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Body composition in Iranian boys with autism spectrum disorders

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The aim of this study was to assess body composition of boys with autism and also to investigate the association of demographic factors, autism severity and drug therapy with their body composition. We recruited 85 boys aged 7-14 years by stratified random sampling in autism-specific schools in Tehran. Body composition was measured using bioelectrical impedance analysis. The study revealed that 9.4% of participants were underweight and 47.3% were suffering from overweight and obesity. The mean total body fat percentage and fat mass index were 23.46% and 4.8, respectively. A high rate of obesity was found in Iranian children and adolescents with autism. Furthermore, boys whose mothers had higher educational levels may have less chance of being within the normal weight ranges in comparison with sons of lower-educated mothers (p=0.002), while father's educational level had no effect on the child's body mass index. In conclusion, a high prevalence of overweight and obesity was observed in Iranian male children and adolescents suffering from autism according to their body mass index and body fat percentage.

Keywords: autistic disorder; body composition; demography; body mass index

INTRODUCTION

Autism spectrum disorders (ASDs) are complex sets of neurodevelopmental diseases that occur in very early childhood and can usually persist throughout life. Autism falls under the broad diagnostic category of Pervasive Developmental Disorders (PDD). ASD is characterized by having problems in social behavior, atypical verbal and nonverbal communication, and restricted interests that can be accompanied by repetitive behavior (1). The frequency of this disease is about 11.3 cases in 1000 people in the US population. Moreover, the male-to-female ratio is 4.3:1 in autistic cases. Empirical evidence indicates that although ASD is mostly heritable and therefore genetic human disease, environmental factors appear to play important roles in developing this abnormality (2). Many conflicting theories have proposed to clarify the environmental components associated with the disease, including nutrition, economic status, vaccination and general health care, as well as environmental pollutants and family lifestyle (3-5).

On the other hand, obesity is regarded as a nutrition/lifestyle-related disorder defined as weight or body mass index (BMI) (which is obtained by dividing weight by height square) exceeding the threshold of a criterion standard or reference value. Several growth reference charts such as Centers for Disease Control (CDC) and World Health Organization (WHO) provide comparators with the general population, which are used to determine weight status of children. CDC and WHO suggest a set of defined thresholds for classifying individual children as overweight or obese. In Iranian healthy children, the prevalence of overweight and obesity was 10.8% and 5.1%, respectively (6). The prevalence of being underweight, overweight and obese among

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240 school aged children in Iran was 7.1%, 13.8% and 14.6%, respectively (7). Overweight and obesity in children have been proven to be associated with some disorders such as type 2 diabetes, narcoleptic and orthopedic problems, cardiovascular diseases, and disarranged menstruation (8). There are limited studies on physical growth, body composition and nutritional conditions of autistic children and most of the researches were focused on language impairments, behavioral and psychological disturbances (1, 9). It has been shown that autistic children have limited physical activity and social interactions (8), while preferring self-centered activities such as watching TV and playing computer games; consequently, they are more prone to gaining weight (8). Several studies have indicated that the prevalence of overweight is considerably higher in autistic children prescribed risperidone and/or other antipsychotic drugs in comparison with non-autistic counterparts (10, 11).

The common side effects of antipsychotic drugs are sedation, dizziness, increased appetite, weight gain, changes in the electrocardiogram parameters, drooling, hyperprolactinemia and risk of drug-related dyskinesias (12). The WHO has delineated the risk of overweight from 85th to 97th percentile of BMI and overweight at or above 97th percentile BMI (13). The prevalence of at risk and being overweight in Chinese autistic children was 31.8% and 17.0% in 2- to 5-year-old age group, and 37.9% and 21.8% in 6- to 11-year age group, respectively (1). Similar statistics have been reported for British children suffering from ASD, with the overall prevalence of at risk of overweight of 35.7% and 19% prevalence of overweight (8).

Data indicated that during the 1960-1984 period, the mean BMI in autistic children (about 15% of whom were underweight) was lower compared to the reference population, although at the same time, some autistic children were overweight (14). This means that a wide range of weight disorders (underweight and overweight) is found in autistic children. In a study of 33 autistic males (children and adolescents), lower BMI was reported compared to standard reference value, which was attributed to their eating problems (15).

Memari et al. report on 8.7% of underweight, 50.4% of normal weight, 13.3% of overweight, 11.5% of obesity and 15.9% of severe obesity in autistic children aged 7-14 (16). Recent studies suggest that BMI is not an appropriate index for determination of obesity, as it does not distinguish between body fat and non-body fat; therefore, muscular children may be considered as obese (17). Since fatness is defined as increased body fat, it would be better to employ objective methods such as bioelectrical impedance analysis (BIA), magnetic resonance imaging (MRI) or dual x-ray densitometry (DXA). BIA is often used in large sample populations. Cross-sectional studies indicated that BIA could significantly determine whole body fluids, fat mass (FM), fat free mass (FFM), body fat percentage (BF%), and also their changes over a set period of time (18). BIA is also more applicable as it can determine not only the amount of fat but also its distribution, which is regarded as a cardiovascular risk factor, in adults and children, and may also be predictive of obstructive sleep apnea (OSA) severity in obese children (17, 19). Furthermore, BIA is a very precise method for measuring body fat in comparison with BMI, hence we applied this method to measure fatness among autistic children and adolescents in the present study.

MATERIAL AND METHODS

Subjects

We conducted a stratified randomized survey in which 85 autistic boys aged 7-14 years were recruited from four autism-specific schools in Tehran, in 2012. Because of the lower prevalence of autism in girls compared to boys, and the lack of sufficient female sample, according to the study criteria, gender separation was not possible. The Autism Diagnostic Interviews (ADI-R) (20) were completed by a professional doctoral level psychiatrist in order to diagnose the children with autism based on the DSM-IV-TR criteria. ASD subjects who were mentally retarded were excluded from the study. The study was approved by the Ethics Committee of the Tehran University of Medical Sciences with the following identification: (91-02-27-17958) and written consent forms were obtained from the children's parents or caretakers.

Measurement of height and body composition

The height was measured using standard stadiometer and body composition, fat mass (FM) and fat free mass (FFM) were assayed using the Body Composition Analyzer, TANITA BC-418 (TANITA, Japan). In order to limit the hydration influence on BIA results, the children were instructed to remain hydrated and asked not to have any exercise for at least 12 hours before the measurement. This procedure required the autistic patients to stand on the analyzer and hold a pair of handgrips, one in each hand. The validation of this method against DXA has been reported previously (21). The amount of body fat related to morbidity for boys was considered at 20%-25% as a criterion diagnosis of obesity in children (22, 23). BMI was calculated as weight (kg)/height^2 (m^2). Age and sex-specific percentiles (the WHO criteria) were used to categorize obese (≥97th percentile for BMI), overweight (85th ≤ BMI <97th percentile), healthy (3rd < BMI < 85th), and finally underweight boys (≤3rd percentile).

Family information

Parents/caregivers were surveyed for family sociodemographic information such as education, and drugs taken by the child. The level of education was classified as high – doctoral degree (PhD or physician); medium – bachelor (BSc) or Master (MSc) degree; low – high school or associate degree; and very low – illiterate and under high school

Evaluating autism severity

Parents were requested to fill in the Autism Treatment Evaluation Checklist (ATEC) in order to provide description of autism symptoms in children. The ATEC accurately evaluates the autistic symptoms in total and specific subscales, i.e. Speech and Language (ATEC I), Sociability (ATEC II), Cognitive and Sensory Awareness (ATEC III) and Health-Physical-Behavior (ATEC IV) (24). The severity of the disorder is diagnosed by a higher score (ranges from 0 to 180). According to an autism research institute report, the ATEC is a reliable instrument with a satisfactory internal consistency (25), and its validity and reliability are approved in Iranian culture (16).

Statistics

We calculated descriptive statistics such as mean and standard deviation for quantitative variables and abundance for qualitative variables. We also used χ^2-test to analyze the relationship between educational level and weight. Pearson correlation was applied to determine the correlation among ATEC, FMI, BMI-for-age weight status categories and FM%. One-way ANOVA was employed to compare means among all groups (p value <0.05 was set as significant). All analyses were performed using the SPSS software (version 18) for Windows (SPSS Inc., Chicago, IL, USA).

RESULTS

A total of 85 male children and adolescents were included in this study; the mean values and standard deviations of variables are shown in Table 1. Based on the WHO classification of BMI for age, 9.4% of children and adolescents were underweight, 43.5% were normal, 24.7% were overweight, and 22.4% were obese. There was no significant association of BMI percentile and age (p=0.796). The results of BIA indicated that 29% of boys had FM over 25 percents of their body weight. This percentage rose to 49% by considering the 20% as a cutoff point for obesity and overweight.

We expressed body composition data as FMI and fat free mass index (FFMI) as adjusted for variability in height (HT):

$FMI = FM/(HT)^2$ (equation 1)

$FFMI = FFM/(HT)^2$ (equation 2)

TABLE 1. Descriptive information from participants (N=85)

	Mean	SD	Max	Min
Age (yrs)	10.19	1.88	14.6	7.1
Weight (kg)	37.48	12.12	80.6	20.3
Height (cm)	138.56	11.41	168	110
BMI (kg/m^2)	19.14	4.23	30	11.3
FMI (kg/m^2)	4.8	2.74	10.43	0.65
FM%	23.46	8.16	39.6	5.9
FFM (kg)	28.02	7.29	58.3	16.6
FFMI (kg/m^2)	14.36	2.01	20.66	10.16
Right leg (FM%)	28.92	7.25	48.6	11.3
Left leg (FM%)	29.16	7.17	49.7	11.7
Right Arm (FM%)	32.33	7.23	48.4	7.1
Left Arm (FM%)	32.88	7.42	51.4	12.5
Trunk (FM%)	17.46	6.86	35.7	3
ATEC I (speech)	9.71	5.44	25	0
ATEC II (sociability)	12.34	6.19	32	4
ATEC III (cognitive-sensory awareness)	16.7	5.76	31	3
ATEC IV (physical, health, behavior)	20.44	9.27	48	5
ATEC total	59.06	19.85	116	24

BMI = body mass index; FMI = fat mass index; FM = fat mass; FFM = fat free mass; FFMI = fat free mass index; ATEC = autism treatment evaluation checklist

TABLE 2. Effect of parental education on body mass index of autistic children

	Underweight	Normal weight	Overweight	Obese	p value
Maternal education degree:					
PhD, BSc and MSc	16.1	22.6	41.9	19.4	0.002
Diploma – High school	3.8	56.6	15.1	24.5	
Paternal education degree:					
PhD, BSc and MSc	13.9	38.9	27.8	19.4	0.361
Diploma – High school	8.5	43.9	24.4	23.2	

p values are from Pearson χ^2-tests

TABLE 3. Weight status in children based on parental (maternal) education

	Underweight	Normal weight	Overweight	Obese
Maternal education degree:				
PhD	50	0	0	50
BSc and MSc	14.3	25	42.9	17.9
High school or associate degree	4.7	58.1	14	23.3
Illiterate and under high school	9.1	45.5	18.2	27.3
% of maternal education	9.5	44	23.8	22.6

TABLE 4. ANOVA comparison of fat free mass index (FFMI) among age categories

	Sample size	Mean	SD	Sig (p value)	F
Age category					
<9	31	13.7	1.61	0.042*	3.295
9-11	25	14.3	1.99		
>11	29	15	2.22		
Total	85	14.3	2		

p<0.05

We divided the children and adolescents into three age groups. Group 1 consisted of 31 subjects (<9-year-old); group 2 consisted of 25 subjects (9-11 years old); and group 3 consisted of 29 subjects (>11-year-old). There were no significant differences among the three age groups in terms of FM% (F=0.673, p=0.513) and FMI (F=0.113, p=0.893). Group 1 children and adolescents were more likely to have lower FFMI compared to those in group 3 (F=3.29, p=0.04) (Table 4).

A significant difference (p=0.002) was found regarding the maternal educational level and BMI-for-age as well as weight status categories of children and adolescents (Table 2). The children and adolescents of mothers with lower educational levels (including high school or associate degree, illiterate and under high school) were more likely to have normal body weight compared to those whose mothers achieved higher educational levels including BSc or MSc degree as well as PhD and physicians; a higher risk of overweight was also observed in sons of these mothers (Table 2). There were no significant differences in the children's ATEC scores according to the maternal education levels (F=1.104, p=0.296) and paternal education levels (F=1.857, p=0.177).

No significant correlations were found for ATEC and other quantitative variables including age (r=0.042, p=0.704), weight (r=0.051, p=0.644),height (r=0.150, p=0.891), BMI percentile (r=0.059, p=0.595), FMI (r=0.032, p=0.773), FFMI (r=0.062, p=0.544) and FM% (r=0.033, p=0.769) among the groups of subjects.

Most children and adolescents were prescribed medication, 38% of them taking a single drug, 25% taking two kinds of drugs, and 23% taking no drug. Risperidone and Ritalin as antipsychotic drugs were the most commonly taken medications. Moreover, 65% of boys were taking antipsychotic drugs, 25% central nervous system stimulants (analeptics) and 12% antiepileptic drugs. No significant differences were found between the subjects taking antipsychotic drugs and those taking no drugs according to age (F=0.104, p=0.748), weight (F=0.158, p=0.692), height (F=0.038, p=0.846), BMI percentiles (F=0.390, p=0.534), FM% (F=0.243, p=0.623), FMI (F=0.268, p=0.606) and FFMI (F=0.138, p=0.711)

DISCUSSION

Determining childhood obesity and overweight is difficult as the available methods assessing obesity and overweight in pediatric population have been challenging. Based on BMI, results of this study indicated that more than 47% of subjects were obese. A similar finding (49%) was obtained for obesity and overweight when we used FM over 20% as a cutoff point. Since BMI cannot differentiate FM from FFM, it is not a reliable index to measure body fat (26). Furthermore, high BMI levels neither represent high fat percentages nor abnormal fat distributions, but we measured BMI to compare it with fat mass. The mean body fat mass can be reliably used to determine obesity and overweight (27). Autistic children and adolescents are known to be at risk of being overweight as well as having a high percentage of body fat, which are probably due to the intake of pharmaceuticals such as risperidone (10).

To our knowledge, *Memari et al*. were the first to report on body weight status of Iranian children with autism (16). In addition, we have reported body composition as well as BMI percentiles in autistic children. Some studies suggest that the prevalence of obesity is 2-3 times higher in autistic children compared to their healthy counterparts (1, 28).

Although previous data have indicated a high prevalence of obesity and overweight in Iranian children (13.6% in girls and 9.3% in boys) (18), one study demonstrated that healthy Iranian children were actually more underweight (13.9%) rather than overweight (8.82%) or obese (4.5%) (29). *Xiong* has reported a higher prevalence of overweight and obesity in autistic children in comparison with healthy ones (1), while Curtin showed a lower prevalence of overweight and obesity in autistic children (8). Many studies have revealed that more than 30% of autism patients are suffering from obesity. Several studies have reported a higher BMI level in healthy teenagers compared to the autistic cases (14, 30). Hence, the findings of the studies regarding the worldwide prevalence of obesity and overweight in autistic children are inconclusive. However, it is revealed that overweight and obesity rates have upward trends in the populations of both healthy and autistic children (1, 8, 28, 31). In the present study, higher rates of obese as well as overweight autistic children were found in comparison with the statistics from other related studies.

It has been suggested that the ideal method for assessing body fat in children would be a local standard, as the ethnicity has an influence on body composition. Due to the lack of such a standard in Iranian population, we used %FM cutoff values defined for obesity in western populations (22, 23). *McCarthy et al*. regarded 85 and 95 percentiles of body fat as overweight and obesity (27, 32). *Kurtoglu et al*. report

low body fat mean in Turkish boys aged 7-13 (27) and *Nakao et al*. also report such results in Japanese boys aged 6-11 (33). In their study of body fat percentage in children, *Eto et al*. showed FMI to be more sensitive than BMI for such weight classifications (34). In fact, FMI identified high body fat percentage in children who had normal BMI (33). Our study found a high mean for FMI (4.8 kg/m^2) in Iranian autistic children, while the value of 2.8-3.6 kg/m^2 for normal children has been reported from the *Nakao* study (33).

No association was found between autism severity (ATEC IV score) and other measured variables in the current study. Similar to the results of *Xiong*, but against that of *Memari's* study, no correlation was found between ATEC and weight in the present study (35).

It has been well documented that children living in a family with lower level of education have higher BMI level (36, 37). In *Lamerz's* study, the prevalence of obesity was three times higher in children whose mothers were non-well educated compared to the children of high-educated mothers. Parental level of education may affect food selections, physical activity and consequently children's weight (36, 38). This is more obvious when the mother of children eats healthy and keeps checking the quality and quantity of food intake (36, 38). In contrast to our findings, the results of a study conducted in 2000 showed that children of well educated mothers were more likely to have normal weight in comparison with children of non-well educated mothers (37).

Suggestively, to prevent obesity in children from in low-level societies, designing a qualified education system and providing facilities could be appropriate actions to control weight abnormalities amongst them (38). Additionally, pharmaceutical drugs (such as risperidone and olanzapine) ought to be carefully prescribed by physicians due to their adverse effects, especially on children's weight (39).

CONCLUSION

We found the prevalence of obesity (22.4) and overweight among Iranian boys and adolescents with autism to be higher as compared to normal children (13.6) in Iran. BIA as a valid tool can be used to determine their body composition. However, further studies are needed to address the determining reference percentiles for measuring body fat mass in Iranian children and adolescents using BIA method. Moreover, maternal education may be associated with body weigh status in autistic children. We also suggest that other principal factors in developing obesity in autistic children, particularly low level of physical activity, over-eating patterns, as well as lacking close relationships with their friends and parents' awareness should be studied. Besides, the correlation regarding severity of the disease (using Childhood Autism Rating Scale (CARS), ATEC and other tests) and weight/BMI status (including underweight, normal, overweight and obese) should be taken into account in future studies.

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Autori su popunili *the Unified Competing Interest form na www.icmje.org/coi_disclosure.pdf (dostupno na zahtjev)* obrazac i izjavljuju: nemaju potporu niti jedne organizacije za objavljeni rad; nemaju financijsku potporu niti jedne organizacije koja bi mogla imati interes za objavu ovog rada u posljednje 3 godine; nemaju drugih veza ili aktivnosti koje bi mogle utjecati na objavljeni rad./*All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.*

REFERENCES

1. Xiong N, Ji C, Li Y, He Z, Bo H, Zhao Y. The physical status of children with autism in China. Res Develop Disabil. 2009;30:70-6. doi: 10.1016/j.ridd.2007.11.001.
2. Newschaffer CJ, Croen LA, Daniels J, et al. The epidemiology of autism spectrum disorders. Ann Rev Public Health. 2007;28:235-58.
3. Durkin MS, Maenner MJ, Meaney FJ, et al. Socioeconomic inequality in the prevalence of autism spectrum disorder: evidence from a U.S. cross-sectional study. PLoS One. 2010;5:e11551.
4. Curtis LT, Patel K. Nutritional and environmental approaches to preventing and treating autism and attention deficit hyperactivity disorder (ADHD): a review. J Altern Complement Med. 2008;14:79-85.
5. Hertz-Picciotto I, Croen LA, Hansen R, Jones CR, van de Water J, Pessah IN. The CHARGE study: an epidemiologic investigation of genetic and environmental factors contributing to autism. Environ Health Perspect. 2006;114:1119-25.
6. Kelishadi R, Haghdoost A-A, Sadeghirad B, Khajehkazemi R. Trend in the prevalence of obesity and overweight among Iranian children and adolescents: A systematic review and meta-analysis. Nutrition. 2014;30:393-400.
7. Khodaverdi F, Bahram A, Jafarabadi MA. Quality of life, motor ability, and weight status among school-aged children of Tehran. Iran J Public Health. 2012;41:97-102.
8. Curtin C, Bandini L, Perrin E, Tybor D, Must A. Prevalence of overweight in children and adolescents with attention deficit hyperactivity disorder and autism spectrum disorders: a chart review. BMC Pediatrics. 2005;5:48.
9. Memari A, Ziaee V, Mirfazeli F, Kordi R. Investigation of autism comorbidities and associations in a school-based community sample. J Child Adolesc Psychiatr Nurs. 2012;25:84-90.

10. Shea S, Turgay A, Carroll A, et al. Risperidone in the treatment of disruptive behavioral symptoms in children with autistic and other pervasive developmental disorders. Pediatrics. 2004;114:e634-e41.
11. Calarge C, Nicol G, Xie D, Zimmerman B. Correlates of weight gain during long-term risperidone treatment in children and adolescents. Child Adolesc Psychiatr Mental Health. 2012;6:21.
12. Malone RP, Gratz SS, Mary Anne D, Hyman SB. Advances in drug treatments for children and adolescents with autism and other pervasive developmental disorders. CNS Drugs. 2005;19:923-34.
13. Demerath EW, Schubert CM, Maynard LM, et al. Do changes in body mass index percentile reflect changes in body composition in children? Data from the fels longitudinal study. Pediatrics. 2006;117:e487-e95.
14. Mouridsen SE, Rich B, Isager T. Body mass index in male and female children with pervasive developmental disorders. Ped Int. 2008;50:569-71.
15. Keen DV. Childhood autism, feeding problems and failure to thrive in early infancy. Eur Child Adolesc Psychiatr. 2008;17:209-16.
16. Memari A, Kordi R, Ziaee V, Mirfazeli F, Setoodeh MS. Weight status in Iranian children with autism spectrum disorders: Investigation of underweight, overweight and obesity. Res Autism Spectr Disord. 2013;In Press, Corrected Proof. doi: 10.1016/j.rasd.2011.05.004.
17. Botton J, Heude B, Kettaneh A, et al. Cardiovascular risk factor levels and their relationships with overweight and fat distribution in children: the Fleurbaix Laventie Ville Sante II study. Metabolism. 2007;56:614-22.
18. Dehghan M, Akhtar-Danesh N, Merchant AT. Childhood obesity, prevalence and prevention. Nutr J. 2005;4:24.
19. Dencker M, Wollmer P, Karlsson MK, Lindén C, Andersen LB, Thorsson O. Body fat, abdominal fat and body fat distribution related to cardiovascular risk factors in prepubertal children. Acta Paediatr. 2012;101:852-7.
20. Lord C, Rutter M, Couteur A. Autism diagnostic interview-revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. J Autism Dev Disord. 1994;24:659-85.
21. Kyle UG, Bosaeus I, De Lorenzo AD, et al. Bioelectrical impedance analysis--part I: review of principles and methods. Clin Nutr. 2004;23:1226-43.
22. Lohman TG. Exercise training and body composition in childhood. Can J Sport Sci. 1992;17:284-7.
23. Dwyer T, Blizzard CL. Defining obesity in children by biological endpoint rather than population distribution. Int J Obes Relat Metab Disord. 1996;20:472-80.
24. Magiati I, Moss J, Yates R, Charman T, Howlin P. Is the Autism Treatment Evaluation Checklist a useful tool for monitoring progress in children with autism spectrum disorders? J Intellect Disabil Res. 2011;55:302-12.
25. Rimland B, Edelson M. Autism Treatment Evaluation Checklist (ATEC). Autism Res Inst. 1999.
26. Flegal Km, Carroll MD, Kit BK, Ogden CL. Prevalence of obesity and trends in the distribution of body mass index among us adults, 1999-2010. JAMA. 2012;307:491-7. doi: 10.1001/jama.2012.39.
27. Kurtoglu S, Mazicioglu MM, Ozturk A, Hatipoglu N, Cicek B, Ustunbas HB. Body fat reference curves for healthy Turkish children and adolescents. Eur J Pediatr. 2010;169:1329-35.
28. Yamaki K, Rimmer JH, Lowry BD, Vogel LC. Prevalence of obesity-related chronic health conditions in overweight adolescents with disabilities. Res Dev Disabil. 2011;32:280-8.
29. Kelishadi R, Ardalan G, Gheiratmand R, et al. Association of physical activity and dietary behaviours in relation to the body mass index in a national sample of Iranian children and adolescents: CASPIAN Study. Bull World Health Organ. 2007;85:19-26.
30. Bölte S, Özkara N, Poustka F. Autism spectrum disorders and low body weight: Is there really a systematic association? Int J Eat Disord. 2002;31:349-51.
31. Curtin C, Anderson S, Must A, Bandini L. The prevalence of obesity in children with autism: a secondary data analysis using nationally representative data from the National Survey of Children's Health. BMC Pediatrics. 2010;10:11.
32. McCarthy HD, Cole TJ, Fry T, Jebb SA, Prentice AM. Body fat reference curves for children. Int J Obes. 2006;30:598-602.
33. Nakao T, Komiya S. Reference norms for a fat-free mass index and fat mass index in the Japanese child population. J Physiol Anthropol Appl Human Sci. 2003;22:293-8.
34. Eto C, Komiya S, Nakao T, Kikkawa K. Validity of the body mass index and fat mass index as an indicator of obesity in children aged 3-5 year. J Physiol Anthropol Appl Human Sci. 2004;23:25-30.
35. Memari AH, Kordi R, Ziaee V, Mirfazeli FS, Setoodeh MS. Weight status in Iranian children with autism spectrum disorders: Investigation of underweight, overweight and obesity. Res Autism Spectr Disord. In Press, Corrected Proof. doi: 10.1016/j.rasd.2011.05.004.
36. Parizkova J. Impact of education on food behaviour, body composition and physical fitness in children. Br J Nutr. 2008;99 (Suppl 1):S26-32.
37. Baughcum AE, Chamberlin LA, Deeks CM, Powers SW, Whitaker RC. Maternal perceptions of overweight preschool children. Pediatrics. 2000;106:1380-6.
38. Lamerz A, Kuepper-Nybelen J, Wehle C, et al. Social class, parental education, and obesity prevalence in a study of six-year-old children in Germany. Int J Obes (Lond). 2005;29:373-80.
39. Ratzoni G, Gothelf D, Brand-Gothelf A, et al. Weight gain associated with olanzapine and risperidone in adolescent patients: A comparative prospective study. J Am Acad Child Adolesc Psychiatr. 2002;41:337-43.

SAŽETAK

Tjelesni sastav u iranskih dječaka s poremećajima autističnog spektra

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Cilj ovoga istraživanja bio je procijeniti tjelesni sastav dječaka s autizmom te ispitati povezanost demografskih čimbenika, težine autizma te lijekova s njihovim tjelesnim sastavom. Ispitivanje je obuhvatilo 85 dječaka u dobi od 7 do 14 godina slučajno odabranih u teheranskim školama za autističnu djecu. Tjelesni sastav mjeren je analizom bioelektrične impedancije. Rezultati istraživanja su pokazali da 9,4% ispitanika ima nedovoljnu masu, dok njih 47,3% ima prekomjernu masu ili su pretili. Srednji postotak ukupne tjelesne masti bio je 23,46%, a indeks tjelesne masti 4,8. U iranske djece i adolescenata s autizmom utvrđena je visoka stopa pretilosti. Nadalje, za dječake čije majke imaju višu razinu obrazovanja manja je vjerojatnost da će biti unutar normalnih granica za masu u usporedbu sa sinovima majki s nižom razinom obrazovanja (p=0,002), dok obrazovanje očeva nema učinka na djetetov indeks tjelesne mase. Prema indeksu tjelesne mase i postotku tjelesne masti, visoka je učestalost prekomjerne tjelesne mase i pretilosti među iranskom djecom i adolescentima muškog spola koji boluju od autizma.

Ključne riječi: autistični spektar; tjelesni sastav; demografija; indeks tjelesne mase