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BMI Changes in Children and Adolescents with Attention Deficit Hyperactivity Disorder Before and After Treatment with Methylphenidate

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Abstract

Objectives: We aimed to assess BMI changes in children and adolescents with Aatention deficit hyperactivity disorder before and after treatment with methylphenidate.
Methods: This was a prospective cohort study on 90 adolescents with a diagnosis of ADHD. Clinicians measured height by a tape meter, weight by the Seca scale and BMI, was calculated. Spearman's correlation test was used to determine the correlation between age and BMI. The level of statistical significance was established with at least 0.05 in SPSS v21.
Results: Results showed that 65 patients (72.2%) were boys. Most of the participants (41) were aged between 7 - 11 years. Most of them (58 patients) had combined type of disorder. A total of 22 (24.4%) attention deficit and 10 (11.1%) hyperactive type of disorder were noted. Mean of height, weigth, and BMI in participants were significantly higher after 1 year of treatment with methylphenidate.
Conclusions: ADHD could be indicated as a risk factor for overweight and obesity in Iranian adolescents; thus, clinicians should consider it from the beginning of the diagnosis of ADHD.

Keywords: ADHD, Overweight, Obesity, Methylphenidat, BMI

1. Background

Childhood and adolescent overweight and obesity have increased substantially in the past 2 decades, raising concerns about the physical and psychosocial consequences of childhood obesity (1, 2). Being overweight or obese among young children is increasing. It should be considered by providers of interventional preventive programs at national and regional levels (3, 4). There is a significant relationship between obesity and its contributing psychological and behavioral disease such as Attention deficit hyperactivity disorder (ADHD). ADHD is characterized by a persistent and impairing pattern of inattention and or hyperactivity/impulsivity. It affects 5% to 8 % of school-aged children. According to the results, being 'hyperactive' in the sense of the DSM-IV diagnosis of ADHD does not prevent the development or persistence of overweight and obesity in children (5). Methylphenidate is the first choice in the treatment of attention deficit-hyperactivity disorder and in regards to weight-loss purposes, the use of amphetamine-like compounds are very controversial (6). The aim of this study was to compare the mean body mass index (BMI) in ADHD children and adolescents before and after 1 year of medication with methylphenidate. The results of this article can be used in the treatment and screening of obesity. Also, this study is proposed to assess complications of weight change in treatment of ADHD.

2. Methods

This was a prospective cohort study. The study was approved by the ethical committee of Guilan University of Medical Sciences.

2.1. Participants

The study was conducted in 2 outpatient child/adolescent psychiatric clinics in Rasht, a city in

north Iran, between 2014 through 2016. These 2 clinics are the only child and adolescent psychiatry referral centers in the province of Guilan. We included both clinics (1 private and 1 university-based community clinic) in order to represent all socio economic status and cultural levels of the region.

Participants were recruited from first admitted youth with a diagnosis of ADHD. Diagnosis of ADHD is made by a child and adolescent psychiatrist, according to standard diagnostic interview sessions based on the Diagnostic and Statistical Manual of Mental Disorders, 5th edition criteria (DSM-5).

Before inclusion, eligible youth were reassessed by KSADS-PL-P in order to confirm the diagnosis and it's specifies and psychiatric co morbidities. We included children and adolescents with pure ADHD, without history of any medication. Written informed consent was obtained from parents and youth.

The exclusion critters were:

- Known medical and neurological disorders (ex. epilepsy).

- Additional mental disorder (ex. Autism Spectrum Disorder, mood and anxiety disorder).

- Use of obesogenic pharmacological agent or supplement.

- Refuse to participate.

The study was conducted in 90 youth (65 boys and 25 girls) aged 3 - 18 years (mean age 9 year).

2.2. Procedure

After primary diagnosis of ADHD and complete description of the study to the subjects and parents, secure written informed consents were obtained from all parents before the start of the study. K-SADS-PL-P was conducted for participants. Complete medical history and physical examination including height and weight were performed. Clinical assessments were conducted weekly until acquiring optimal dosage, and then continued treatment with effective dosage of methylphenidate. For each child, the dose adjusted individually.

The dose titrated gradually to a level with lowest adverse reactions and admissible treatment response. The treatment response was assessed by the clinical impression of child and adolescent psychiatrist from clinical examination. Height and weight were measured at the 3, 6, 9, and 12 months after starting treatment and BMI were calculated.

2.3. Instruments

Kiddie Schedule for affective disorders and Schizophrenia for school-age children- present and the life time-Persian version (K-SADS-PL-P) : It is a semi structured diagnostic Interview tool to assess current, past, and lifetime diagnostic status in children and adolescents. The K-SADS-PL-P has an acceptable concurrent validity in diagnosing current major disorders. Test-retest reliabilities of most of the current diagnoses were good to excellent. Its sensitivity and specificity of current diagnosis for ADHD are 90% and 91%, respectively (Kappa = 0.80, p b 0.000) (Shahrivar et al. 2010).

Height: was measured by linear meter according to meter.

Weight: was measured by Seca weighing scale manufactured by German company.

BMI: calculated by BMI calculator for age and sex.

2.4. Statistics

As BMI had no normal distributions according to the Shaphiro-Wilks test, non parametric tests including Mann-Whiteny U test, Wilcoxon, Kruskal-Walis were used to compare BMI of ADHD patients before and after treatment and between categorical variables. Spearman's correlation test was used to determine the correlation between age and BMI. The level of statistical significance was established at least with 0.05 (2-tailed). The statistical package used for the analysis was SPSS 21.

3. Results

Results showed that 65 patients (72.2%) were boy. Most of the participants (41) aged 7 - 11 years. Most of them (58 patients) had a combined type of disorder. A total of 22 (24.4%) attention deficit and 10 (11.1%) hyperactive type of disorders were noted.

Table 1 showed that the mean BMI after treatment was significantly higher than the before treatment ($P < 0.001$). Also, significant increased BMI was noted regarding each sex (boys: $P < 0.0001$ and girls: $P < 0.0001$).

Although BMI increased significantly after 1 year, the BMI in the first 6 months of treatment decreased and then increased based on Figure 1.

Wilcoxon test and positive mean showed a significant increase difference in BMI (Table 2). The lowest difference between BMI in boys was -2.20 and in girls -4.00. This negative difference noted the decrease in BMI for some of the participants. The highest difference in boys and girls were respectively 3.00 and 2.00. Although, the increase in BMI in boys was slightly higher than girls, the Mann-Whitney U test noted no significant difference (0.194) between them (Table 3).

Spearman correlation coefficient showed that BMI changes until 1 year did not correlate with age ($r = -0.063$, $P = 0.552$).

Table 1. The BMI Changes Before and After Treatment

BMI	Number	Minimum	Maximum	Mean ± Sd	P Value
Before treatment	90	11.50	32.00	18.24 ± 4.49	0.0001 >
After treatment	90	12.40	29.70	18.54 ± 4.21	

Table 2. The Comparison Between BMI Before and After Treatment

Sex/Time	N	BMI			P Value
		Minimum	Maximum	Mean ± Sd	
Girls	25				< 0.0001[a]
Before treatment		12.20	32.00	19.26 ± 5.86	
After treatment		12.40	29.70	18.85 ± 4.90	
Boys	65				< 0.0001[a]
Before treatment		11.50	29.70	17.74 ± 5.07	
After treatment		13.00	28.60	18.47 ± 3.96	
Total	90				< 0.0001[a]
Before treatment		11.50	32.00	18.24 ± 4.49	
After treatment		12.40	29.70	18.54 ± 4.21	

[a]Wilcoxon test.

Table 3. The Comparison of the BMI Changes Until One Year Regarding Sex

Sex	BMI Changes Until One Year			P Value
	Minimum	Maximum	Mean ± Sd	
Girls	-4.00	2.00	0.30 ± 1.04	0.194[a]
Boys	-2.20	3.00	0.30 ± 0.81	
Total	-4.00	3.00	0.3±0.87	

[a]Mann-Whitney U test.

Kruskal-walllis test showed no significant difference between types of ADHD regarding changes of BMI. Wilcoxon test showed that in patients with hyperactivity disorder, the BMI didn't change significantly before and after treatment (P < 0.799). However, in the attention deficit and combined type, the changes in BMI was significantly noted, respectively (P = 0 < 0.0001 and P = 0.008). The majority of patients (62 (86.9%)) used 20 mg/kg methyl phenedit daily. Kruskal-walllis test noted no significant difference regarding 1 year of BMI changes among different dosage of drugs (P = 0.760). Wilcoxon test showed a significant difference between BMI before and after treatment with 20 mg/kg/day of methyl phenedit (P < 0.0001).

4. Discussion

This study compared the mean of BMI in ADHD children and adolescents before and after 1 year of medication with methylphenidate.

The most important finding of our study was the increased mean of BMI in participants after the first 1 year of treatment in both sexes. Although increasing the mean BMI in boys was more than girls, this difference was not statistically significant.

Regarding the higher prevalence of hyperactive subtype in ADHD boys than girls, maybe the effect of treatment on boys should be considered as a more effective item in order to reduce the physical activity and more increase in BMI. On the other hand, girls have more inattentive subtype and with treatment they didn't show changes in physical activity and BMI.

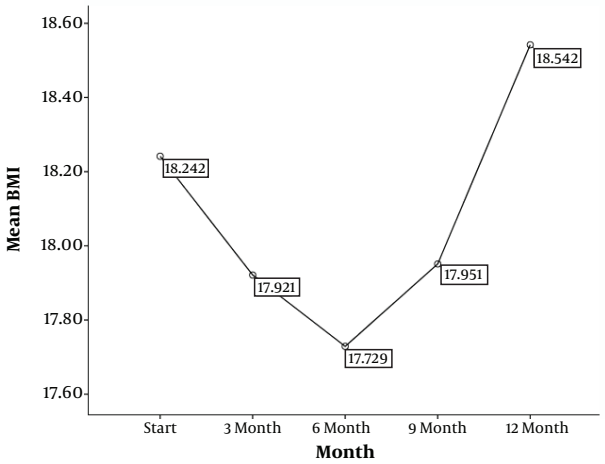

Figure 1. The trend of BMI changes before treatment until 1 year after

Results showed that most of the patients who participated in this study (58 patients) had combined type of disorder, which was consistent with previous investigations. They mentioned combined inattentive-hyperactive-impulsive presentation of ADHD as the most prevalent type of disorder in children, adolescents, and adults (7-9). Although BMI increased significantly after 1 year, the BMI in the first 6 months of treatment decreased and then increased based on the Figure 1. Previous investigations mentioned relatively consistent results regarding consuming Methylphenidate on BMI changes. In a first longitudinal study, results showed that childhood ADHD not treated with stimulants was associated with higher childhood BMIs. However, slower early BMI growth and a later rebound of BMI was noted in ADHD children treated with stimulants (10). Dubnov-Raz et al. which compared ADHD children with local controls, and indicated that children with ADHD had lower rates of being overweight and obese. They noted that consuming Methylphenidate did not significantly affect height, weight, or overweight status (11). These results showed that the effect of methylphenidate can be different and may be as a result of different duration of treatment. Therefore, further multicenter evaluation with longer duration of follow-up can be recommended. According to the results about the effect of methylphenidate on BMI, we can recommend to the parents that they should not only relax about their children's weight loss, but should also be aware of their weight gain and pay attention to their feeding behavior.

Although we found that methylphenidate finally could not decrease weight and BMI in children with ADHD, previous investigations in other diseases showed that methylphenidate could decrease BMI. Albayrak et al. mentioned that methylphenidate could successfully treat early onset extreme obesity in children with melanocortin-4 receptor gene mutation and ADHD (12). Furthermore, Danilovich et al. reported decreased energy intake from fat and carbohydrates by consuming 1 dose of MPH in obese adolescents. This effect underscores the importance of central dopamine signaling on eating behavior (13). Elfers et al. noted that methylphenidate could inhibit food intake (14), which may be the different effect of methylphenidate as a result of ADHD, and therefore, could decrease the effect of methylphenidate and investigations mentioned association between ADHD and obesity (15-18). Resent findings indicated impulsivity, inattention, and deficient inhibitory control as possible poor eating behavioral regulation that increased the risk of overweight and obesity in ADHD patients (17).

As the therapeutic effect of methylprednisolone is time limited, at the final point, youths with ADHD may be hungry and there will be no good control on their eating habits.

According to results, ADHD could be indicated as a risk factor for overweight and obese Iranian youth and therefore, clinicians should consider it from the beginning of the diagnosis of ADHD. Authors recommend further multicenter biochemical studies to solve this problem.

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Footnotes

Authors' Contribution: Study concept and design: Maryam Kousha, Setila Dalili, Seyyed Amir Kiani, Mohammad Mahdi Karambin, Abtin Heidarzadeh; analysis and interpretation of data: Maryam Kousha, Setila Dalili, Seyyed Amir Kiani, Maryam Zare, Abtin Heidarzadeh; drafting of the manuscript: Maryam Kousha, Setila Dalili, Seyyed Amir Kiani, Mohammad Mahdi Karambin, Abtin Heidarzadeh, Shahin Koohmanaee, Afagh Hassanzadeh Rad; critical revision of the manuscript for important intellectual content: Maryam Kousha, Setila Dalili, Seyyed Amir Kiani, Maryam Zare, Mohammad Mahdi Karambin, Abtin Heidarzadeh, Shahin Koohmanaee, Afagh Hassanzadeh Rad; statistical analysis: Maryam Kousha, Setila Dalili, Seyyed Amir Kiani, Maryam Zare, Abtin Heidarzadeh.

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