Original article / *Araştırma*

Investigation of autism spectrum disorder and autistic symptoms in obese children and adolescents

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ABSTRACT

Objective: *Obesity remains a chronic disorder, which triggers both psychological and physical challenges and need not to be probed only from the biological viewpoint. Various obesity-linked psychiatric diseases have been documented in past studies. Nevertheless, there is never adequate information on the correlation between obesity and autism/autistic symptoms in literature. However, high rates of obesity among autistic adolescents and children remained further stressed in the latest studies. The purpose of this study is to compare autistic and autistic symptoms in normal weight and body-mass index (BMI) and obese children.* ***Methods:*** *The study group entailed 204 adolescents and children with obesity whereas the control group entailed 143 children and adolescents in normal weight. The participants were handed sociodemographic data form, Social Communication Questionnaire (SCQ), and Autism Behavior Checklist (ABC). The assessment of autism spectrum disorder and autistic symptoms were done utilizing questionnaires and clinical interviews based on DSM-5.* ***Results:*** *Three children had positive ASD diagnosis. All of them were from obese group. The total score of ABC alongside relating (social skills) and sensory scores subgroups was found higher significantly in obese group. The SCQ total and subgroup scores were higher in the obese group, it was not significant. Nonetheless, the quantity of children with SCQ (positive score) beyond cutoff stood higher significantly in obese group.* ***Discussion:*** *We found a close correlation between obesity and autism and autistic symptoms. We suggest that common genetic studies to be performed on this field should clarify the relationship between autism and obesity more clearly.* ***(Anatolian Journal of Psychiatry 2018; 19(5):518-525)***

Keywords: *obesity, social communication questionnaire, autistic symptom, autism, prevalence*

Obez çocuk ve ergenlerde otizm spektrum bozukluğu ve otistik belirtilerin araştırılması

ÖZ

Amaç: *Obezite hem ruhsal, hem de fiziksel zorlukları tetikleyen ve sadece biyolojik yönüyle irdelenmemesi gereken, kronik bir bozukluktur. Geçmişteki çalışmalarda obeziteye bağlı çeşitli psikiyatrik bozukluklar ortaya konmuştur. Bununla birlikte, literatürde obezite ile otizm/otistik belirtiler arasındaki korelasyon hakkında yeterli bilgi yoktur. Son çalışmalarda otistik çocuklar ve ergenler arasında yüksek obezite oranları sık vurgulanmıştır. Bu çalışmanın amacı normal kilo ve beden kitle indeksine (BKİ) sahip çocuklarla obez çocukları otizm spektrum bozukluğu ve otistik belirtiler açısından karşılaştırmaktır.* ***Yöntem:*** *Çalışma grubuna 204 obez çocuk ve ergen, kontrol grubuna 143 normal ağırlığa sahip çocuk ve ergen alındı. Katılımcılara Sosyodemografik Veri Formu, Sosyal İletişim Ölçeği (SİÖ) ve Otizm Davranış Kontrol Listesi (ODKL) verildi. Otizm spektrum bozukluğu ve otistik belirtilerin değerlendirilmesi DSM-5 temelli klinik görüşmeler ve ölçekler kullanılarak yapıldı.* ***Bulgular:*** *Üç çocukta otizm spektrum bozukluğu saptandı ve bu üç çocuk obez grubundaydı. Obez grupta ODKL ilişki kurma (sosyal beceriler) ve duyusal puanlar gibi alt ölçek puanların yanı sıra ODKL toplam puanı da yüksekti. SİÖ toplam ve alt grup puanları obez grupta daha*

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yüksek, ancak anlamlı değildi. Bununla birlikte, SİÖ ölçeği pozitifliği (kesme puanı üstündeki çocuk sayısı) obez grupta belirgin olarak daha yüksekti. ***Tartışma:*** *Obezite ile otizm ve otistik belirtiler arasında yakın bir ilişki bulduk. Bu alandaki ortak genetik çalışmaların, otizm ile obezite arasındaki ilişkiyi daha açık bir şekilde açıklamasını öneriyoruz.* ***(Anadolu Psikiyatri Derg 2018; 19(5):518-525)***

Anahtar sözcükler: *Obezite, sosyal iletişim ölçeği, otistik belirti, otizm, yaygınlık*

INTRODUCTION

Obesity is among the most severe global health issue in the 21st century. The World Health Organization (WHO) defines obesity as the 'abnormal/excessive accumulation of fat which presents a real risk to health'. A metabolic disease is triggered by the interaction of genetic and environmental factors. Studies have found that approximately two-hundred genes take part in the development of obesity.[1] Obesity is amongst the most shared chronic illnesses of childhood. It affects nearly between 25% and 30% of adolescents and children. Currently, over forty million obese or overweight children exit globally.[2]

The prevalence of obesity continues to rise. It is probably that there exists an interaction between environment and genetic predisposition whereby genetically vulnerable children react with put on weight on the environment with a surged existence of energy-dense foods and reduced energy spending. Obesity has social, mental and physical complications that severely affect life. For this reasons, studies about mental health and obesity have increasingly gained momentum in the recent years.[3] A strong statistical relationship between anxiety and depression disorders has been acknowledged in a community-wide study.[4] Mental illness linked with low self-esteem, depression, eating disorder, body dysmorphic and social interactions problems have been more prevalence in obese adolescents than normal peers.[5,6] Obese children have been less successful in school. They also experience additional problems among friends and families compared to non-obese children.

Obese adolescents showed weaker cognitive functions when given neurocognitive assignments. Recent studies have recognized that attention deficit hyperactivity disorder (ADHD) is more prevalent among the obese adolescents and children than normal weight peers. Children with ADHD show higher prevalence of obesity.[7] According to the study by Lundström et al.[8] conducted to compare the prevalence of annual autism symptom phenotype and of registered diagnose for ASD during a ten-year period in children, it was found that the annual prevalence of autism phenotype stood stable during the ten-year period (p=0.870 for the linear time trend). In comparison, the study established a monotonic significant increase in prevalence of registered diagnose of ASD in national patient register for liner time trend. The study further established that autism symptom phenotype's prevalence has stayed stable in children in Sweden whereas the official prevalence for registered, clinically diagnosed, ASD has increased significantly. This suggested that administrative changes that affect registered prevalence, instead of secular factors that affect the pathogenesis, are significant for the increase in reported ASD prevalence.[8] It has also been reported that autistic symptoms can further be observed usually in unaffected societal individuals. Nevertheless, only limited studies have focused on autism and obesity in scientific literature. In such limited studies, high risks of obesity and unhealthy gain in weight were recorded among autistic adolescents and children.[9-11] It has been discovered that obesity and unhealthy weight gain prevalence stood higher amongst autistic children aged between two and five years as opposed to the general population.[12] Very little study exists in literature on whether or not obese children and adolescents showcase autism and autistic symptoms. It was hypothesized that there is a close correlation between obesity and autism and autistic symptoms. In the present study, obese adolescents and children were compared to normal weight peers in relation to autism and autistic symptoms.

METHODS

Study setting and design

The cross-sectional case-control prospective study was used. The study group encompassed 204 of adolescents and children applied to Department of Pediatrics at Ankara Children's Health and Diseases Hematology-Oncology Training and Research Hospital between June 2016 and June 2017. The subjects were aged between seven and seventeen years. The parents of the subjects and patients showed fluency in Turkish language and had been diagnosed with obesity. The patients with intellectual abilities, applied to the psychiatric clinic, chronic

illness, and genetic syndrome of obesity were excluded from the study group. No subject was diagnosed with a known genetic syndrome with obesity alongside neurodevelopment characteristics like Bardet-Biedl Syndrome, Fragile X or Prader-Willi Syndrome based on clinical interview according to the Diagnostic and Statistical Manual of Mental Disorders-5th edition (DSM-5) criteria.[13] The control group entailed 143 of volunteer normal weight adolescents and children chosen for health check-ups purposes in same hospital. The control group had no chronic illness and was not applied to the psychiatric clinic. The control group also had similar age and gender as the treated group.

Subjects' body weight measurements were carried out after a ten-hour fasting, barefoot and daily clothes retained, using the BarimedR Electronic Body Scale (SC-105 with 0.10 kg accuracy). The heights of participants were measured by using Ayrton R Stadiometer Model S100 with 0.1 centimeter accuracy. Then, the BMI was calculated using formula, kg/m^2. Obesity was defined as a BMI of over 95th percentile for sex and age, whereas normal weight was pointed out as a BMI between fifth and eighty-fifth percentile for sex and age.[14] The researcher used Centers for Disease Control and Prevention (CDC) data to calculate the BMI standard deviation score (BMISDS).[15]

A consecutive approach was used to reduce bias and it included all referred patients. The process of participants' recruitment is shown in figure 1 below.

Both control and treated groups were given Sociodemographic Data Form, Social Communication Questionnaire (SCQ) and Autism Behavior Checklist (ABC). Psychometric tests or psychiatric interviews were performed when re-quired by specialists in adolescents and children mental health for feasible intellectual insufficiency or psychopathologies detections in the control and study group based on clinical interview ac-

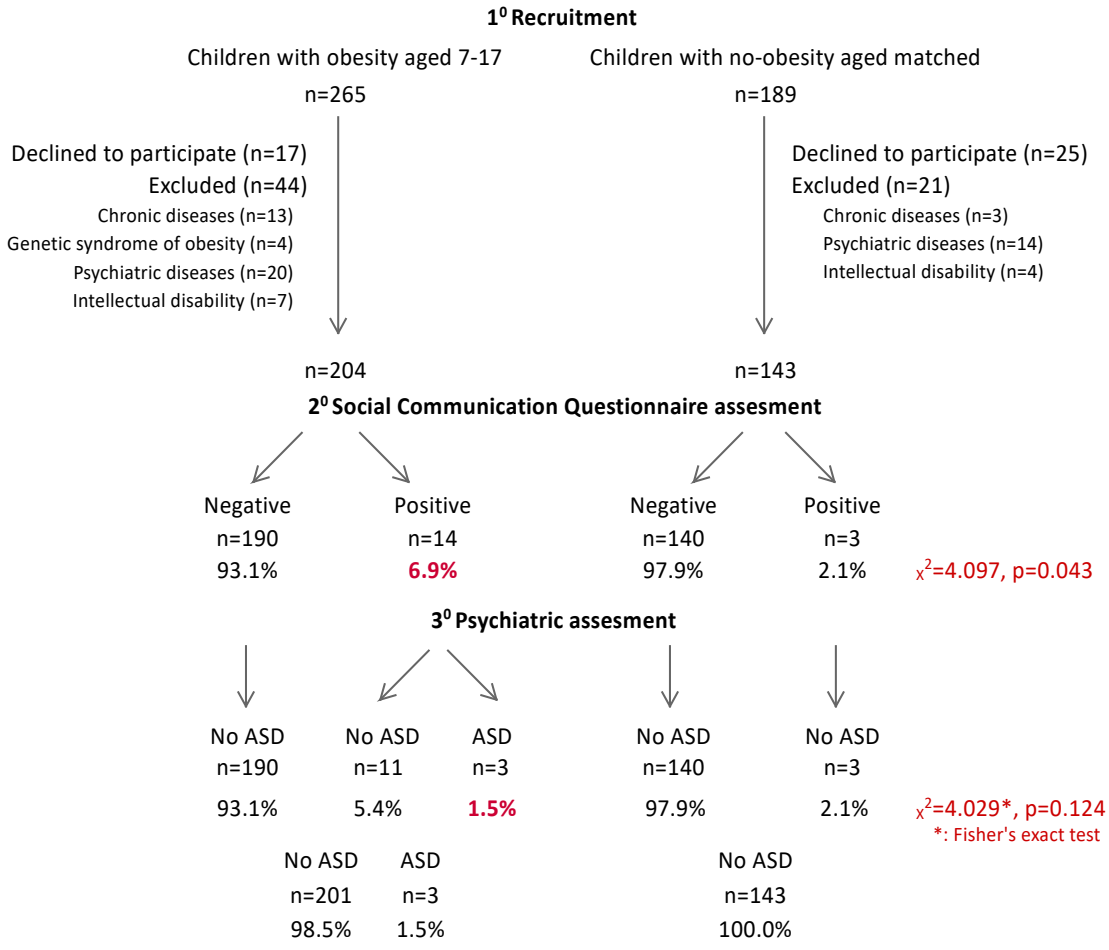

Figure 1. The process of participants' recruitment

cording to the DSM-5 criteria.

A total of 107 amount them, 46 controls and 61 obese in the study group, diagnosed with intellectual disability or any illness (anxiety, depression, or ADHD among others with an exception of autism) and were subsequently excluded from the study. Diagnosis of autism and associated autistic symptoms were determined by clinical interviews based on DSM-5 criteria and ABC, SCQ scales. The participants with higher ABC and/or SCQ cut-off scores were subsequently re-evaluated for Autism Spectrum Disorder (ASD for a 2nd round amongst adolescents and children by a specialist in the mental health. The Local Ethics Committee of Ankara Children's Health and Diseases Hematology-Oncology Training Research Hospital approved the study. All families were informed regarding the study and the corresponding informed consents were taken in adherence to the Declaration of Helsinki requirements.

Tools utilized

Demographic Information Form (DIF): The sociodemographic of participants were surveyed by questionnaires that the researchers prepared besides the regularly utilized forms in clinic. All the participants filled the DIF.

Autism Behavior Checklist (ABC): The researcher used this scale in assessing the symptoms of autism particularly among school children with severe complaints. Comprising 57 items in five subscales (measuring sensory, relating (social skills), body and object use, language, and social and self-help skills) ABC scale was completed by parents or teachers who knew the children best.[16] The reliability and validity study of Turkish version was carried out by Yilmaz-Irmak et al.[17]

Social Communication Questionnaire (SCQ): The SCQ was initially known as Autism Screening Questionnaire (ASQ). It is a reliable and valid measure utilized as a screening tool for Pervasive Developmental Disorder (PDD).[18] This tool consists of forty items hinged on Autism Diagnostic Interview-Revised (ADI-R). It is completed by primary caregivers. The forty items query reciprocal interactions, language-communication and restricted, repetitive and stereotyped behavior. These queries remain consistent with autism criteria in DSM-5. The questions on scale were answered 'yes' or 'no'. About ten minutes is taken to apply and about five minutes is taken to score. The reliability and validity study of Turkish version was carried out by Avcil et al.[3]

Statistics

One hundred and forty patients was the minimum sample size needed to compare age groups based on symptoms in every group with a value of 0.05 and an eighty-five percent statistical power. The researcher expressed categorycal variables as frequency (n) and percentage (%). The researcher expressed the continuous variables as minimum-maximum, mean, median, and standard deviation. The researcher analyzed the fitness to normal distribution using the Kolmogorov-Smirnov test. The categorical variables were compared by the researcher using Fischer's exact test and chi-square test. The continuous variables were compared by the researcher using the Mann-Whitney U test. The level of significance was accepted as $p<0.05$.

RESULTS

The two groups were similar in respect of sex distribution ($p>0.05$) and material range of parental education and birth ($p>0.05$). The researcher discovered that the quantity of siblings was mainly three or two. The two groups were similar in respect of family history of psychiatric disorder ($p>0.05$). The history of postnatal ($p=0.027$) and parental ($p<0.001$) problems were found significantly high in obese group. The two groups were similar based on variable of type of birth and preterm-post term birth ($p>0.05$). Albeit peer association problems were frequent in study group (18.6%-14.0%), the variance was statistically insignificant ($p>0.05$). Two groups were not significantly different in terms of birth type and preterm-post term birth variables ($p>0.05$). The poor school performance stood significantly pronounced in study group ($p<0.001$). Each of these demographic alongside clinical variables is shown in Table 1.

Two groups did not differ in terms of child age, education, mother's or father's age and developmental milestones (for all variables $p>0.05$) (Table 2).

The obesity group had a higher percentage of children and adolescents with ASD, diagnosed with DSM-5 criteria, as 1.5% of the children and adolescent had ASD. However, the difference in the percentage of children and adolescents with ASD in the obese group and the control group was not statistically significant ($p>0.05$). Nevertheless, there was a significant difference in SCQ positive and negative scores ($p=0.043$), ABC total scores ($p=0.144$), and SCQ subscale scores in the sensory group ($p=0.004$) between

Table 1. Demographic characteristics of groups

	Total (n=347)		Normal (n=143)		Obese (n=204)		
	n	%	n	%	n	%	p
Gender							0.650
Girl	208	59.9	85	59.4	123	60.3	
Boy	139	40.1	58	40.6	81	39.7	
Maternal age of birth							0.719
18-24 years	153	44.1	65	45.5	88	43.1	
25-34 years	147	42.4	58	40.6	89	43.6	
35-40 years	45	13.0	20	14.0	25	12.3	
41 years and over	2	0.6	0	0.0	2	1.0	
Mother education							0.791
Primary	187	53.9	80	55.9	107	52.5	
High school	110	31.7	44	30.8	66	32.4	
University	50	14.4	19	13.3	31	15.2	
Father education							0.604
Primary	181	52.2	79	55.2	102	50.0	
High school	106	30.5	40	28.0	66	32.4	
University	60	17.3	24	16.8	36	17.6	
Number of siblings							0.001
No	34	9.8	30	21.0	4	2.0	
One	123	35.4	56	39.2	67	32.8	
Two	118	34.0	41	28.7	77	37.7	
Three	49	14.1	12	8.4	37	18.1	
Four	17	4.9	4	2.8	13	6.4	
Five	5	1.4	0	0.0	5	2.5	
Six	1	0.3	0	0.0	1	0.5	
History of							
Family psychiatric disord.	33	9.5	13	9.1	20	9.8	0.824
Prenatal problem	31	8.9	2	1.4	29	14.2	<0.001
Postnatal problem	34	9.8	8	5.6	26	12.7	0.027*
Type of delivery							
Vaginal	201	57.9	77	53.8	124	60.8	0.419
C/S	138	39.8	62	43.4	76	37.3	
Forceps or vacuum	8	2.3	4	2.8	4	2.0	
Pre-post maturity							0.941
Preterm birth	13	3.7	5	3.5	8	3.9	
Postterm birth	3	0.9	1	0.7	2	1.0	
Peer relationship							0.492
Good	289	83.3	123	86.0	166	81.4	
Few friends	44	12.7	17	11.9	27	13.2	
Having problems	10	2.9	2	1.4	8	3.9	
Cannot relationship	4	1.2	1	0.7	3	1.5	
School success							<0.001
Poor	27	7.8	3	2.1	24	11.8	
Good	81	23.3	23	16.1	58	28.4	
Perfect	239	68.9	117	81.8	122	59.8	

*: *Fisher's exact test*

the control group and the obese group (Table 3).

DISCUSSION

The present study is amongst the unique ones that have systematically interrogated the autism and autistic symptoms in obese adolescents and children. Autistic symptoms in obese children prevalence stood at 6.9%. This denotes an approximately 3.5-fold greater prevalence of autistic symptoms in obese children than in control group.[12] The ASD prevalence in the entire sample stood at 0.9% and 1.5% in obese children particularly (1.66-times greater). This denotes approximately identical ASD prevalence in obese children than in entire population. Obese

Table 2. Analysis of continuous variables in two groups

	Total (n=347) Mean±SD (range)	Normal (n=143) Mean±SD (range)	Obese (n=204) Mean±SD (range)	p
Child age (months)	10.5±2.5 (7-17)	10.2±2.4(7-17)	10.6±2.7 (7-17)	0.246
Education (years)	5.3±2.7 (1-11)	4.8±2.1 (2-11)	5.1±2.2 (1-11)	0.115
Mother age (years)	33.4±4.2 (27-42)	32.3±4.8 (25-48)	33.0±4.3 (23-42)	0.445
Father age (years)	36.6±5.2 (27-57)	36.0±5.4 (29-57)	37.0±4.9 (30-51)	0.405
Developmental milestones				
Walking (months)	12.1±0.7 (10-16)	12.1±0.7 (10-16)	12.1±0.6 (10-16)	0.484
Talking (months)	24.1±2.6 (16-36)	24.1±2.7 (16-36)	24.2±2.5 (16-36)	0.587

Table 3. Analysis of the SCQ and ABC scales categorically in two groups

	Total (n=347) n	%	Normal (n=143) n	%	Obese (n=204) n	%	p
SCQ scores							0.043*
Negative	330	95.1	140	97.9	190	93.1	
Positive	17	4.9	3	2.1	14	6.9	
ABC scores							0.144
Negative	340	98.0	142	99.3	198	97.1	
Positive	7	2.0	1	0.7	6	2.9	

**: Fisher's exact test; SCQ: Social Communication Questionnaire; ABC: Autism Behavior Checklist*

Table 4. Analysis of the two groups in terms of mean scores of the scales

	Total (n=347) Mean±SD (range)	Normal (n=143) Mean±SD (range)	Obese (n=204) Mean±SD (range)	p
SCQ				
Total	7.6±4.0 (0-21)	7.3±3.7 (0-20)	7.7±4.3 (0-21)	0.397
Reciprocal social interactions	2.7±1.7 (0-9)	2.5±1.5 (0-9)	2.8±1.9 (0-9)	0.951
Communication	3.5±2.0 (0-11)	2.8±2.0 (0-11)	3.5±1.9 (0-9)	0.228
Stereotypical behavior	1.3±1.5 (0-7)	0.3±1.0 (0-6)	0.6±2.0 (0-7)	0.437
ABC				
Total	12.4±8.7 (0-60)	10.9±6.9 (0-41)	13.5±9.7 (1-60)	0.014*
Sensory	3.3±2.2 (0-10)	3.0±1.9 (0-10)	3.8±2.5 (0-9)	0.004*
Relating (social)	3.3±4.1 (0-28)	1.3±1.8 (0-13)	4.8±4.7 (0-28)	<0.001
Body and object use	0.5±1.7 (0-23)	0.3±1.0 (0-9)	0.6±2.0 (0-23)	0.117
Language	3.8±3.4 (0-20)	4.0±3.3 (0-12)	3.6±3.5 (0-20)	0.190
Social and self-help	1.4±1.3 (0-10)	1.3±1.1 (0-6)	1.5±1.4 (0-10)	0.168

*SCQ: Social Communication Questionnaire; ABC: Autism Behavior Checklist; *: Fisher's exact test*

adolescents and children in this study were compared based on sociodemographic features and autistic symptoms to those of normal weight children. The number of participants with SCQ score beyond cutoff mark was found significantly greater in obese than control group. ABC total score stayed significantly greater in study than control group. Of the subscale of ABC, only relating and sensory scores stood significantly greater in obese group. Therefore, we discovered that autistic symptoms were detected significantly greater in obese adolescents and children than normal weight group. This may suggest that the prevalence of obesity is higher (1.5 fold) in children and adolescents with ASD than those with normal weight. It also suggests

that children and adolescents with ASD are more likely (1.5 fold) than the non-obese children to be obese than normal children.

Accordingly, the groups were compared with one another based on autistic symptoms. The obesity group autistic symptoms stood greater than the healthy group (p=0.043). Albeit autism illness being more pronounced in study group (three children), the difference stood statistically insignificant (p>0.05). In three autistic subjects in study group and were positively diagnosed with autism in the course of study. These children were male with average age being 8.40.

The findings of current study discovered compatible with Wentz et al.[19] where seventy-six obese adolescents and children (aged between 7 and 17 years) were discovered to have greater autism frequency of 13.2%. Nevertheless, some limitations were noted in the study including absence of control group. No literature research has interrogated this issue. Recently, researchers have focused on whether a correlation exists between ASD and obesity.[20] This correlation is forecasted as a phenomenological one in various studies like Broder et al.[10] It was discovered that ASD children stood more probably to be obese and overweight than normal counterparts. Here, the obese rate stood at five percent among autistic children and two percent among normal children.

Chen at al. in 2010 study used 46.707 children and families to interrogate obesity risk factors amongst children aged between ten and seventeen years and discovered that 23.40% were autistic.[9] It remains imperative to perform neurodevelopmental screening from an early age to prevent obesity development in such risk instances like ASD-children.[21] This is because a link between autism and obesity has been affirmed as a gene-based correlation.[22] The 16p11.2 copy number variants have a reciprocal effect that triggers obesity and autism.[23] Clinicians who work with obesity face difficulties in ASD identification. It remains significant to expand successful lifestyle modification management amongst obese patients alongside comorbid ASD though.[24]

This study drew its strength from initial power analysis, sufficient sample (right age and gender-matched health control group) inclusion. Sample selection from obese patients referred to clinic, consecutive and randomly directed towards the clinic also gives this study undoubted strength.[10] Prospective and that individual's IQ assessment alongside systematic collection of socioeconomic data is further a source of strength for this study. The assessment of confounding variables and subsequent exclusion in addition to psychiatric diseases like main depression, ADHD, anxiety, intellectual disability alongside obesity to the genetic syndrome was a further source of strength. However, the study was primarily limited by the inclusion of singly clinically obese instances thereby limiting finding's generalizability. The present study was undertaken in a comparatively larger age group with a broad age spectrum and it was carried out at younger-age group is another source of limitation. Most importantly, this study was limited because the structured tools like ADI-R and Autism Diagnostic Observation Schedule (ADOS) used in diagnosing ASD in children is unsuitable in this present study because their validity and reliability are yet to be tested in the country.

The study is finally limited by the fact that children with big autism phenotypes in their 1st degree relatives are not interrogated and expunged from the study.[4] The recommendation is that tools are utilized in measuring communication or interaction variables in obese adolescents and children and those studies be undertaken to determine the correlation between autistic symptoms and obesity comprehensively and expunge the confounding variables as far as feasible. Such studies might discover autism or autistic symptoms equivalent among obese or might buttress the outcomes of this present study. The random outcomes might have ensued in case of extreme low possibility because of naturalistic error in this current study. Nevertheless, other reasons might be acknowledged to explain the rationale behind autistic people being obese in general in the society.[25]

Conclusion

Autistic symptoms and ASD have not been fully assessed previously in context of obese children. This study has found autistic symptoms to be more profound amongst obese adolescents and children. This revelation, particularly, relating to ASD-children, could contribute to the increased understanding absence of therapy adherence by obesity units' subgroup of patients. This emphasizes the need for novel therapeutic approaches to obesity to give suitable comorbidities' treatment and provide specific and customized educational modalities to modify lifestyle in obesity. This is due to the neurodevelopmental symptoms' over- representation among parents and patients.

Authors' contributions: *Ç.U.: designed and coordinated the study, collected and analyzed the data, writing of the manuscript; A.U.: collected and analyzed the data, wrote and revised the content of the manuscript; E.M.U.: contributed to the collection of data, wrote and revised the content of the manuscript.*

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