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BODY MASS INDEX AND SKIN FOLD THICKNESS AS MARKERS OF UNDER-NUTRITION OF SCHOOL CHILDREN IN THE AGE GROUP OF 6 TO 8 YEARS IN KOLKATA WEST BENGAL, INDIA.

Biochemistry

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ABSTRACT

Background: Under-nutrition of a society is grossly reflected in school-going children. Body mass index (BMI) and skin fold thickness (SFT) are major indicators of nutritional status in growing children.

Aims: The present study intends to evaluate the relative roles of BMI and SFT as markers of age-wise under-nutrition in school going children belonging to low socioeconomic (LSE) status and high socioeconomic status (HSE) of the age group of 6 to 8 years.

Methods: BMI and SFT were measured age-wise in both LSE and HSE school-going children in the age group of 6 to 8 years by standard techniques. Their differences were evaluated between the LSE and HSE group children using their mean and SD values. Changes in the BMI and SFT values of the LSE group children were analyzed age-wise using ANOVA to assess their relative importance in each group.

Results: BMI and SFT were significantly reduced in the LSE group in male and female children in their 6 and 7 yrs of age group. In the 8 years age group BMI became comparable with the HSE group in both sexes. SFT remained significantly lower in the LSE group in both genders.

Conclusions: From the present study we can conclude that the children of LSE status have significantly lower BMI and SFT compared to those of HSE group of children irrespective of gender variations. SFT stands out to be a better indicator for under-nutrition in both sexes from 6 to 8 years of age.

KEYWORDS

Body mass index (BMI), Skin fold thickness (SFT), Low socioeconomic status, High socioeconomic status.

1. INTRODUCTION:

Malnutrition is a term that encompasses both over and under-nutrition. Although malnutrition is an overall concern for children under five years of age in developing countries (1), its under-nutrition component remains the most important health concern in these countries including India (2). Under-nutrition is one of the most haunting problems of the developing world that has been grossly under-addressed, since its prevalence has not been found to decrease substantially in many parts of the world. It has been estimated that undernutrition is responsible for at least 35 percent of all deaths in children below 5 years of age and has been a great hindrance to those children who do survive the period of under-nutrition, for achieving their full potential development (3). It has been estimated that almost 19 million children around the world face a 9-times greater risk of dying at any one point time in the whole world due to effects of undernutrition (4). In India the problems of undernutrition are quite severe as National Health and Family Survey (NHFS 4) has reported a 36 percent of underweight children in the country in comparison to 2 percent of overweight children (5). The major health hazard of under-nutrition in school children enforced different governments to enact the school feeding programmes. Living in small houses with a crowded, low income family , all pertaining to a lower socioeconomic status, have been reported to be the main contributing factors for under-nutrition in school going children so far in different countries (6). In an Western Indian population, health supervision among the school children has revealed a significant amount of morbidity related to malnutrition in urban community which suggests that urban communities are susceptible to childhood under-nutrition as well (7).

In humans there are three postnatal growth spurts, i.e., infantile growth, mid-growth (6-8 years) and adolescent growth. The opinions of researchers all over the globe are divided regarding the separate entity of mid-growth spurt. Stalwarts like Tanner do not believe that there is a mid-growth spurt in children. However, present day thinking favours the possibility of a mid growth spurt in children (8).

Growth during middle childhood averages 3-3.5 kg and 5 cm per year. This growth occurs discontinuously in 3 to 6 growth spurts each year, each lasting an average of 8 weeks .The head grows only 2-3 cm in circumference throughout this entire period, reflecting slower brain growth than earlier . Myelinization is completed by 7 years of age (9). Overall, the socioeconomic status of the children and other environmental factors is very important in the growth and development of their various organ systems during the period of 6 to 8 years. Rapid growth rate in children belonging to 5-12 years age group makes them vulnerable to under-nutrition. Chronic under-nutrition is considered to be the primary cause of ill-health and premature mortality among this group of children in developing countries (10, 11). Dietary intake seems to be one of the most important determinants of nutritional status (12). Inadequate food habits along with traditional socio-cultural and biological activities due to unique lifestyles in the Indian population makes them substantially vulnerable to a high proportion of under-nutrition in their children which is reflected in their body growth and development (13).

The physical growth and nutritional status of school-going children are two of the most significant indicators of the general health status of the country. The health status of the young school going girls are particularly important regarding their future role in motherhood and child rearing. Keeping these factors in mind, we hypothesize that under-nutrition is a prevalent problem in the 6 to 8 years children belonging to lower socioeconomic status in our region and designed the present study accordingly. We also aim to study the relative role of BMI and skin fold thickness (SFT) as major markers of malnutrition in this age group.

2. MATERIALS AND METHODS:

2.1. Selections / criteria

In this study, school going children belonging to 6-8 years of age were chosen from local schools in Kolkata following a simple random method without replacement. The selected children were classified into low and high socio-economic groups following the Kuppuswamy index. Informed consents were obtained from the school authorities and legal guardians. The study was initiated after obtaining permission from the institutional ethical committee. Any student suffering from any chronic illness or any other inflammatory or immunological disorders were not included in this study.

A total of 457 children of different schools of Kolkata of this age group were studied. The total study population was divided into three age-groups of 6, 7 and 8 years. The 6-year group included all the children aged between 6 years and 6 years 364 days. Similarly the 7-year group included children aged between 7 years and 7 years 364 days, and 8-year group included children aged between 8 years and 8 years 364 days.

2.2. The physical growth was assessed by following anthropo metric measurements :

Weight and height of all children were assessed using standardized techniques. The skin fold thickness (SFT) measurement was done at the triceps level to assess nutritional status and also to assess the characteristics of subcutaneous fat in these children.

The socio-economic status was taken into consideration and was assessed by Kuppuswamy index (14).

Details of the techniques used in this study were as follows:

Anthropometric measurement All anthropometric measurement were done by standardized techniques as follows :

Parameters	Instruments methodology	Degree of accuracy
Weight in kgs	Beam balance	To nearest of 25 gms
Height in cms	Stadiometer	Nearest of 0.5 cm
Skin fold thickness in mm	Herpendens skin fold calipers	Nearest of 1 mm

Body mass index (BMI) was calculated using the following formula:
BMI = Body weight in Kg/(Height in Meter)^2

Data analysis for the obtained parameters was done using SPSS softare 17.0 for MicrosoftWindows.

2.3. Statistical analysis:

BMI and SFT both were significantly lower in the lower socioeconomic group belonging to all three age groups. However, the t values for the SFT were greater than that of the BMI for all, indicating a greater link between the mass of subcutaneous fat with the nutritional status. This observation was found to be true for all children irrespective of their gender, except female children who fell in the 6-year age group. For ascertaining a better association between SFT and under-nutrition, we carried out the ordinal regression analysis exploring the relationship between the socioeconomic status with the BMI and SFT in both groups. Results indicated a significantly stronger relationship of SFT with the socioeconomic status in all age groups except in the 8-year group.

3. RESULTS:

Data in the Table 1 and Table 2 show significantly decreased values of BMI and SFT in 6-year and 7-year age groups in comparison to their non-obese counterparts. BMI, however, was not significantly different from that in the HSE children. When these changes were assessed in a year-wise manner among the LSE group of children, increments in BMI were found to be significant in the later age groups in male children and earlier age groups in female children. Increase in SFT was significant only in females at a later age group.

4. DISCUSSION:

The present study was designed with an aim to evaluate and assess the roles of SFT and BMI as effective markers of under-nutrition in male and female school children within the ages of 6 to 8 years. It was evident that SFT in both male and female children had a lower increase with age compared to their BMI (Table 1 and 2). This explains the significantly decreased SFT value at the 8 yrs age group in male and female children in the LSE group (Table 1 and 2). However, there was a significant increase in BMI at later ages i.e. 7 years and 8 years in both male and female children that made their BMI almost comparable to the 8-year old children in the HSE group.

The growth pattern was found to be slightly different in female children in the LSE group than their male counterparts in our study population. In the female children, SFT increased significantly at the later stage, i.e., at 7 and 8 years of age, although this was not significant enough to bridge the gap with their HSE counterparts of the same age group ($P < 0.001$, Table 2). In contrast, no significant change was observed in SFT in the male children year -wise although the overall difference was significant from 6 to 8 yrs (Table 3, ANOVA). BMI, on the other hand, increased maximally at the earlier part i.e. during the period of 6 to 7 years of age in the LSE female group, and in the later part, in male children. These differences between changes in BMI and SFT can be attributed to the differences in overall mid-growth spurt (as reflected by BMI) and subcutaneous body fat distribution (as reflected by SFT) in male and female children.

In the present study, a lowered BMI in the 6 to 7-year age group and SFT in the 6 to 8-year age group of children belonging to the lower socioeconomic status indicates that their nutritional status is significantly lower compared to their counterparts belonging to the higher socioeconomic status . However, significant similarity as well as variation has been reported in several studies undertaken in different parts of the world and India. Some workers reported that well nourished Indian girls and American girls showed better performance in their physical growth parameters such as BMI, SFT, sitting height, biepicondylar humerus, bicondylar femur, head circumference, chest circumference and upper arm circumference, compared to Garhwali girls between 5 to 12 years of age (15) . Grade-I and Grade-II malnutrition were prevalent among Garhwali girls (16) and they were found to be comparable with rural Indian girls in their growth status. This may be attributed to low dietary intake, low socio-economic background, uneducated or partially educated parents, large family size and gender discrimination . A lowered BMI indicated poor weight gain whereas a decreased SFT pointed towards reduced body fat in these children. Our findings were well matched with other studies which also reported statistically significant variation in the nutritional markers between children belonging to high and low socio-economic status (17). As the elite children coming from the higher socioeconomic class are expected to have adequate nutrition they are found to have less number and better indicators of nutrition like BMI and SFT (18).

Other than the nutritional status of the children, the maternal condition also plays a major role. Data analysis of National Family Health Survey (NFHS) 1 showed that the mother's education has a strong independent effect on a child's nutritional status even after controlling the potentially confounding effects of the 12 other demographic and socioeconomic variables (19) . In other studies, improvement in nutritional status has been found to have a significant positive correlation with maternal education (20, 21). Hence, we propose that further studies related to the evaluation of maternal conditions are needed to reach a holistic conclusion about the causes and remedies of under-nutrition that is prevalent in our study population.

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Table 1: Distribution of BMI and SFT in male children among the LSE and HSE groups.

Age (in years)		BMI (Mean ± SD)	t value	P value	SFT (Mean ± SD)	t value	P value
6 years	LSE (N =32)	14.18 ± 1.37	-5.8	< .001	12.19 ± 1.59	-8.38	<.001
	HSE (N =32)	16.25 ± 1.55			16.11 ± 2.19		
7 years	LSE (N =33)	13.86±0.90	-6.12	< .001	12.72±1.66	-8.41	< .001
	HSE (N =30)	15.25±0.89			16.37±1.77		
8 years	LSE (N =45)	15.41±1.49	-1.89	0.67	13.16±1.46	-5.89	< .001
	HSE (N =25)	16.06±1.22			15.57±1.90		

P value significant at $P < 0.05$ for 95% confidence interval.

Table 2: Distribution of BMI and SFT in female children among the LSE and HSE groups.

Age (in years)		BMI (Mean ± SD)	t value	P value	SFT (Mean ± SD)	t value	P value
6 years	LSE (N =59)	13.74 ± 1.39	-8.1	< .001	11.26 ± 0.94	-7.1	<.001
	HSE (N =68)	15.85 ± 1.50			13.70 ± 2.19		
7 years	LSE (N =33)	13.86±0.90	-6.12	< .001	12.72±1.66	-8.41	< .001
	HSE (N =30)	15.25±0.89			16.37±1.77		
8 years	LSE (N =45)	15.41±1.49	-1.89	0.67	13.16±1.46	-5.89	< .001
	HSE (N =25)	16.06±1.22			15.57±1.90		

P value significant at P < 0.05 for 95% confidence interval.

Table 3: Differences in the BMI and SFT in both male and female children among the LSE group age wise.

	Male children		Female children	
	BMI	SFT	BMI	SFT
6 yrs. Vs 7 yrs	.996	.523	<.001	1.0
6 yrs. Vs 8 yrs.	<.001	.025	.003	<.001
7 yrs. Vs 8 yrs.	<.001	.668	1.0	<.001

P value significant at P < 0.05 for 95% confidence interval.

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