables including age, gender family income.

Table 1: Comparison of mean Height, Weight and BMI in study groups

Variable	Group		t-test		Wilcoxon-Mann-Whitney U Test		Fischer exact	
	Case	Control	t	p value	W	p value	X2	P value
Mean height (in cm)	125.93	126.37	-0.126	0.900				
Mean weight (in Kg))	27.67	23.38			561.500	0.100		
Mean BMI (in Kg/m²)	17.02	14.68			610.500	0.018		
Underweight	5(16.7%)	12(40.0%)					8.470	0.039
Normal	13(43.3%)	15(50.0%)						
Overweight	7(23.3%)	2(6.7%)						
Obese	5(16.7%)	1(3.3%)						

Table 2: Comparison of BMI and ADHD type

ADHD Type (Vanderbilt Scale)	BMI					Fisher's Exact Test	
	Underweight	Normal	Overweight	Obese	Total	χ2	P Value
Combined	3 (60.0%)	11 (84.6%)	6 (85.7%)	4 (80.0%)	24 (80.0%)	5.192	0.445
Hyperactive	1 (20.0%)	2 (15.4%)	1 (14.3%)	0 (0.0%)	4 (13.3%)		
Inattentive	1 (20.0%)	0 (0.0%)	0 (0.0%)	1 (20.0%)	2 (6.7%)		
Total	5 (100.0%)	13 (100.0%)	7 (100.0%)	5 (100.0%)	30 (100.0%)		

DISCUSSION

The study compared the BMI in children with ADHD and typically developing children.

The mean age of children was 8.17 ± 2.21 years with an age range of 6-11years. The age of participants was well matched between the groups and there is no statistical difference. Similar age group is studied in western studies.[12,13]

The male: female ratio was also matched between the two groups and was 5:1. Same ratio has been reported by Aykutlu and Bourke.[18-21] Several western studies have documented greater incidence of ADHD among

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boys than in girls.[18-20] The male preponderance in clinical samples could be a reflection of presence of more disruptive symptoms of ADHD in males as compared to females.[22]

When compared for family structure, the two study groups did not show much difference. Majority of children in both study groups hailed from nuclear family. This might reflect the changing structure of society in India. It was also observed that the participants who belonged to nuclear family had more weight and high BMI as compared to the participants who belonged to the joint and extended families. This difference was statistically significant. The reason could be because of sedentary life style, less opportunity to be physically active which otherwise would be high in the presence of cousins and more family members, and more interaction in joint and extended family type. However the results of a China based study had shown the otherwise results i.e. more susceptibility of children to be obese when raised by their grandparents.[23] But this again might be reflection of the family structure in China where though grandparents are taking care of children of working parents but the absence of cousins and less number of family members would have the same effect as discussed above.

The mean height was less whereas mean weight was more in case group as compared to that in the control group. The findings are consistent with earlier studies.[11-13] The tendency of children with ADHD in school age and adolescence to be over-weight could be associated with psychological complications of ADHD.24 Because of social isolation, children with ADHD may have fewer opportunities to participate in team sports associated with physical activity, and therefore, spend more time watching television or playing on a computer than with their peers.[24,25]

In our study the cumulative prevalence of being underweight of the total group was 28.4%; the same being 8.4% for the case group and 20% for control group. Cumulative prevalence of being overweight of the total group was 15% and 11.7% for the case group and 3.3% for the control group. Prevalence of obesity was 10% for the whole study population; this being 8.4% for the case group and 1.6% for the control group. In other words the pooled prevalence of overweight and obesity is higher in children with ADHD as compared to typically developing children. Similar results were reported by Courtese et al.[26] According to a Turkish study the frequency of overweight/obesity was higher in ADHD group (24.8%) as compared to control group (18.9%).[12] In another study, the frequency of overweight (9.4%) and obesity (7.1%) was higher in ADHD group than in control (1.5% and 0.2%).[27,28]

A cross sectional study by Serhat reported that the rate of being overweight/obese was higher in the ADHD group.[7] Findings in a cross-sectional study, by Yang et al demonstrated that the children with diagnosis of ADHD were at higher risk for obesity than their counter part in general population. Prevalence of obesity, overweight, and combined obesity/overweight were 12.0%, 17.1%, and 29.1%, respectively which were statistically significantly higher than the rates seen in general Chinese population, that is, 2.1%, 4.5%, and 6.6%, respectively. Pubertal Children with ADHD combined subtype were more likely to be overweight or obese. Findings of this study point out that obesity is a common co-morbidity in children with ADHD.[13]

In an epidemiological survey conducted by Kim et al to study the connection between ADHD symptoms, food habits and obesity, reported a prevalence of ADHD as 7.6% and that of obesity as 4.5% and concluded that ADHD was a risk factor for obesity through dietary behavioral change and socio-economic status.[16]

We also found that combined subtype of ADHD is associated with higher severity of symptoms (as evident from Conner's score) followed by hyperactive subtype and then inattentive subtype. These findings are also supported by a study conducted in India.[29-40] Study by Shahrbabaki et al reported a significant relationship between obesity and severity of ADHD,19 and attributed ADHD as a risk factor for increasing eating disorder in children.[33] The result of our study are on the same line, however are not significant statistically. To the best of our knowledge, no other study has reported any association between severity of ADHD and BMI.[41-45]

CONCLUSION

To summarise, to the best of our knowledge, our study is the first of its type to investigate the prevalence of underweight, overweight and obesity in children with ADHD and children without ADHD. The prevalence of obesity and overweight was found higher in children with ADHD than in children without ADHD whereas there were more underweight children in control group as compared to case group. Mean height was less in children with ADHD whereas the mean weight and BMI were more in children with ADHD as compared to normal children. Oppositional defiant disorder is the most commonly associated comorbid condition with ADHD and is more prevalent with combined subtype which is associated with higher severity of ADHD symptoms and obesity. Strengths of the present study to the best of our knowledge, this is probably the first study in India comparing eating behaviour and BMI in children with and without ADHD. Sociodemographic variables of the study group were well matched between both the study groups. Though it is one of its own type study in this part of country, there are certain limitations including the small sample size of the study. The study had cross sectional design devoiding us of the knowledge about how BMI change over time in the same individual and in relation to treatment. This study was hospital-based study so the findings cannot be generalised to the community. The confounding factors such as parent's economic and educational level, parental

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feeding practices, home environment can easily influence the study variables and should have been controlled.[46-50]

Future directions: Community based studies with larger samples should be carried out. A longitudinal, prospective study must be planned in order to look into change in level of BMI after treatment of children with ADHD. In adolescent group, the same study should be conducted as the most differences in physique occur in this age group.[51-58]

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