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A Study on the Assessment of BMI and its Association with Malnutrition among Rural Preschool and Primary School Children in Hardoi District, Uttar Pradesh, India

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Abstract: Malnutrition is a major health problem among rural children in developing countries such as India. The present study aimed to analyze the trends in the growth pattern of both boys and girls among preschool and primary school children in rural areas using body mass index (BMI) and the association between BMI and socio-economic status of children's parents. A total of 486 children (aged 2-8 years) were examined of which 230 were preschool children aged 2-4 years and 256 were primary school children aged 5-8 years. Out of 230 preschool children, 21.74% were underweight, 67.83% normal and 10.43% overweight while obesity was not reported. Out of 256 children of primary school, 33.59% were underweight, 52.35% normal, 11.72% overweight and 2.34% obese. Prevalence of underweight was found the highest 33.59% in primary school children while preschool children were found to be relatively healthier with 67.83%. The study found an association between BMI and socio-economic status of children's parents. Findings of this study also support the need of proper and honest implementation of Mid-Day Meal Scheme in primary schools.

Keywords: Body Mass Index, Malnutrition, Underweight, Overweight, Obesity, Preschool, Primary School, Rural, Socio-economic Status

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Introduction

The nutritional status of an individual refers to his/her health as indicated by the quality of nutrients consumed and the body's ability to utilize them for its metabolic needs. World Health

Organization (WHO) believes that the ultimate objective of nutritional assessment is overall improvement in the quality of human health (Beghin *et al.*, 1988). Malnutrition is widely

recognized as a major health problem among rural children in developing countries such as India. According to FAO Report "The State of Food Insecurity in the World" (2004), India contributes to about 5.6 million child deaths every year due to undernutrition, more than half of the world's total. According to UNICEF data, 90% of developing world's malnourished children live in Asia and Africa; while 40% of the world's malnourished live in India (UNICEF, 2009). Nutrition plays a vital role in the growth and development of children. Inadequate nutrition may lead to malnutrition, growth retardation, reduced work capacity and poor mental and social development (Manna *et al.*, 2011, Bergman *et al.*, 2011). Growing children in particular are the most vulnerable to its consequences (Ahmad *et al.*, 2011). There are several ways of measuring nutritional status. Anthropometry is one of the most useful tools for assessment of the nutritional status of children and adolescents. The anthropometric measurements which are commonly used to assess nutritional status during childhood stages are height-for-age (stunting), weight-for-height (wasting), weight-for-age (underweight) and thinness (Body Mass Index (BMI)-for-age). 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. Body mass index (BMI) is commonly used to quantify anthropometrics in identification of children at risk due to its simplicity (Bose *et al.*, 2007). The problem of undernutrition is higher in rural areas compared to urban areas (Smith *et al.*, 2006). The condition of being underweight may have resulted from low dietary intake, excessive workout and chronic infections (Ramzan *et al.*, 2008). Early developmental opportunities establish a critical foundation for children's academic success, health and general well-being (Van Landeghem *et al.*, 2002). Keeping this in view, the present study was conducted under the National Service Scheme, Uttar Pradesh-- (a) To access the body mass index, (b) To access the nutritional status of rural

preschool and primary school children of different socio-economic groups in terms of body mass index, and (c) To find out the association of BMI with the nutritional and socio-economic status between preschool and primary school children in rural areas of Hardoi district, Uttar Pradesh.

Materials and Methods

Study design and Settings:

Anthropometric surveys were conducted under the National Service Scheme, Uttar Pradesh by NSS volunteers of Government Degree College Pihani, Hardoi with the help of ASHA workers. This was a community and school-based, cross-sectional study carried out over a period of six months, from August 2019 to January 2020. Ten primary schools and their neighboring communities (villages) were selected to collect primary data by simple random technique. The present study was carried out among preschool children aged 2-4 years and primary school children aged 5-8 years who were belonging to rural areas under Pihani block of district Hardoi, Uttar Pradesh. Preschool children were watched over under the Integrated Child Development Scheme (ICDS). The ICDS was launched by the Government of India on 2nd October, 1975. This scheme now includes preschool children, pregnant and lactating mothers and women in the age group of 15 years to 44 years and is the largest national program for promotion and development of health of mother and child (Tigga *et al.*, 2015). All the children were free from physical deformities and were not suffering from any illness or diseases at the time of data collection. The objectives of the study were explained to either parent of the children as well as the principals of primary schools and an informed consent was obtained from them. Measuring tape and electronic weighing machines were used to measure height and weight. BMI was calculated by formula $\text{weight (kg)} / \text{height (m)}^2$ and graded as per WHO guidelines (Table 1).

Indicators of socio-economic status were primarily based on parent's occupation and education. Occupation was classified into

Table 1: Classification of BMI

Classification	BMI (kg/m ²)
Underweight	< 18.50
Normal weight	18.50 - 24.99
Overweight	25.00 - 29.99
Obese	≥ 30.00

Source: BMI chart adopted from the WHO report, 2006

Table 2: Gender and age wise distribution of sample

Group (Age)	Gender	N	%
Preschool Children (2-4 years)	Boys	122	53.04 %
	Girls	108	46.96%
Primary School Children (5-8 years)	Boys	135	52.73%
	Girls	121	47.27%

Table 3: Descriptive statistics (mean ± SD) of age, gender and anthropometric variables related to nutritional status of preschool children

Variables	N	Boys	Girls	Total
Age	230	3.56 ± 1.02	3.24 ± 0.95	3.40 ± 0.99
Height	230	85.91 ± 9.37	78.18 ± 8.41	82.05 ± 8.89
Weight	230	14.12 ± 3.46	12.59 ± 2.85	13.34 ± 3.16
BMI	230	21.16 ± 1.62	19.86 ± 1.37	20.51 ± 1.50

employed (government or private sector) and unemployed. Education level of parents was divided into 5 groups: illiterate, write and read, primary education, secondary education and higher education.

Variables: Age group: 2-4 years (Preschool Children) and 5-8 years (Primary School Children); Gender: Male and female; Socio-economic Status (SES) of Parents: Occupation and Educational level.

Statistical tools:

Percentage and ANOVA have been computed. The software used to compute the statistical data is SPSS, Windows version 21.0.

Results

A total of 486 children (aged 2-8 years) were examined of which 230 were preschool children aged 2-4 years and 256 were primary school

children aged 5-8 years. Out of 230 preschool children, 122 were boys and 108 were girls. On the other hand, out of 256 primary school children, 135 were boys and 121 were girls (Table 2).

Preschool Children:

The age and gender-specific nutritional status among preschool children were analyzed (Table 3). Among boys, overall mean ± SD of age, height, weight, and BMI were 3.56 ± 1.02 years, 85.91 ± 9.37 cm, 14.12 ± 3.46 kg and 21.16 ± 1.62 kg/m², while, among girls, these respective values were 3.24 ± 0.95 years, 78.18 ± 8.41 cm, 12.59 ± 2.85 kg and 19.86 ± 1.37 kg/m². Among preschool girls, mean height, weight and BMI exhibited a decreasing trend which was lower than that shown by boys. According to BMI for age, out of 108 girls 28.70% were underweight, 62.96% normal and 8.34% overweight, while out of 122

Table 4: Descriptive statistics (mean $\pm$ SD) of age, gender and anthropometric variables related to nutritional status of primary school children

Variables	N	Boys	Girls	Total
Age	256	6.24 $\pm$ 1.35	6.52 $\pm$ 1.26	6.38 $\pm$ 1.31
Height	256	112.34 $\pm$ 10.23	114.15 $\pm$ 9.67	113.25 $\pm$ 9.95
Weight	256	24.03 $\pm$ 4.14	25.58 $\pm$ 4.65	24.81 $\pm$ 4.40
BMI	256	19.26 $\pm$ 1.45	18.36 $\pm$ 2.12	18.81 $\pm$ 1.79

Table 5: Age-wise comparison of BMI grades

BMI grades (kg/m ²)	Preschool Children (2-4 years) N=230 %	Primary school children (5-8 years) N=256 %	Total N=486 %
Underweight < 18.50	21.74	33.59	27.98
Normal weight 18.50 - 24.99	67.83	52.35	59.67
Overweight 25.00 - 29.99	10.43	11.72	11.11
Obese > 30.00	-	2.34	1.24

boys 15.57% were underweight, 72.13% normal and 12.30% overweight. Overall out of 230 preschool children, 21.74% were underweight, 67.83% normal and 10.43% overweight while obesity was not reported among boys and girls in rural areas. The study clearly showed that malnutrition was higher among girls in compare with boys of same group.

Primary School Children:

The age and gender-specific nutritional status among primary school children were analyzed (Tables 4, 5). Among boys, overall mean $\pm$ SD of age, height, weight, and BMI were 6.24 $\pm$ 1.35 years, 112.34 $\pm$ 10.23 cm, 24.03 $\pm$ 4.14 kg and 19.26 $\pm$ 1.45 kg/m², while, among girls, these respective values were 6.52 $\pm$ 1.26 years, 114.15 $\pm$ 9.67 cm, 25.58 $\pm$ 4.65 kg and 18.36 $\pm$ 2.12 kg/m². Among girls of primary school, mean height and weight exhibited an increasing trend except in case of BMI which was lower than that shown by boys. According to BMI for age, out of 121 girls 38.02% were underweight, 50.42% normal, 9.91% overweight and 1.65% obese, while out of 135 boys 29.62% were underweight, 54.08% normal, 13.34% overweight and 2.96% obese. Overall out of 256 children of primary school, 33.59% were

underweight, 52.35% normal, 11.72% overweight and 2.34% obese. Results of the study showed a mark of concern to note that malnutrition was a bigger problem among girls of primary school in compare with boys.

Table 5 shows that 33.59% children of primary school were underweight that was higher than preschool children (21.74%) while negligible percentages of children were overweight and obese in both groups.

The mean BMI value of 21.16 and 19.86 shows that the boys average BMI value exceeds that of girls in preschool children aged 2-4 years (Table 6). Similarly the mean BMI value of 19.26 and 18.36 shows same result in primary school children aged 5-8 years. The p value 0.0001 of both age groups indicates that there is a significant difference between boys and girls in their mean BMI values. The p value (0.0025) of preschool vs primary school children shows that there is a significant relationship between age and BMI in the age range of 2-4 vs 5-8 years.

BMI in relation to Socio-Economic Status:

In our study, among 486 children's parents, 43 (8.85 %) parents were illiterate, 96 (19.75 %)

Table 6: Gender wise comparison of mean BMI between boys and girls using ANOVA

Group (Age)	Gender	BMI (mean ± SD)	p-value	S*-Significant
Preschool Children (2-4 years)	Boys	21.16 ± 1.6	0.0001 S*	
	Girls	19.86 ± 1.37		
Primary School Children (5-8 years)	Boys	19.26 ± 1.45	0.0001 S*	
	Girls	18.36 ± 2.12		

Table 7: Socio-economic Status of Parents

Indicators of SES	Groups	Percentage
Parent's Education	Illiterate	43 (8.85%)
	Write and read	96 (19.75%)
	Primary education	164 (33.75%)
	Secondary education	123 (25.30%)
	Higher education	60 (12.35%)
Parent's Occupation	Employed	178 (36.63%)
	Unemployed	308 (63.37%)

Table 8: Association of BMI with Socio-economic Status of Parents

Indicators of SES	Groups	Underweight	Normal Weight	Overweight	Obese	p-value
Parent's Education	Illiterate	27 (62.8%)	13 (30.3%)	3 (6.9%)	0 (0%)	0.426
	Write and read	46 (47.9%)	37 (38.5%)	9 (9.4%)	4 (4.2%)	
	Primary education	44 (26.8%)	98 (59.8%)	16 (9.8%)	6 (3.6%)	
	Secondary education	18 (14.6%)	78 (63.4%)	19 (15.5%)	8 (6.5%)	
	Higher education	6 (10.0%)	18 (30.0%)	23 (38.3%)	13(21.7%)	
Parent's Occupation	Employed	23 (12.9%)	95 (53.4%)	41 (23.0%)	19(10.7%)	0.064
	Unemployed	136 (44.2%)	126 (40.9%)	37 (12.0%)	9 (2.9%)	

parents were able to write and read, 164 (33.75%) parents had primary education, 123 (25.30%) parents had secondary education and 60 (12.35%) parents had higher education. 178 (36.63%) parents were employed and 308 (63.37%) parents were unemployed (Table 7).

Table 8 shows the association of BMI with socio-economic status of children's parents. Among the participant parents, 62.8% and 47.9%

of children with illiterate parents or parents able to write and read, respectively were underweight that was higher than that of children with parents having primary, secondary and higher education. 59.8% and 63.4% of children with parents having primary and secondary education respectively were normal weight that was higher among other SES groups. 38.3% of children with parents having higher education were overweight that was higher

among the other SES groups. 44.2% of children of unemployed parents were underweight while 53.4% of children of employed parents were normal weight that were higher than that of other SES groups.

Discussion

An anthropometric study was carried out among 230 preschool children and 256 primary school children with age groups 2-4 years and 5-8 years, respectively to understand the BMI profile in rural area of district Hardoi, Uttar Pradesh.

Prevalence of underweight was found highest 33.59% in primary school children. Preschool children were found to be relatively healthier with 67.83% due to proper and regular health camps by ASHA workers under the Integrated Child Development Scheme (ICDS). The results reported overweight to be prevalent among 10.43% of preschool and 11.72% of primary school children while obesity among 2.34% of only primary school children. Previous study carried out in Kochi, Kerala and Chennai, Adyar, Tamil Nadu in India, also validates present finding for the prevalence of obesity as 2.96% among boys and 1.65% among girls. The gender difference in BMI was found to be significant as denoted by the p value 0.0001 likewise the p value 0.0025 indicated a significant relation between age and BMI. Age was more significantly related within the age group of 2-4 vs 5-8. This indicates that BMI progresses as a continuum from childhood. Another interesting finding from present study was that the average BMI of preschool children (20.51 ± 1.50) exceeded the national standards of the WHO (16.1) while average BMI of primary school children (18.81 ± 1.79) was almost same with the national standards of the WHO (19.0). But it is a concern to note that the prevalence of malnutrition is higher among primary school children. A new finding of the study was the prevalence of underweight in primary school children. It may be due to sudden workload of their study during early period of schooling. But more study needed to find out its real cause.

The present study showed that BMI is directly associated with Parent's Socio-economic status. The fact that young children usually spend more time with their parents (Lamb *et al.*, 1987). It might explained the findings that parent education had a greater influence on childhood BMI. Educated parents are more responsible person for the diet selection and diet intake as well as upbringing of their children (Laessle *et al.*, 2001). The present study found an association between parent's education and BMI. Children with illiterate parents and parent hardly able to write and read were at more risk of underweight due to lack of knowledge about proper diet selection and diet intake as well as upbringing of their children. The study also showed an association between parent's occupation and BMI. Children with employed parents were found at risk of overweight that might be the initial stage of obesity. Highest percentage of children with normal weight were recorded in SES groups of educated and employed parents. The results of our study showed contradiction with some previous study conducted in developed countries that showed BMI was inversely associated with Socio-economic status (Morgenstern *et al.*, 2009).

Conclusion

The present study revealed some new findings which are valuable in understanding the factors related to health during preschool and primary school age of children. High prevalence of underweight in the years of primary school education needs to be looked into, in terms of nutritional spooning. 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 during earlier period of education. The study also supports the need of proper and honest implementation of Mid-Day Meal and Yoga practices in primary schools.

The results of this study also showed the association of socio-economic status of parents with BMI. The prevalence of underweight is higher in children of parents with low education level and

unemployed and the prevalence of normal weight and overweight is higher in children of parents with high education level and employed. Since the parent occupation is indirectly related to family income that could be fulfill the needs of children during their early childhood.

The children were screened only through physical examination and not through any clinical investigation during survey. BMI (Body Mass Index) as a screening tool is only an indicator and not a definite report of growth and development analysis.

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