

# Comparison of World Health Organization body mass index for age Z scores and revised Indian Academy of Pediatrics growth standards for the diagnosis of thinness, overweight, and obesity among adolescent girls

Soma Venkatesh<sup>1</sup>, Natarajan Pachaiappan<sup>1</sup>, Vanitha Ramalingam<sup>2</sup>

From <sup>1</sup>Department of Pediatrics, Sri Venkateswara Medical College Hospital & Research Centre, Ariyur, Pondicherry, India, <sup>2</sup>Consultant Pediatrician, NMC Specialty Hospital, Abudhabi, UAE

**Correspondence to:** Dr. Soma Venkatesh, Department of Pediatrics, Sri Venkateswara Medical College Hospital & Research Centre, Puducherry - 605 102, India. E-mail: drsomainvenky@gmail.com

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## Abstract

**Background:** In spite of the rapid economic growth of India in recent years, the health of our children is being challenged by the troublesome duo of over nutrition and under nutrition. Determination of the magnitude of this problem needs uniform and representative growth standards across the country. **Aim:** To compare the prevalence of thinness, overweight, and obesity among girls aged 10-15 years belonging to urban Pondicherry using the World Health Organization (WHO) body mass index (BMI) for age Z scores and revised Indian Academy of Pediatrics (IAP) growth standards. **Materials and Methods:** A total of 287 girls were included in the study. Weight and height were measured for all of them as per standard guidelines and BMI were calculated. Thin, overweight and obese girls were identified based on the WHO Z scores for BMI-for-age as well as revised IAP growth standards 2015. **Results:** The prevalence of thinness as per WHO BMI for age Z scores was 22.6%. The prevalence of overweight and obesity were 6.6% and 2.1%, respectively. In comparison, the prevalence of thinness according to revised IAP growth standards was 10% and that of overweight and obesity were 6.3% and 1.4% respectively. The prevalence of thinness as per recent IAP growth standards is significantly less compared to the prevalence obtained using WHO Z scores. **Conclusion:** Using the WHO BMI for age Z scores is likely to overestimate the prevalence of thinness significantly when compared to revised IAP growth standards for Indian children. BMI for age Z scores for Indian children is needed to address this issue in large prospective multicenter studies.

**Key words:** Adolescent, Body mass index, Comparison, Growth, Girls

The Indian Academy of Pediatrics (IAP) recommends pediatricians to use the revised IAP growth standards for interpreting anthropometry in Indian children 5-18 years of age [1]. The previous Indian growth charts published in 2007 was considered as not being representative of the geopolitical and ethnic variations across the country. Some authors have mooted the idea of having regional growth charts representative of the population. The revised IAP growth charts published in 2015 collated data from anthropometric studies conducted at 14 different cities across the country so as to have a better representation. In this study, we intend to compare the prevalence of thinness, overweight and obesity among adolescent girls (aged 10-15 years) belonging to an urban locality of the south Indian city using World Health Organization (WHO) body mass index (BMI) for age Z scores and the revised IAP growth standards.

## MATERIALS AND METHODS

The data for this study were taken from an unpublished cross-sectional observational study involving girls aged 10-15 years

from an urban school in Pondicherry in the year 2012 which was conducted as a pilot study to estimate the sample size required for a future study to find out the risk factors associated with obesity. The sample size required was calculated to be 290, based on the incidence of obesity taken as 8.82% reported by a previous study [2] with a precision of 5% at confidence level of 95%, considering a design effect of 1, two age groups (10-12 years and 13-15 years) and a response rate of 85%. A number of girls in each age group was calculated based on probability proportionate to the size of population technique. Students from different standards from an urban school were then selected by systematic random sampling. Girls with an inaccurate date of birth, doubtful anthropometric measurements, chronic illness or disabilities were excluded from the study. Weight and height were measured for all the students by a single investigator to avoid inter-observer variation. Spring balance was used to measure weight to the nearest of 500 g and stadiometer was used to measure height to the nearest 0.5 cm. Obesity, overweight and thinness was defined, as per WHO standards, as Z score for BMI more

than 2, between 1 and 2 and  $<-2$ , respectively. Similarly as per the revised IAP growth standards, thinness was defined as BMI for age and sex less than the third percentile and for overweight and obesity, absolute BMI cut-offs of 23 and 27 were used as recommended [1].

Descriptive statistics has been presented as mean BMI with 95% confidence interval (CI) for each age and estimated population proportion of thinness, overweight, and obesity with 95% CI. Comparison between groups has been done by independent t-test. Comparison between thinness, overweight and obesity has been done by Chi-square test.

## RESULTS

A total of 287 girls were included in the study after excluding 3 girls (2 girls with an inaccurate date of birth and 1 with chronic illness). The mean BMI, standard deviation and 95% CI of individual age groups is shown in Table 1. The overall prevalence of obesity and overweight and thinness was 2.1% (95% CI: 0.4-3.8), 6.6% (95% CI: 3.6-9.6), and 23% (95% CI: 18.3-28.4), respectively on using the WHO BMI for age Z scores. There was no significant difference in prevalence of thinness, overweight, and obesity among 10-12 years age group and 13-15 years age group except for thinness, which was significantly higher in 10-12 years group (Table 2). In comparison, the prevalence of thinness according to revised IAP growth standards was 10% (95% CI: 7-14.3) and that of overweight and obesity were 6.3 (95% CI: 3.9-9.9) and 1.4% (95% CI: 4-3.8), respectively. The prevalence of thinness as per recent IAP standards is significantly less compared to that obtained using WHO Z-score (Table 2). However, no such difference was observed with respect to overweight and obesity.

## DISCUSSION

Despite a 50% increase in GDP since 1991, 43% of Indian children are wasted, and 48% are stunted and more than 60% deaths in under-five children are directly or indirectly related to undernutrition [3]. On the other hand, there is a rise in obesity in children due to multiple factors like the change to sedentary lifestyle, lack of physical activities, increase in intake of fast foods and processed foods compounded by social issues like illiteracy and improper infant and young children feeding practices. This, in turn, is leading to a rise in obesity-related illnesses like hypertension and heart disease in young adults. In developing countries like India, where we are still struggling to bring down undernutrition and under-five mortality rates, increasing the incidence of obesity additionally poses a serious challenge.

Many studies have been conducted to estimate the prevalence of undernutrition and overweight/obesity in India. Different studies across the country have showed a prevalence of obesity ranging from 2.1% to 9.9% and that of overweight from 3.1% to 27.7% among school-age girls [2-16], but the data on thinness in children more than 10 years is limited. The prevalence of thinness, overweight, and obesity in our study is similar to an unpublished Indian Council of Medical Research study by Somashekar et al. from Puducherry according to which the prevalence of thinness and obesity were found to be 30.7% and 1.4%, respectively. The prevalence of both obesity and overweight in our study is much less compared to most of the studies of similar age group [2-9] but similar to the observations made by Bharati et al. [10], Premanath et al. [11], Maiti et al. [12], Deshmukh et al. [13], and Kumaravel et al. [14]. A previous study from Pondicherry reported the prevalence rates of 2.29% for obesity which is similar to our

**Table 1: Mean BMI of individual age groups**

Body mass index	10 years (n=41)	11 years (n=49)	12 years (n=33)	13 years (n=73)	14 years (n=58)	15 years (n=33)
Mean	14.92	16.27	15.55	17.43	18.21	18.25
SD	2.87	2.39	2.29	3.4	3.5	3.11
SE	0.45	0.34	0.4	0.4	0.46	0.54
95% CI	14-15.8	15.6-16.9	14.7-16.4	16.6-18.2	17.3-19.1	17.17-19.3

CI: Confidence interval, SD: Standard deviation, SE: Standard error, BMI: Body mass index

**Table 2: Comparison of prevalence of thinness, overweight and obesity as per WHO Z scores and revised IAP growth standards**

Age	Thinness			Overweight			Obesity		
	WHO	IAP	P value	WHO	IAP	P value	WHO	IAP	P value
10-12 years (n=123)	34 (27.6)	11 (8.9)	<0.002	8 (6.5)	9 (7.3)	0.8	2 (1.6)	2 (1.6)	1.0
13-15 years (n=164)	31 (18.9)	18 (10.9)	0.04	11 (6.7)	9 (5.5)	0.6	4 (2.4)	2 (1.2)	0.4
Overall	65 (22.6)	29 (10)	<0.001	19 (6.6)	18 (6.3)	0.86	6 (2.1)	4 (1.4)	0.52

IAP: Indian Academy of Pediatrics

observation; however, it included both rural and urban girls aged 6-12 years [15].

The prevalence of thinness in our study is comparable to the observation by Saraswathi et al. in their study on school going children in Mysore [16], but is much less compared to that reported by Deshmukh et al. [13]. The growth standards used by the former were WHO percentiles for BMI, and the later were the CDC 2000 standards. The study from Mysore by Premanath et al. [11], using previous IAP standards, reported a lower prevalence of 17.2% of thinness among school going girls. Kumaravel et al. [14] also reported a lower prevalence of thinness of 13.4% among school going girls aged 10-15 years using International Obesity Task Force standards. However, none of the studies used BMI for age Z score, which is supposed to be better in the quantification of extreme growth status at both ends of the distribution.

There is no significant difference in the prevalence of overweight, obesity and severe thinness in the two study groups, but significantly more girls aged 10-12 years were thinner compared to girls aged 13-15 years. The reason could be due to maximal growth occurring in mid-puberty thereby contributing to better anthropometric measures in 13-15 year old girls. Our observation is contrary to the study by Kumaravel et al. [14], where the proportion of thinness was significantly higher in 13-15 years age group and the study by Sidhu et al. where no significant difference was found [6].

Prevalence of thinness as defined by new IAP growth standards [1] is significantly less in our study compared to that obtained using WHO Z scores. No such difference was observed in the case of overweight or obesity which could be due to small sample size and paucity of obese or overweight children in some age groups. Garg et al. in a recent study compared the prevalence of thinness among school children using four different BMI reference standards and found a higher prevalence of thinness using WHO standards compared to IAP (2006) growth standard for girls (9% vs. 6.5%) as well as for boys (14.9% vs. 6.6%) [17].

Our study is one of the first studies comparing BMI for age Z scores and revised IAP growth standards which were released in 2015. However, this study is limited by its small sample size from a particular geographical area as this study is an early and exploratory one. One should not be too quick to arrive at any conclusion before large multicentric comparative studies involving representative samples across the country are carried out to determine whether the WHO Z scores overestimate or the recent IAP growth standard underestimates the prevalence of thinness in Indian children.

## CONCLUSION

There is a discrepancy between WHO BMI for age Z scores and the IAP new growth standards in calculating the prevalence of thinness in Indian adolescent girls. The WHO BMI for age Z scores is likely to overestimate the prevalence of thinness compared to revised IAP growth standards.

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