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Evaluating Obesity Index among Children with Developmental Disorders

Keiko Kasagi

Department of Community Health, Faculty of Health and Welfare, Prefectural University of Hiroshima, Hiroshima, Japan
Email: kasagi@pu-hiroshima.ac.jp

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Abstract

The prevalence of obesity not only among adults but also among children has been increasing globally. Furthermore, obese children reportedly go on to be obese in adulthood. Obesity is likely to cause lifestyle-related diseases not only in able-bodied individuals but also in disabled children. Specific cognitive behavior observed in disabled children often hinders the provision of lifestyle guidance, such as nutritional and physical exercise instructions. To prevent such situations, early identification of obesity is required to improve lifestyle habits through diet and exercise in disabled children. This study included 285 children with developmental disorders. To assess a childhood obesity index, three obesity-related parameters were compared: the degree of obesity in school health, which has been used to evaluate the health of school children in Japan; abdominal circumference, which is useful for predicting visceral fat obesity; and the waist-to-height ratio (WHtR), which reflects visceral fat and physique. The abdominal circumference was significantly dependent on age. The degree of obesity and WHtR did not show a significant association with age. WHtR was significantly associated with the degree of obesity in school health. The WHtR is easily calculated as compared to the degree of index in school health which needs rather complicated calculations depending on age and age-specific coefficients. The study findings suggest that WHtR might be an easy-to-use obesity index comparable to the degree of obesity in school health in children with developmental disorders.

Keywords

Obesity Index, Waist-to-Height Ratio, Children with Development Disorders

1. Introduction

Recently, the prevalence of obesity among adults and children has been increas-

ing globally; however, there have been no signs of improvement. In Japan, the prevalence of obese students (elementary and junior high schools) has been nearly flat or has increased over the past 10 years [1].

We reported that the proportion of obese children with developmental disorders increased with age. In particular, such a tendency was observed in children with intellectual disabilities. Given that severely obesity was found in a 5-year-old child, interventions from an early age are required to improve obesity [2]. Factors contributing to obesity in children with developmental disorders included diet, their specific eating behaviors and dietary preferences, low physical activity, and a family history of obesity [2].

Obesity is known to be a risk factor for ischemic heart disease, hypertension, and diabetes. An increase in the number of obese individuals eventually leads to an increase in medical costs. A lot of obesity index have been suggested and used for early prevention of these diseases, including body mass index (BMI), an international indicator of obesity, and waist circumference (abdominal circumference), which is related to the accumulation of visceral fat. Additional criteria for identifying childhood obesity include the Kaup index (children aged < 5 years), and Rohrer index for childhood. There is another obesity index in Japan, which has been applied as a degree of obesity in school health (described in Methods section).

Previous studies involving children reported that serum leptin concentrations were highly associated with body fat concentration [3], and that the commonly used obesity indices were of practical use in relation to association with Atherogenic Index [4].

In previous studies for adults, one study assessed the validity of the obesity indices (BMI and abdominal circumference) regarding the diagnosis of dyslipidemia among a worksite population [5], and another study evaluated the associations between body fat percentage and other obesity indices (BMI, and the waist-hip ratio, and subcutaneous fat thickness) among a community residences [6].

In this way, various indices have been proposed to detect obesity, and their significance has been discussed through the association with obesity-related biomarkers. Because childhood obesity is likely to cause lifestyle-related diseases not only in healthy but also in disabled children, early detection of obese children is required for providing dietary and/or exercise interventions. Although the specific cognitive behavior observed among disabled children frequently hinders the provision of lifestyle guidance, such as nutritional and exercise instruction, there are no studies examining obesity indicators for children with developmental disorders. In that respect, a useful obesity index is required in children with developmental disorders as simplified and easy-to-use tool.

2. Purpose

This study evaluated obesity indices (the degree of obesity in school health, ab-

dominal circumference, and WHtR) to determine the most useful index among children with developmental disorders for the implementation of interventions in obesity as early as possible.

3. Methods

3.1. Subjects

This study included 285 outpatient children diagnosed with developmental disorder in the developmental disorder department of a clinic attached to Autism Disorder University "A" in Hiroshima, Japan. Their disorders were classified as Autism Disorder, Attention-deficit/hyperactivity Disorder, Learning Disability, and Mental Retardation based on the Diagnostic and Statistical Manual of Mental Disorders guidelines [7]. They received physical measurements including body height, body weight, and waist circumference. The children discussed here ranged in age from five to eighteen defined as the Childhood Obesity Guidelines [8]. **Table 1** shows the study subjects by gender, age, and diagnostic classification.

3.2. Data Analysis

Based on physical measurements, the degree of obesity in school health, abdominal circumference, and the waist-to-height ratio (WHtR) were calculated. The degree of obesity in school health used here was derived from the difference between the measured body weight and the standard body weight with dependence on body height and age-specific coefficients, which was proposed by the "Health Checkup Manual for School Children (Revision), Japan Society of School Health, March 2006 (under the supervision of the Ministry of Education, Culture, Sports, Science and Technology)".

Pearson's product-moment correlation coefficients were calculated to estimate the associations among age and obesity indices.

3.3. Ethical Considerations

In advance of the study, the participants received an explanation about the

Table 1. Study subjects (N = 285).

Gender	Type of Developmental Disorders	Age (yrs.)			Total (%)
		5 - 8	9 - 12	13 - 17	
Men	Autism Disorder	49	24	12	85 (37.6)
	Attention-deficit/hyperactivity Disorder	33	22	8	63 (27.9)
	Learning Disability	8	4	2	14 (6.2)
	Mental Retardation	20	37	7	64 (28.3)
Women	Autism Disorder	15	5	3	23 (39.0)
	Attention-deficit/hyperactivity Disorder	7	2	0	9 (15.2)
	Learning Disability	4	2	2	8 (13.6)
	Mental Retardation	7	11	1	19 (32.2)

study's objective, methodology, the freedom to participate in the study, and privacy considerations. The informed consent was obtained individually in writing from the participants.

This study was conducted under the approval of the Ethics Review Committee of this university (No. 25, Date Nov 25, 2008).

4. Results

4.1. Relationship between Obesity Index and Age

Figure 1 shows the relationship between age and the degree of obesity in school health by gender. The degree of obesity was not significantly associated with age in men or women (a correlation coefficient (r) of 0.04 for men and r = 0.03 for women). Figure 2 shows the relationship between age and abdominal circumference by gender. Abdominal circumference increased with age, with a significant association (r = 0.61, p < 0.01 both in men and women). Figure 3 shows the

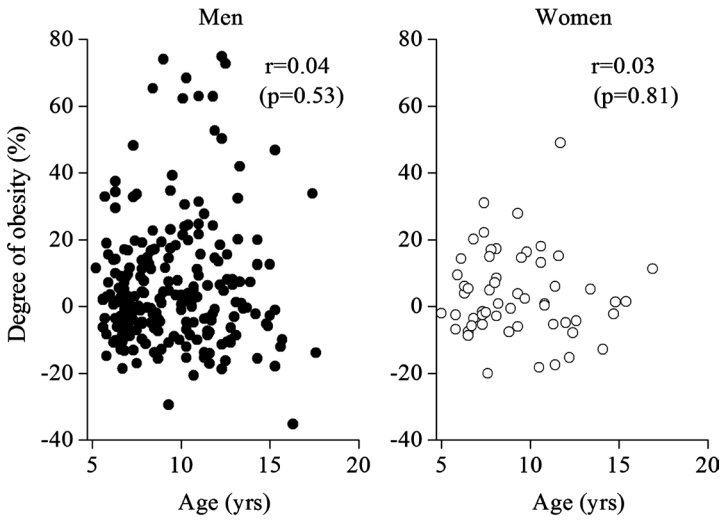

Figure 1. Relationship between age and the degree of obesity in school health by gender.

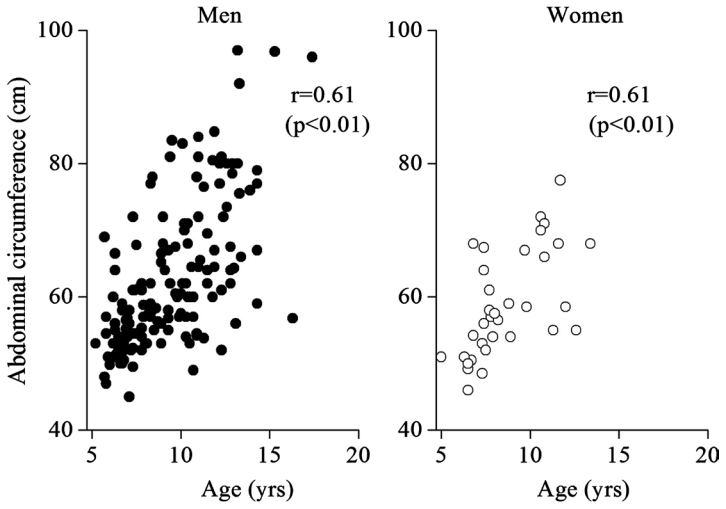

Figure 2. Relationship between age and abdominal circumference by gender.

relationship between age and WHtR by gender. WHtR was not significantly associated with age in men or women.

4.2. Relationship among Obesity Indices

Figure 4 shows the relationship between the degree of obesity in school health and abdominal circumference in men and women. There was a significant association between these parameters both in men and women (r = 0.76 for men and r = 0.69 for women). Figure 5 shows the relationship between the degree of obesity in school health and WHtR. There was a significant association both in men and women (r = 0.90 for men and r = 0.71 for women). This WHtR association with the degree of obesity in school health was stronger than that with abdominal circumference in both genders.

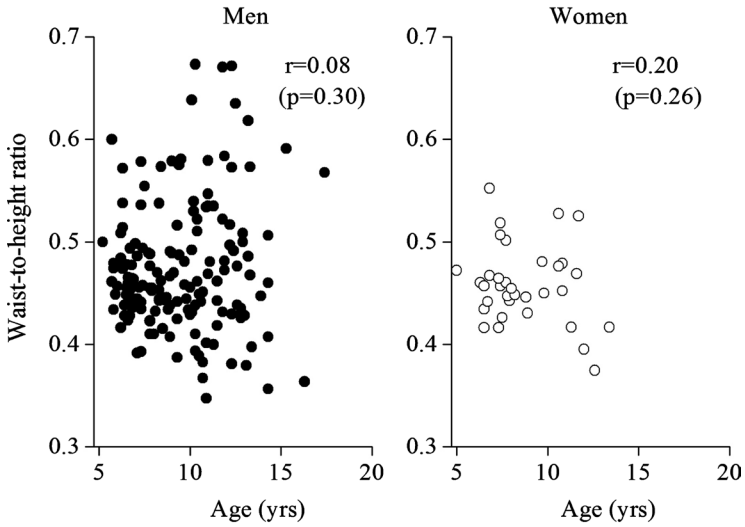

Figure 3. shows the relationship between age and waist-to-height ratio WHtR by gender. WHtR: waist-to-height ratio.

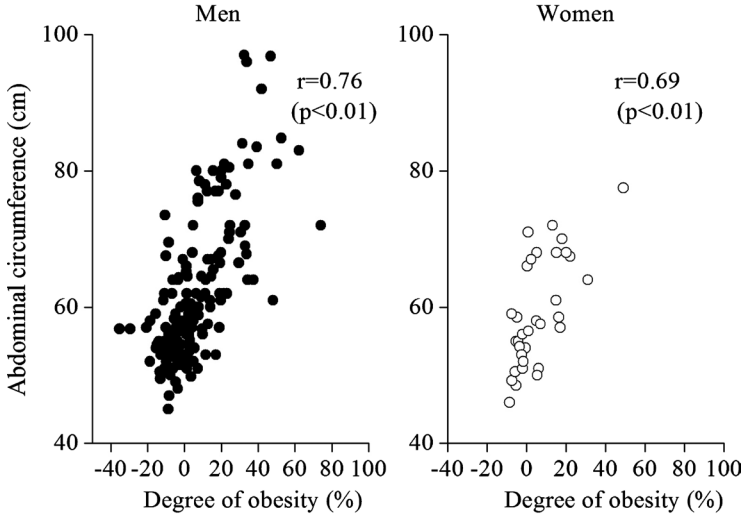

Figure 4. Relationship between the degree of obesity in school health and abdominal circumference by gender.

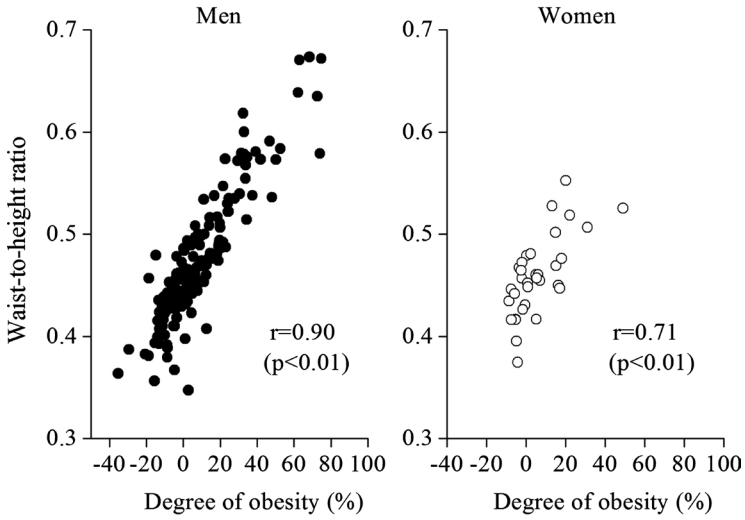

Figure 5. Relationship between the degree of obesity in school health and WHtR by gender.

5. Discussion

In comparison with three obesity indices (abdominal circumference, waist-to-hip ratio, and WHtR) in 85 male and female volunteers aged 40 to 60 who participated in a health checkup, Arai indicated that abdominal circumference primarily reflected the subcutaneous fat amount rather than the visceral fat amount [9]. Hsieh et al. evaluated the relationship between the obesity index and risk factors for coronary artery disease in subjects who underwent a medical checkup. The results showed that among BMI, the subcutaneous fat thickness in the bottom of the shoulder blade, waist-to-hip ratio, and WHtR, the WHtR was associated with risk factors of coronary artery disease in both men and women to a remarkable degree; thus, they reported that WHtR is a useful and convenient indicator [10].

One previous study reported that serum leptin concentrations, which increase with obesity, were positively correlated with BMI, abdominal circumference, and body fat percentage in junior high school students. In particular, body fat percentage showed the highest positive association with serum leptin concentrations [3]. Another study reported that the obesity indices (degree of obesity in school health, Rohrer's index, and BMI) were equally useful as a screening method for arteriosclerosis for children aged between 8 and 15 years [4].

The criteria for metabolic syndrome in children include an abdominal circumference ≥ 80 cm for junior high school students and ≥75 cm for elementary school students and/or WHtR ≥ 0.5 [8].

However, to our knowledge, no studies have evaluated the WHtR as an obesity index for children, still less for children with developmental disorders.

The degree of obesity in school health has traditionally been used as an index of childhood obesity. Its calculation, however, is relatively complicated in terms of using standard body weight derived based on body height and age-specific coefficients.

The present study suggested that WHtR might be a useful and effective obesity index of children with developmental disorders in consideration for easy calculation and high association with the degree of obesity in school health.

The present study had several limitations. The first is the small sample size of the study participants. This is because the subjects consisted of children with developmental disorders who were diagnosed in one clinic in a limited region. However, all children with developmental disorders whose physical measurements were available participated in the study. The results observed here might provide one suggestion of the effectiveness of WHtR as obesity index. Future studies need to examine on a larger number of participants in other regions and facilities so as to reproducibly observe the effectiveness of WHtR. The study was based on a cross-sectional association among physical measurements. A study based on the association with obesity-related biomarkers might strengthen the effectiveness of WHtR as obesity index. Furthermore, given that posture of children with high-grade obesity during measurement may affect abdominal circumference, sufficient instruction should be provided prior to measurement in children with developmental disorders.

6. Conclusion

The useful obesity index is important in children with developmental disorders for preventing the life-related diseases from the childhood. The present study suggests that the WHtR is more appropriate than the degree of obesity in school health and abdominal circumference as a simple and useful index of obesity in children with developmental disorders. In order to work to improve obesity in children with developmental disorders, it is necessary to provide support including diet and exercise during early childhood of 5 to 6 years of age, and to maintain a support system in collaboration with family members and teachers.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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