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NEÜ YAYINEVİ

Evaluation of Executive Functions, Obesity and Self-Esteem in Adolescents with Attention Deficit Hyperactivity Disorder

Dikkat Eksikliği Hiperaktivite Bozukluğu Tanılı Ergenlerde Yönetici İşlevler, Obezite ve Benlik Saygısının Değerlendirilmesi

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Öz

Amaç: Yönetici işlevlerde bozukluklar dikkat eksikliği hiperaktivite bozukluğu (DEHB) kliniğinde oldukça sık görülmektedir. Güncel çalışmalarda obezite ve DEHB'nin patofizyolojisindeki ortak mekanizmaların dürtü kontrolü ve yönetici işlevlerle ilişkili olabileceği öne sürülmektedir. Bu çalışma, aşırı kiloluluk / obezitesi olan ve olmayan DEHB tanılı çocuk ve ergenlerin yönetici işlevleri ve benlik saygısı düzeylerinin karşılaştırılması amaçlanmıştır. Ayrıca, çocuk ve ergenlerde aşırı kiloluluk / obezite, yönetici işlevler, DEHB ve benlik saygısı arasındaki karmaşık ilişkinin incelenmesi amaçlanmıştır.
Hastalar ve Yöntem: Mart 2021- Nisan 2022 arasında Gazi Üniversitesi Çocuk ve Ergen Psikiyatrisi polikliniklerine başvuran DEHB tanılı herhangi bir ilaç kullanmayan 71 ergenin dahil edildiği örneklemin yaş ortalaması 16.12±1.71 (yaş aralığı= 12-18 yıl) yıl olup, %71.83'ü erkeklerden oluşmaktadır. Katılımcılara Yönetici İşlevlere Yönelik Davranış Değerlendirme Envanteri Ölçeği (anne baba formu), Rosenberg Benlik Saygısı Ölçeği ve Conners Ana baba Derecelendirme Ölçeği- Yenilenmiş Kısa Formu verilmiştir.
Bulgular: DEHB tanılı ergenlerde hiperaktivite belirtilerinin ve çalışma belleği fonksiyonunun benlik saygısının en önemli yordayıcıları olduğu saptanmıştır. Ayrıca aşırı kiloluluk / obezite durumuna göre DEHB'li ergenler karşılaştırıldığında çalışma belleği ve planlama/örgütleme fonksiyonları açısından gruplar arası farklılık bulunmuştur. Ancak gruplar arasında benlik saygısı ve DEHB şiddeti açısından bir farklılık saptanmamıştır.
Sonuç: Çalışmamızın sonuçları değerlendirildiğinde DEHB'li ergenlerin benlik saygısında çalışma belleği ve hiperaktivite belirti şiddetinin önemli rol oynayabileceğini göstermektedir. Aşırı kiloluluk/obezite durumuna göre DEHB tanılı ergenlerde benlik saygısı ve DEHB kliniğini açısından farklılık saptanmazken çalışma belleği ve planlama/örgütleme becerilerinde farklılık saptanması, DEHB'de yönetici işlevlerin aşırı kiloluk/obezite için kritik bir rol oynadığını düşündürmektedir.

Anahtar Kelimeler: Yürütücü fonksiyon, obezite, özsaygı, dikkat eksikliği hiperaktivite bozukluğu

Abstract

Aim: Executive function deficits are very common in attention deficit hyperactivity disorders (ADHD). Recent studies suggest that common mechanisms in the pathophysiology of obesity and ADHD may be related to impulse control and executive functions. This study aimed to compare the executive functions and self-esteem levels of children and adolescents with ADHD with and without overweight/obesity. The study also aimed to examine the relationships between overweight/obesity, executive functions, ADHD and self-esteem in children and adolescents.
Patients and Method: Participants included 71 children/adolescents (mean age = 16.12±1.71; age range= 12-18 years; 71.83% males) with ADHD who applied to Gazi University Child and Adolescent Psychiatry outpatient clinics between March 2021 and April 2022 and did not use any medication. Participants completed the Executive Functions Behavior Evaluation Inventory Scale (parent form), Conners Parent Rating Scale-Revised Short Form and Rosenberg Self-Esteem Scale.
Results: Results showed that hyperactivity symptoms and working memory function were significant predictors of self-esteem in adolescents with ADHD. In addition, when adolescents with ADHD were compared according to their overweight/obesity level, significant differences were found between the groups in working memory and planning/organization functions. However, no difference was found between the groups in terms of self-esteem and ADHD severity.
Conclusion: The findings suggest that working memory and hyperactivity symptom severity may play an important role in understanding the self-esteem of adolescents with ADHD. While no difference was found in terms of self-esteem and ADHD clinic in adolescents diagnosed with ADHD according to overweight/obesity status, differences in working memory and planning/organization skills suggest that executive functions play a critical role in overweight/obesity in ADHD.

Key words: Executive function, obesity, self-esteem, attention deficit hyperactivity disorder

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INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder that begins in childhood and is characterized by symptoms of inattention, hyperactivity, and impulsivity that are inappropriate for the person's age (1). In recent epidemiological studies, the prevalence of ADHD has been reported to be between 5.9% and 7.1% in the world and 12.7% in Turkey (2). A growing body of evidence shows a significant association between ADHD and overweight/obesity (3). Recent studies suggest that common mechanisms in the pathophysiology of obesity and ADHD include changes in abnormal reward center responses, impulse control, and executive functions (4). Executive functions, which are defined as high-level cognitive functions, are skills such as inhibition, abstraction, working memory, emotional regulation, the use of previously acquired skills for environmental conditions, towards the appropriate target, verbal fluency, organization and planning (5). Impairments in executive functions can lead to inadequate attention and planning, difficulties in forming and implementing solution strategies, difficulty in benefiting from feedback, and impaired flexible thinking (6). It has been suggested that learning problems related to executive functions, difficulties in regulating emotional responses, and low academic achievement may lead to negative environmental comments, leading to frustration, failure, and a decrease in self-efficacy and self-esteem in children with ADHD (7, 8). Self-esteem is related to the evaluation of the person about himself, expressing whether he likes it or not, and it shows how important and valuable he sees himself (9-11). This concept is a value judgment expressed by the attitudes developed by the individual for himself. Self-esteem is one of the leading components of mental health and personality development. (12). Low self-esteem can hinder social and cognitive development in children and contribute to the emergence of various mental and physical diseases in adulthood. There is strong evidence that childhood obesity has negative effects on self-esteem and quality of life. (13). Similarly, there are studies showing that children with ADHD have lower self-esteem than controls. (8). In a recent study, children with ADHD are prone to obesity; therefore, it has been suggested that low self-esteem may create more serious problems in obese children with ADHD (14). The findings suggest that there may be a complex relationship between overweight/obesity, self-esteem and executive functions in children and adolescents with ADHD. As far as in our knowledge, there is no study examining this relationship simultaneously. To fill this gap in the literature, this research aimed to examine the complex relationship between overweight/obesity, executive functions, ADHD and self-esteem in children and adolescents with ADHD.

PATIENTS AND METHODS

The sample of this study consisted of 71 adolescents aged 12-18 years who met the diagnostic criteria for attention deficit hyperactivity disorder according to the 5th Edition of the Diagnostic and Statistical Manual of Mental Diseases (DSM-5), who applied to the outpatient clinics of Gazi University Hospital between March 2021 and April 2022. The exclusion criteria of the study were;

1. Diagnosed with additional psychiatric disorders other than ADHD in the DSM-5-based clinical evaluation.
2. Using any psychopharmacological agent (methylphenidate, atomoxetine, risperidone, aripiprazole etc.) in the last three months.
3. While the medical history was questioned in the clinical interview with both the adolescent and the parent, the adolescents who were learned to have a history of any chronic physical disease (eg asthma, epilepsy, hypothyroidism, phenylketonuria, diabetes mellitus, hypertension etc.) that were or should be followed up by pediatrics were not included in the study.

Measures

Sociodemographic Data Form: For this study, sociodemographic form was prepared to obtain from interviews with children, adolescents, and their parents. The form included participants' age, class, family status and age at first diagnosis, clinical evaluation data such as body mass index scores and percentile values calculated according to the reference values of weight, height and body mass index in Turkish children determined by Neyzi et al alongside ADHD predominantly presentation (15).

Conners Parent Rating Scale-Revised Short (CPRS-SF): CPRS-SF was revised from its long form by Conners in 1997 (16). Kaner et al. translated the scale into Turkish and conducted a validity and reliability study in 2013 (17). CPRS-SF consists of 27 items and is answered on a 4-point Likert scale ranging from 0 (never) to 3 (always). Items were collected in three subscales (Oppositional, Hyperactivity and Cognitive problems) and an auxiliary scale (ADHD Index). The CPRS-SF is frequently used in the screening/

determination of ADHD severity and symptoms and in the evaluation of treatment effectiveness in the treatment follow-up period (17).

Rosenberg Self-Esteem Scale (RSES): RSES, developed by Rosenberg to evaluate people's judgments about themselves, consists of 10 items (9). RSES, which is a 4-point Likert-type scale ranging from 1 (very trure) to 4 (very false). High scores on the self-report scale indicate high self-esteem. The validity and reliability study of the scale in our country was performed by Çuhadaroğlu (18).

Behavior Rating Inventory of Executive Function (BRIEF): It was developed by Gioia et al (2002). BRIEF is used to measure executive functions, complex problem-solving skills and adaptive behaviors in daily life in individuals between the ages of 5 and 18 (19). The 86 questions in the BRIEF include 8 subscales (Inhibition, Shift, Emotional Control, Initiate, Working Memory, Plan/ Organize, Organization of Materials and Monitor), 2 comprehensive indexes (Behavioral Regulation Index, Metacognition Index) and the Global Executive Composite, which evaluates both indexes together. (20). High scores on the scale indicate high levels of executive dysfunction. The validity and reliability study for its use in patients with ADHD in our country was conducted by Bakar et al. (2011) (21).

Procedure

After the purpose and method of the study were verbally explained, written and verbal informed consent forms were obtained from the adolescents and their parents who agreed to participate in the study. Overweight and obesity were determined by considering the body mass index values of the World Health Organization (under 5th percentile underweight; 5-84th percentile normal; 85-94th percentile overweight; 95th percentile and above obese) (22). Adolescents with ADHD were divided into two groups according to their body mass index as above the 85th percentile and below the 85th percentile. To evaluate the executive functions and ADHD severity of adolescents, their parents were given the Executive Functions Behavior Evaluation Inventory Scale (parent form), and Conners Parent Rating Scale-Revised Short form, respectively. A self-reported Rosenberg Self-Esteem scale was given to assess adolescents' self-esteem. Ethics committee approval of the study was received from the Ethics Committee of Ağrı İbrahim Çeçen University (Date: 2021, Number: 51).

Statistical Analysis

After the raw data of this study were entered into Microsoft Excel, Statistical Package for Social Sciences (SPSS) version 24.0 was used for statistical analysis of the data. Descriptive analysis was performed to present the demographic characteristics of the variables. Categorical variables such as gender, body mass index, and family structure were presented as numbers and percentages. Continuous variables such as self-esteem, ADHD, and executive function scores were expressed as mean and standard deviation. Skewness and kurtosis statistics are reported to explain the distribution of the variables (Table 1). Findings from the preliminary analysis showed that skewness scores ranged from -1.17 to .46, and kurtosis values ranged from -1.27

Table 1. Descriptive statistics for variables

Variable	Min	Max	Mean	S.D.	Skewness	Kurtosis
Body mass index (Percentile)	5.30	99.20	65.78	28.61	-0.77	-0.56
Self-esteem	17	39	28.86	6.73	-0.34	-0.99
CPRS-SF Oppositional	2	18	9.07	3.90	0.46	-0.11
CPRS-SF Hyperactivity	0	18	8.79	5.00	0.13	-1.27
CPRS-SF Cognitive problems	3	18	13.90	3.96	-0.25	-0.56
CPRS-SF ADHD index	9	35	23.52	6.24	-0.24	-0.40
BRIEF Inhibition	12	30	21.68	4.19	-0.22	-0.39
BRIEF Shift	10	22	16.87	2.92	-0.43	-0.55
BRIEF Emotional control	10	29	20.70	4.54	-0.41	-0.10
BRIEF Initiate	10	24	17.56	3.04	-0.40	0.41
BRIEF Working Memory	13	29	22.17	3.46	-0.69	0.29
BRIEF Plan/Organize	13	34	27.37	4.12	-1.17	1.68
BRIEF Organization of Materials	6	18	13.00	2.47	-0.70	0.90
BRIEF Monitor	12	24	18.07	2.72	-0.45	-0.40
BRIEF Behavioral Regulation Index	41	80	59.24	9.06	-0.10	-0.85
BRIEF Metacognition Index	64	124	98.17	12.26	-0.89	0.96
BRIEF Global Executive Composite	111	204	157.41	19.25	-0.43	0.13

Table 2. Clinical and Sociodemographic data (N=71)

Variable	Groups	N	Yüzde
Gender	Boys	51	71.83
	Girls	20	28.17
Body mass index (Percentile)	Obese	9	12,68
	Over-weight	22	30,98
	Normal	40	56.34
Family	Married	55	77.46
	Divorced	16	22.54
ADHD Presentations	Predominantly Inattentive	27	38.02
	Predominantly Hyperactive/impulsive	2	2.82
	Combined	42	59.16

to 1.68. These scores showed that all variables had a relatively normal distribution (skewness and skewed values <|2|). Visual examination of the variable distribution (eg, histogram) , as well as the Kolmogorov-Smirnov and Shapiro-Wilk tests, also provided further evidence of the normality of the data. An independent sample t-test was used to compare scores for the main variables based on overweight/ obesity. Pearson correlation analysis was applied to determine the relationships between the variables. Multiple regression analysis was performed to determine the predictors of self-esteem. The statistical significance value is based on p <0.05.

RESULTS

The mean age of the sample was 16.12±1.71 years (age range= 12-18 years), while there was71.83% (n=51) boys. Their height ranges from 133 cm to 182 cm (average height = 161.03, SD = 10.73), and their weight ranges from 37kg to 109 kg (average weight = 57.23 kg, SD = 15.43). According to the percentiles calculated according to the body mass index, 12.68% of the participants were considered obese (n=9) and 30.98% (n=22) were considered overweight.

Table 3. Independent sample t-test results

Variable	Over-weight and Obese ADHD Group n=31	Normal Weight ADHD Group n=40	p
Self-Esteem (Mean ± S.D)	27.48±7.52	29.93±5.93	0.13
According to CPRS-SF ADHD scores Oppositional (Mean ± S.D)	9.26±4.16	8.93±3.74	0.72
Hyperactivity (Mean ± S.D)	9.16±5.33	8.93±3.74	0.58
Cognitive problems (Mean ± S.D)	12.81±3.93	11.20±3.88	0.09
ADHD index (Mean ± S.D)	24.77±5.74	22.55±6.51	0.14
According to BRIEF, executive function scores Inhibition (Mean ± S.D)	22.00±4.72	21.43±3.78	0.57
Shift (Mean ± S.D)	17.42±2.88	16.45±2.92	0.17
Emotional control (Mean ± S.D)	21.35±4.62	20.20±4.47	0.29
Initiate (Mean ± S.D)	18.16±2.49	17.10±3.36	0.15
Working Memory (Mean ± S.D)	23.13±2.33	21.43±3.99	0.04
Plan/Organize (Mean ± S.D)	28.45±3.22	26.53±4.56	0.05
Organization of Materials (Mean ± S.D)	13.55±2.29	12.58±2.54	0.10
Monitor (Mean ± S.D)	18.55±2.50	17.70±2.85	0.19
Behavioral Regulation Index (Mean ± S.D)	60.74±8.91	58.08±9.11	0.22
Metacognition Index (Mean ± S.D)	101.84±9.65	95.33±13.39	0.03
Global Executive Composite (Mean ± S.D)	162.58±15.89	153.40±20.81	0.05

Table 4. Correlation between variables

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Body mass index (Percentile)	—													
2. Self-Esteem	-0.20	—												
According to CPRS-SF ADHD scores														
3. Oppositional	0.03	-0.04	—											
4. Hyperactivity	0.00	0.14	0.63**	—										
5. Cognitive problems	0.23*	-0.14	0.61**	0.39**	—									
6. ADHD index	0.21	-0.18	0.59**	0.44**	0.80**	—								
According to BRIEF, executive function scores														
7. Inhibition	-0.01	-0.28*	0.25*	0.14	0.36**	0.29*	—							
8. Shift	0.10	-0.22	0.20	0.26*	0.33**	0.39**	0.35**	—						
9. Emotional control	0.04	-0.13	0.14	0.05	0.25*	0.11	0.38**	0.46**	—					
10. Initiate	0.17	-0.13	0.32**	0.48**	0.44**	0.47**	0.47**	0.40**	0.33**	—				
11. Working Memory	0.22	-0.34**	0.27*	0.40**	0.44**	0.49**	0.39**	0.48**	0.17	0.61**	—			
12. Plan/Organize	0.10	-0.12	0.33**	0.37**	0.49**	0.45**	0.44**	0.69**	0.50**	0.56**	0.50**	—		
13. Organization of Materials	0.14	-0.16	0.23	0.30*	0.36**	0.39**	0.16	0.41**	0.09	0.51**	0.52**	0.41**	—	
14. Monitor	0.06	-0.23	0.35**	0.45**	0.27*	0.31**	0.42**	0.44**	0.20	0.43**	0.53**	0.54**	0.28*	—

Not. *. $p < .05$; **. $p < .05$

Detailed sociodemographic and clinical information is presented in Table 2.

To compare the CPRS-SF subscale scores, self-esteem, and executive functions assessed by BRIEF of adolescents with ADHD who are at or above the 85th percentile (overweight and obese adolescents) and below the 85th percentile according to body mass index, independent sample test-test was applied. (Table 3). It has been determined that overweight/obese adolescents have higher working memory, planning/organization, metacognition index and global executive scores of BRIEF than normal-weight adolescents.

Pearson correlation analysis was performed to examine the relationships between self-esteem, percentile, executive functions and ADHD symptoms in adolescents with ADHD and is shown in Table 4. Accordingly, it was found that percentile values in

Table 5. Predictors of self-esteem levels

Variable	B	β	t	p
Model 1		F (3, 70) = 1.52, R = .25, R2 = .06, p > 0.05		
Age	0.67	0.17	1.44	0.15
Gender	0.51	0.03	0.29	0.78
Obesity	2.43	0.18	1.51	0.13
Model 2		F (15, 70) = 2.28, R = .62, R2 = .38, ΔR2 = .32, p < 0.05		
Age	0.47	0.30	0.84	0.22
Gender	1.72	0.12	1.00	0.32
Obesity	0.93	0.07	0.60	0.55
Oppositional	-0.30	-0.17	-1.01	0.32
Hyperactivity	0.73	0.54	3.23	0.01
Cognitive problems	0.20	0.12	0.58	0.56
ADHD index	-0.22	-0.20	-0.98	0.33
Inhibition	-0.22	-0.14	-0.98	0.33
Shift	-0.10	-0.04	-0.27	0.79
Emotional control	-0.11	-0.08	-0.54	0.59
Initiate	-0.06	-0.03	-0.17	0.87
Working Memory	-0.60	-0.31	-1.85	0.07
Plan/Organize	0.25	0.15	0.82	0.42
Organization of Materials	-0.23	-0.08	-0.61	0.55
Monitor	-0.52	-0.21	-1.39	0.17

Not. B = non-standardized coefficients; β = Standard coefficients; Gender (1 = boy, 2 = girl); Obezite (1= existing, 2 = absence)

adolescents with ADHD were positively correlated with the cognitive problems/inattention subscale scores of CPRS-SF. In addition, a negative correlation was found between self-esteem, working memory and inhibition subscales of BRIEF. Positive correlations were found between CPRS-SF's oppositional subscale scores and BRIEF's inhibition, initiate, working memory, plan/organize, and monitor subscales and between CPRS-SF's hyperactivity subscale scores and BRIEF subscales other than inhibition and emotional control. In ,addition positive correlations were found between CPRS-SF's inattention subscale scores and all subscales of BRIEF, and between the ADHD index and all subscales except emotional control.

Multiple regression analysis was performed to examine the roles of executive functions and clinical features of ADHD in predicting self-esteem in adolescents with ADHD. In the regression model, age, gender and obesity variables were controlled in Model 1. The results showed that executive functions (Model 2) explained 32% of the variance in self-esteem. In the regression model, hyperactivity (β = .73, $p<0.01$) and working memory (β = -.60, $p<0.05$) were found to be significant predictors of self-esteem in adolescents with ADHD $F(15, 70) = 2.28$, $R = .62$, $R2 = .38$, $\Delta R2 = .32$, $p < 0.05$. The results are shown in Table 5.

DISCUSSION

In this study, the relationship between overweight/obesity, executive functions, self-esteem, and ADHD symptoms and severity were investigated in adolescents with ADHD. Hyperactivity symptoms and working memory function were found to be the most important predictors of self-esteem in adolescents with ADHD. In addition, when adolescents with ADHD were compared according to their overweight/obesity status, although there was a difference between the groups in terms of working memory and planning/organization functions, no difference was found in terms of self-esteem, ADHD symptoms, severity and other executive functions.

In this study, it was found that hyperactivity symptoms were a positive predictor of self-esteem in children and adolescents with ADHD. Although there are conflicting findings in studies investigating self-esteem in children with ADHD, many studies have shown that children with ADHD have lower self-esteem than controls (23-25). However, some studies did not find a significant relationship between ADHD and self-esteem. (26). In parallel with our results, in a recent study in which self-esteem was examined according to ADHD presentation; It was determined that the self-esteem of adolescents with predominantly hyperactive/impulsive ADHD was higher than that of adolescents with both combined and predominantly inattentive ADHD. In the same study, it was stated that the level of self-esteem was related to cognitive functions, and when cognitive functions were evaluated according to predominantly presentations, those with low cognitive functions also had low self-esteem. (27). In our study, due to the low sample size, self-esteem in adolescents with ADHD could not be examined according to predominantly presentations. While internalizing symptoms and learning disorders are more common in adolescents with predominantly inattentive presentation ADHD, it has been reported that adolescents with combined or predominantly hyperactive/impulsive presentation are more frequently accompanied by externalizing problems such as conduct disorder, oppositional defiant disorder, and aggression (28). The fact that self-esteem is more closely associated with internalizing disorders may help explain the relationship between hyperactivity symptoms and self-esteem in adolescents with ADHD, although not directly.

A negative correlation was found between self-esteem and inhibition and working memory scores in children and adolescents with ADHD. In addition, working memory functions were found to be an important predictor of self-esteem in children and adolescents with ADHD. According to these results, low self-esteem is associated with impaired working memory and inhibition in adolescents with ADHD. There are conflicting results in the literature regarding the relationship between working memory and self-esteem. In a recent study evaluating the relationship between executive functions and self-esteem in children and adolescents with ADHD, a positive relationship was found between working memory functions and self-esteem (27). Contrary to these results, Alloway et al. (2009), with the of 308 children aged 5-11 years, it was shown that there is no strong relationship between self-esteem and working memory functions (29). Conflicting findings in the literature may have resulted from differences in sample selection or the methods used to assess working memory and self-esteem. Our results support the results of studies showing a relationship between self-esteem and executive functions in children with ADHD. Besides, it draws attention to the clinical importance of inhibition

and working memory functions in interventions to be developed to strengthen the self-esteem of these children.

While a difference was found in inattention symptoms between adolescents with normal weight and overweight/obese adolescents, no difference was found in terms of self-esteem and ADHD severity. In a few studies, one of which was carried out in our country; When predominantly presentations of ADHD were compared, it was found that there was a higher risk of obesity for the predominantly inattentive presentation compared to the other dominant presentations. (30, 31). It was also pointed out that patients with ADHD may be relatively inattentive to the internal symptoms of hunger and satiety (32). It has been suggested that this situation can be explained by the ADHD-related attention deficit and consequent deficiencies in executive functions, causing difficulties in adhering to a regular eating pattern, and thus the emergence of abnormal eating behaviors.

In a study conducted with the participation of 580 university students with ADHD, the effects of ADHD severity and overweight/obesity on self-esteem, anxiety, depression and stress were examined. In parallel with our results, no significant relationship was found between the presence of overweight/obesity and self-esteem in youth with ADHD (33). Many studies have shown that adolescents with ADHD have lower self-esteem than controls, and that obesity has negative effects on self-esteem. (7, 24, 34). The lack of difference in self-esteem levels between groups with and without obesity in this study can be explained by the low sample size. To our knowledge, this is the first study to examine obesity and self-esteem together in children and adolescents with ADHD. Multicenter longitudinal studies with larger participation are needed to confirm the results of this study.

Many studies from preschool age to adolescence show a negative relationship between overweight/obesity and executive functions, especially inhibition (35-37). According to the results of a comprehensive meta-analysis examining 72 studies evaluating executive functions in overweight/obese individuals, it was reported that while common executive dysfunctions were observed in obese individuals, the most prominent impairments among executive functions in overweight individuals were in inhibition and working memory. (38). In our study, when adolescents with ADHD were compared according to their overweight/obesity status, the working memory, planning organization, metacognition index and global executive scores of the overweight/obese group were higher than the other group. However, no difference was found between the groups in terms of ADHD severity and self-esteem. Similar to our findings, Graziano et al. (2012) in a study conducted with the participation of children and adolescents with ADHD between the ages of 4-18; It has been reported that children with ADHD with poor executive functions have higher BMI scores and are more likely to be classified as overweight/obese compared to children with ADHD with better executive functions (39). However, in a recent study conducted in our country, when children and adolescents aged 6-13 with ADHD were divided into groups according to the 85th percentile, no difference was found between the groups in terms of ADHD severity and executive functions (40). While the results of this study on ADHD severity are similar to our results, the results obtained regarding executive functions are contradictory. This may be due to the differences between the evaluation methods of executive functions.

One of the strengths of this study is that it is the first time that the overweight/obesity, executive functions, self-esteem, and ADHD severity have been examined simultanously in adolescents with ADHD. In addition, considering that variables such as overweight/obesity, executive functions, and self-esteem may also be affected by other psychiatric disorders, the inclusion of only ADHD adolescents can be considered as another strength of the study. The main limitation of this study that should be accepted is the absence of a control group and the examination of overweight and obese adolescents in the same group. In addition, the fact that the sample was collected from a single center and is relatively small makes it difficult to generalize the findings. Finally, the fact that the study is in a cross-sectional model causes no cause-effect relationship between the variables. Our results should be supported by multicenter, broader participation and longitudinal studies.

CONCLUSIONS

When the results of our study are evaluated, it shows that working memory and hyperactivity symptom severity may play an important role in the self-esteem of adolescents with ADHD. While no difference was found in terms of self-esteem and ADHD clinic in adolescents diagnosed with ADHD according to overweight/obesity status, differences in working memory and planning/organization skills

suggest that executive functions play a critical role in overweight/obesity in ADHD. These results, which show that executive functions may have an impact on the psychosocial status of adolescents with ADHD, emphasize the importance of evaluating working memory functions in adolescents with ADHD, both psychosocially and clinically.

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