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Original Research Article

Body mass index profile among school children: an anthropometric study

S. Mahalakshmi[1]*, M. J. Abirami[2]

Department of Training, [1]Training Head, [2]Dietician, Techmed Healthcare, Chennai, Tamil Nadu, India

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***Correspondence:**
Dr. S. Mahalakshmi,
E-mail: training@techmedhealthcare.com

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ABSTRACT

Background: The study aimed to analyse the trends in the growth pattern of the children in the age group of 3-21 years of both boys and girls using body mass index (BMI). The study also compared the BMI of the sample with the WHO norms and the group average.
Methods: A study was conducted in India covering 1728 children 849 boys and 879 girls from LKG grade to +2 grades in the age group of 3-21 years. BMI grades were computed as per WHO 2006 standards (underweight- <18.50, normal- 18.50-24.99, overweight- >25.00 and obese- >30.00). Results were analyzed using percentage and ANOVA.
Results: The data shows that 88.9% of children in the age group of 3-8 years are underweight and in 15-21 years of age children are relatively healthy, but are inclined to move to overweight (17.66%) and obesity (7.21%). More of boys (31%) tend to be underweight than girls. Age and gender were found to be significantly related to BMI. The average BMI of the sample group is above the national standards of WHO (World Health Organization) in all the three age groups. Boys are found to be on par with WHO norms while girls exceed the same. Majority of the sample were below the average denoting underweight.
Conclusions: Age and gender was significantly related with BMI. Average BMI of the sample was on par with national standard of WHO. BMI was thus found to be an effective tool for predicting the well-being of school children.

Keywords: BMI grades, Children, Age, Gender, Health status

INTRODUCTION

Body mass index (BMI) is the ratio of an individual's weight to height squared. It is the most commonly used sensitive, specific, reliable screening tool to identify individual who are potentially at risk for weight related health problems. It can be used only to assess obesity but not to diagnose obesity.

Thus, schools facilitate early screening, diagnosis, prevention and thus contribute in developing a healthy nation. Earlier studies in this field have clearly indicated two major trends of concern.

A cohort study in Louisiana on 2610 children between 2-37 years between1973-1996 indicated childhood levels of BMI to be associated with adult levels of BMI.[1] The same finding has been indicated by a cross cultural study across 25 villages covering 182 preschool children 59.8% were found to be underweight.[2] Similar findings have been reported by a study done in south Africa reporting 66-70% to be underweight in the age group of 10-12 years and 5% to be overweight indicating the need to improve the nutritional condition of school children.[3]

Based on the earlier studies this study was taken up in schools among 1728 children of 3-21years for the following reasons.

Schools are the best site for mass coverage. They have the responsibility to support the government with data on the health status nutrition and malnutrition. Schools can take up preventive measures and also follow up the outcome.

The objective of the present study was to measure the growth pattern and health status of the children using BMI, to compare the growth pattern among children of different age groups, to study the gender differences among children in BMI, to measure the significance of the impact of age on BMI and to compare the average BMI of the sample with the groups average and WHO average.

METHODS

Research design: An anthropometric survey.

A medical screening camp was conducted in India Tamil Nadu, Chennai, Adyar, in a Co Education school covering the entire population of 1728 children-boys (849) girls (879) children ranging from LKG-STD 12. Their age ranged from 3-21 years.

The camp was held over a period of five days 05 February 2019 to 11 February 2019 by a team of five physicians and three assistants.

Height and weight were taken to compute the BMI and graded as per WHO guidelines given below.

Formula= weight (kg)/[height (m)]$^{2.}$

Sample size

Total sample size was 1728. Boys are 849 and girls are 879. A population study covering the entire children of the school ranging from LKG-STD 12.

Table 1: Classification of BMI.

Classification	BMI (kg/m^2)
Underweight	<18.50
Normal range	18.50-24.99
Overweight	>25.00
Obese	>30.00

Source: Adapted from WHO, 1995, WHO, 2000 and WHO 2004.

Variables

Age group: 3-8 years, 9-14 years and 15-21 years.

Gender: Male and female.

Statistical tools

Percentage and ANOVA have been computed. The software used to compute the statistical data is SPSS package.

RESULTS

In a total population of 1728 school children who attended the screening camp. 36% were in the age group of 3-8 years, 41% were in the age group of 9-14 years and 23% were in the age group of 15-21 years.

Table 2: Age wise distribution of sample in percentage (n=1728).

3-8 years (n=624)	9-14 years (n=702)	15-21 years (n=402)
%	**%**	**%**
36	41	23

Healthy

It is alarming to note that only 11% of children in the 3-8 age groups were found to healthy as against 46% in 15-21 years age group and 41% in the age group of 9-14.

Table 3: Age wise comparison of BMI grades.

BMI grades kg/m^2	3-8 yrs (n=624)	9-14 yrs (n=702)	15-21 yrs (n=402)	Total (n=1728)
	N (%)	N (%)	N (%)	N (%)
Below 18.5 underweight	88.9	51.5	29	60
18.5-24.9 healthy	10.57	41	46	31
25-29.9 overweight	0.48	6.26	17.66	7
30-39.9 obese	----	1.13	7.21	2

Underweight

It's a mark of concern to note that 89% of children in the age group of 3-8 years are underweight. Followed by 52% in the age group of 8-14 years and 29% in the age group of 15-21 years.

Overweight

Table 3 indicates that children in the age group of 15-21 years show a higher percentage (18%) in the overweight

category as against 6.26% in the age group of 9-14 years and 4.28% in the age group of 3-8 years.

Obesity

Obesity is also found to be higher (7.21%) among children in the age group of 15-21 indicating an unhealthy trend. An overall result shows that 60% underweight; 31% healthy; 7% overweight and 2% obese.

From Table 4, we can infer that age is significantly related with BMI as indicated by the p value of 0.0000.

Table 5 shows that there is a significant relationship between age and BMI in the age range of 3-8 vs 9-14 years and 3-8 vs 15-21 years.

Table 4: Relationship between age and BMI using ANOVA.

Year	Mean	SD	P
3-8	16.88	7.33	0.0000 S*
9-14	20.94	3.85	
15-21	24.16	3.55	

*S-significant, NS-non significant.

Table 5: Age wise comparison of BMI within groups using ANOVA.

Age groups	P
3-8 vs. 9-14	0.0000-S*
9 -14 vs. 15-21	0.9948-NS
3-8 vs. 15-21	0.0000-S*

*S-significant, NS-non significant.

Table 6: Age wise comparison of BMI with group average and WHO standards.

Age (in years)	Average BMI-WHO kg/m^2	Average BMI group kg/m^2	Above group average	Group average	Below group average
3-8	16.1	16.88	14.1	8.4	25.3
9-14	19	20.94	8.4	6.2	5.4
15-21	22	24.16	77.4	5.4	69.2

Ref: WHO 2006 (Indian children) and IAP 2015.

Table 6 shows that the group average is on par with WHO norms with a marginal increase in all the three age groups.

Age wise comparison shows the majority of children are below average in their BMI, the highest being 77.4% in the 3-8 years group, 69.2% in 15-21 years group and 66.6% in the 9-14 years age.

Table 7: Gender wise distribution of sample in percentage (n=1728).

Boys (n=849)	Girls (n=879)
%	**%**
49	51

Table 7 shows the distribution to be 49% boys and 51% girls. It reveals that majority of boys (31%) and girls (29%) are underweight. 13% of boys and 18% of girls were found to be in the healthy category. Negligible percentages of students were in the overweight and obese category.

The mean value of 19.91 and 21.88 shows that the girls average BMI value exceeds that of boys. The p value 0.0001 indicates that there is a significant difference between boys and girls in their mean BMI values.

Table 8: Gender wise comparison of BMI grades.

BMI kg/m^2	Boys	Girls
	%	**%**
Below 18.5 underweight	31	29
18.5-24.9 healthy	13	18
25-29.9 overweight	3	0.9
30-39.9 obese	2	4

Table 9: Gender wise comparison of mean between boys and girls using ANOVA.

Gender	Mean	SD	P
Boys	19.91	5.990	0.0001 S*
Girls	21.88	6.174	

*S-significant.

Table 10: Age wise comparison OF BMI with group average and WHO standards.

Gender	Average BMI-WHO kg/m^2	Average BMI-group kg/m^2	Above group average	Group average	Below group average
			%	**%**	**%**
Boys	19.6	19.91	29.69	3.63	66.6
Girls	18.5	21.88	25.25	4.32	70.42

Ref: WHO 2006 (Indian children) and IAP 2015.

From Table 10, we can infer that the group average of boys (19.9 kg/m^2) is on par with WHO norms (19.6 kg/m^2). The average of the girls group (21.88 kg/m^2) exceeds the WHO standard (18.5 kg/m^2). The data also shows that majority of boys (66.6%) and 70.42% of girls are below the group average in their BMI and the shortfall in BMI is more among girls.

DISCUSSION

An anthropometric study was undertaken among 1728 school children in the age group of 3-21 years to understand the BMI profile.

Prevalence of underweight was found highest 88.9% particularly in the age group of 3-8 years. Children in the age of 15-21 years were found to be relatively healthier 46% but they were prone to become overweight 17.66% and obese 7.21%. The finding of this study is supported by a cross sectional study conducted across four regions of Puducherry to study the prevalence of obesity and overweight among children of 6-12 years of age. The results reported overweight to be prevalent among 4.41% of children and obesity 2.12%.[4]

A study also substantiates our finding reporting prevalence of obesity as 2.3% among boys and 4.3% among girls.[5] Similarly, in a study carried out in Kochi, Kerala. The sample included children from 3 schools belonging to lower middle higher income group in the age range of 6-15 years. Obesity was reported to be 3% for boys and 5.3% for girls.[6]

The gender difference in BMI was found to be significant as denoted by the p value 0.0001 likewise the p value 0.000 indicated a significant relation between age and BMI. Age was more significantly related within the age group of 3-8 vs 9-14 and 3-8 vs 15-21. This implies that BMI progresses as a continuum form childhood. 2610 children in the age group of 2-17 year old were followed up to ages 18-7 years in a cohort study conducted in Louisiana between 1973-1996, the result showed that childhood levels of BMI was associated with adult levels of BMI. The BMI levels of even the youngest children (2-5 years) were moderately associated with adult adiposity.[1]

Another interesting finding from this study was that the average BMI of the sample (16.88, 20.94, and 24.16) exceeded the national standards of the WHO (16.1, 19 and 22) at all the three age level respectively. But it is a concern to note that the average value of the group as well as WHO itself denotes underweight in the age group of 3-8 years. 77.4% of the sample being below the average and 88.9% underweight is in accordance with the standards. The average BMI of our sample (20.4%) in the age group of 9-14 years coincide with the findings of a cross cultural study of 293 children in the age group of 9-14 years covering 170 Caucasian and 123 African American children the average BMI for the Caucasian group is reported to be 19.7 at 9 years and 21.5 at 14 years as against 16.4 at 9 years and 23 at 14 years in the case of African American children.[7]

Likewise the average BMI of the boys (19.91) was on par with WHO average 19.6 whereas the girl's average 21.88% exceeded the national standard 18.5 but overall 66.6% of boys and 70.4% of girls were below the group and WHO average which needs to be addressed.

CONCLUSION

This study throws light on several findings which are valuable in understanding the factors related to child health. High prevalence of underweight in the initial years of childhood needs to be looked into, in terms of nutritional intervention. It also indicated that the age and gender has a strong impact on BMI and hence dietary practices need to be tailored accordingly. Malnutrition is thus found to be a major factor in the child's growth. The findings of the study fall in line with the results of the previous studies. A follow up study on BMI would facilitate preventive health in children.

Limitations

The children were screened only through physical examination and not through any clinical investigation. An intensive check-up needs to be done in the case of children who are recommended for further evaluation. BMI as a screening tool is only an indicator and not a conclusive report of the health status.

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