



## Assessment of Nutritional Status of School-age Children in Suburban Area of West Bengal

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### *Author's contribution*

*The sole author designed, analyzed and interpreted and prepared the manuscript.*

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### ABSTRACT

**Objective:** Objective of this study was to assess the nutritional status of primary school children between the age group 6 to 9 years considering reference values proposed by Indian Association of Pediatrics (IAP) and National Centre for Health Statistics (NCHS).

**Methods:** It is a cross sectional school base study. Six hundred and nine female and five hundred and twenty seven male primary school children were participated. Height- for- age, BMI- for- age and weight- for- age were used to assess nutritional status on considering reference values proposed by IAP and NCHS. Health status of the study population was assessed by Rohrer index. Prevalence of malnutrition was expressed in percentage.

**Results:** Significant percentage of children of both gender were suffering under-nutrition like stunting (IAP: female 56.3% and male 10.1%; NCHS: female 64.9% and male 19%), thinness (IAP: female 36.4% and male 38.9%; NCHS: female 59.7% and male 61.5%) and underweight (IAP: female 37.5% and male 57.6%; NCHS: female 65.7% and male 73.6%). Over nutrition like higher body weight than standard (IAP: female 29.2% and male 18.1%; NCHS: female 15.5% and male 11.9%) and overweight and/or obesity was noted in study population. Under-nutrition was coincides with the finding of RI. More than 40% children of either gender were enjoy very low health status and more than 15% with high health status. Prevalence of malnutrition was higher in male than female children.

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**Conclusion:** Present study highlights double burden of malnutrition among children living suburban area of Hooghly district. Thus to reduce both form of malnutrition it is essential to improve knowledge and awareness of personal hygiene and nutrition.

*Keywords: Malnutrition; stunting; thinness; under-nutrition; children.*

## 1. INTRODUCTION

Children are considered as biggest human investment for development of every community. The nutritional status of the children is an index of national investment in the development of its future manpower. Remarkable proportion of children in underdeveloped, developing and developed countries are suffering from malnutrition (undernutrition or over nutrition). 90% of developing world's undernourished children lives in Asia and Africa while 40% of world's malnourished lives in India [1]. Malnutrition in early childhood has serious, long term consequences as it impedes motor, sensory, cognitive, social and emotional development [2]. Nutritional status is an index of quality of life. The school going ages have high significance because this is the period of growth. Thus child nutritional status assessment serves as a means for evaluating health condition and quality of life of that population.

Malnutrition in children is the consequence of multiple factors which are related to poor food quality, insufficient food intake, severe chronic infection etc. [3]. There have been numerous studies regarding epidemiology of underweight and stunting among poor children from different developing countries [4]. Several studies have been done to investigate health and nutritional status from different parts of India [5-7]. India has diverse agro-climatic regions, ethnic multiplicities, socio-cultural practices, life styles and food habit which vary not only between the states but also within districts [8]. Thus there is a need for assessment of nutritional status in various part of our country to obtain a clear picture of nutritional status in various regions. In India alone there is approximately 60 million children who are underweight [9]. This prevalence is higher in rural area than urban areas [10]. India is now facing the emerging problem of overweight [11]. A recent study among Indian children and adolescent suggests the existence of double burden of underweight and overweight [12]. However, there is scanty information on the nutritional status of children living suburban areas of West Bengal. Hence it was necessary to

assess the nutritional status of this demographic group of children.

The use of anthropometry is universally accepted for the evaluation of nutritional status. It has the advantages of being portable, noninvasive, inexpensive, quick to assess and simple to use [13]. The present investigation was undertaken to assess the nutritional status of school going children using anthropometry in suburban area of Hooghly district in West Bengal state of India.

## 2. MATERIALS AND METHODS

### 2.1 Subjects

It is a cross sectional institution based observational study done from June 2014 to August 2016 among school children (standard II to standard IV) having age limit 6 to 9 years in eight Government added Primary school in Chinsurah, district town of Hooghly, West Bengal, India. The prior written permission of the school authority was taken. Written consent from the parents of the students experimented in the study was obtained. Children who were seriously ill and unwilling to anthropometric measurement were excluded from the study. 1136 students (boys- 527 and girls 609) were selected for this study. All the subjects selected and sorted for the study were on the basis their midyear age, i.e., 6.5 to 9.5 on average. Thus in the text ages like 6.5 and 6 or 9.5 and 9 years are mentioned in similar senses.

### 2.2 Anthropometric Measurements

Body weight was measured in light clothing and in bare feet to the nearest 0.5 kg. Height was measured using anthropometric rod without footwear on to the nearest 0.1 cm.

The body mass index (BMI) and Rohrer index (RI) were calculated from the weight and height measurements using the formula:

$$\text{BMI} = \text{weight (kg)} / \text{height (m)}^2$$

$$\text{Rohrer index (RI)} = [\text{weight (gm)} / \text{height (cm)}^3] * 100$$

**Table 1. Grade of malnutrition**

Grade	Undernutrition	Over-nutrition
0	Obtained value 10% less than reference median	Obtained value 10% more than reference median
1	Obtained value more than 10% and up to 25% less than reference median	Obtained value more than 10% and up to 25% greater than reference median
2	Obtained value more than 25% and up to 40% less than reference median	Obtained value more than 25% and up to 40% greater than reference median
3	Obtained value more than 40% less than reference median	Obtained value more than 40% greater than reference median

\*Ref. DeAlmedia CAN, Ricco RG, Nogueira MPC, Ciampo LAD, Mucillo G. Comparison of four anthropometric methods of nutritional assessment and evaluation of the agreement between two reference populations. *J Tropical Pediatrics*, 1999; 45: 345-349

### 2.3 Assessment of Nutritional Status

Children were classified into four degree of malnutrition [14] according to deficit or excess between the data obtained and standard median of anthropometric parameters viz. weight, height and BMI (Table 1). In this study assessment of nutritional status was done using reference standard proposed by Indian Association of Pediatrics (IAP) as well as proposed by National Centre for Health Statistics (NCHS). Health status was estimated using RI (Table 2).

values for weight, height, BMI and RI in age 6 and 7 years in comparison to their girls' counterpart. While girls showed higher value when compared to their boys counterpart in age group 8 and 9 years.

The height-for-age index examines the linear growth and is used as an indicator of chronic under nutrition. Stunting was noted both in male and female children in reference to IAP (male-10.1%; female-56.3%) and NCHS (male-19.0%; female-64.9%) standard. There was no over linear growth in children (Tables 4,5 and Fig. 1).

**Table 2. Health status according to Rohrer index**

Health status	RI value
Very low	≤ 1.12
Low	1.13 to 1.19
Middle	1.20 to 1.25
Upper middle	1.26 to 1.32
High	1.33 to 1.39
Very high	≥ 1.40

\*Ref. De K. Health status evaluation of adolescent girls by Rohrer index. *J Commun Med*. 2017; 7(2): 1-5

Weight-for-age is a composite measure of both chronic and acute malnutrition. Study results suggest that significant percentage of children suffer in male nutrition. According to IAP 55.6% male children suffer in under-nutrition and 16.2% in over-nutrition. Similar trend was noted for female children (under-nutrition 37.5%, over-nutrition 29.2%). By considering NCHS as reference standard 83.6% male children (under-nutrition 73.6%, over-nutrition 9.9%) and 81.2% female children (under-nutrition 65.7%, over-nutrition 15.5%) were under malnutrition (Tables 6,7 and Fig. 2).

### 2.4 Statistical Analysis

Data obtained from the study were given as mean ± SD. Risk of malnutrition were estimated by considering reference value proposed by NCHS and IPA. Various category of malnutrition and health status categories were expressed in percentage. Correlation between age and anthropometric parameters were estimated. P value of 0.05 or less was considered as statistically significant.

The weight-for-height index compare body mass to body length and indicates acute undernutrition. Thinness and obese was estimated on the basis of BMI-for-age. Result of present study suggests that significant number of male and female children suffer in malnutrition in respect to BMI-for-age. According to IAP standard 54.4% male (Thin-38.9%, overweight-15.5%) and 61.3% female (Thin-36.4%, overweight-24.9%) children suffer in malnutrition. In respect to NCHS standard 75.4% female (Thin-59.7%, overweight-15.7%) and 72.3% (Thin-61.5%, overweight-10.8%) were suffering malnutrition (Tables 8,9 and Fig. 3).

### 3. RESULTS

Anthropometric characteristic of boys and girls were given in Table 3. Boys showed higher

**Table 3. Age variation of anthropometric parameters of children**

Age (year)	Sex	N	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )	RI
6	Boys	67	112.8 ± 7.13	18.20 ± 6.89	14.11 ± 4.55	1.25 ± 0.40
	Girls	67	112.6 ± 7.30	17.39 ± 4.45	13.56 ± 1.94	1.20 ± 0.16
7	Boys	132	121.7 ± 6.76	21.66 ± 5.94	14.60 ± 2.68	1.20 ± 0.19
	Girls	99	116.0 ± 5.73	18.28 ± 3.24	13.51 ± 1.65	1.17 ± 0.14
8	Boys	141	122.1 ± 7.09	21.46 ± 5.30	14.27 ± 2.58	1.17 ± 0.20
	Girls	231	124.5 ± 7.24	24.06 ± 6.93	15.17 ± 3.19	1.21 ± 0.23
9	Boys	187	127.1 ± 6.39	23.98 ± 5.44	14.72 ± 2.48	1.16 ± 0.19
	Girls	212	129.7 ± 7.02	31.77 ± 7.59	16.60 ± 3.02	1.21 ± 0.21

*Data represent mean ± standard deviation*

Table 10 exhibits the age wise Rohrer index of male and female children. Significant number of male and female children living with low and very low health status. Overall percentage of health status of male and female children were represented in Fig. 4. Health status of more than 40% of male and female children were very poor. Prevalence of low health status is more in male than female counterpart.

#### 4. DISCUSSION

Several studies have investigated the nutritional status of children from different parts of India. In India alone there are approximately 60 million children who are underweight [9]. The aim of this study was to assess nutritional status of primary school children in, suburban area of West Bengal, India. Three different indices were used to calculate the nutritional status for the children viz. height- for- age, weight- for- height and weight- for- age [15]. The height-for-age index examines the linear growth and is used as an indicator of chronic undernutrition. The weight-for-height index compare body mass to body length and indicates acute undernutrition. Weight-for-age is a composite measure of both chronic and acute malnutrition. The best indicator of child health is growth. It is a dynamic and continuous process and is influenced by intrinsic (genetic) and extrinsic (environmental) factors including nutrition and hygiene. Children do not fulfill their growth according to genetic potential if their basic nutritional needs are not met and leads to stature deficit (stunting) for that age [16].

Study population suffering undernutrition like stunting (the height-for-age less than reference value), thinness (BMI-for-age below reference) and underweight (the weight-for-age less than reference value) which supports previous observations on health status of developing countries [17]. High prevalence of stunting

among school-age girls in comparison with boys in my study supports previous observation of Abdel Wahed et al. [18]. Over nutrition like higher body weight than standard and overweight and/or obesity was noted in study children. Thus results of this study indicates dual burden of malnutrition among school-age children which coincides with previous observations [19,20].

Undernutrition coincides with the finding of RI. More than 40% children of either gender enjoy very low health status and more than 15% with high health status. Prevalence of malnutrition among girls is less in comparison with boys. Similar observation was noted in school children of Andhra Pradesh, India [21]. Prevalence of stunting and overweight and/or obese was more among female children than male counterpart. However prevalence of underweight and thinness was more in male children. Similar pattern of nutritional status was noted in children of Burdwan district [8].

Malnutrition is a major public health crisis in developing nation like India. Stunting, underweight and wasting indicate long term undernutrition. Thus children of study region are said to have prolong deficiency of nutrition. However, significant percentage of children either overweight or obese due to prolong over intake of calorie and proteins than requirement.

Undernutrition is a primary cause of ill health, loss of millions of lives and many more millions of children are not growing and developing to their full potential. Overweight and obesity are the cause of ill health and risk of various disease in future life like hypertension, hyperglycemia and cardiovascular diseases. Nutrition is core pillar of human development thus large scale programming not only can reduce the burden of malnutrition but can also enhance the progress of nations.

**Table 4. Comparison of prevalence of undernutrition of children according to height for age on the basis of IAP and NCHS reference value**

Sex	Age	n	IAP				NCHS			
			Grade-0	Grade-1	Grade-2	Grade-3	Grade-0	Grade-1	Grade-2	Grade-3
Female	6	67	28 (41.8%)	38 (56.7%)	0	0	23 (34.3%)	43 (64.2%)	0	0
	7	99	26 (26.3%)	70 (70.7)	0	0	21 (21.2%)	78 (78.8%)	0	0
	8	230	107 (46.5%)	110 (47.8%)	0	0	95 (41.3%)	127 (55.2%)	0	0
	9	213	80 (37.6%)	125 (58.7%)	0	0	60 (28.2%)	147 (69.1%)	0	0
Male	6	67	38 (56.7%)	11 16.4(%)	0	0	15 (22.5%)	38 (56.7%)	0	0
	7	132	60 (45.5%)	3 (2.3%)	0	0	98 (74.2%)	8 (6.0%)	0	0
	8	141	85 (60.3%)	18 (12.8%)	0	0	24 (17.0%)	29 (20.6%)	0	0
	9	187	125 (16.8%)	21 (11.2%)	0	0	137(73.3%)	25(13.4%)	0	0

**Table 5. Comparison of prevalence of over nutrition of children according to height for age on the basis of IAP and NCHS reference value**

Sex	Age	n	IAP				NCHS			
			Grade-0	Grade-1	Grade-2	Grade-3	Grade-0	Grade-1	Grade-2	Grade-3
Female	6	67	1 (1.5%)	0	0	0	1 (1.5%)	0	0	0
	7	99	0	0	0	0	0	0	0	0
	8	230	8 (3.5%)	0	0	0	4 (1.7%)	0	0	0
	9	213	7 (3.3%)	0	0	0	5 (2.3%)	0	0	0
Male	6	67	14 (20.9%)	0	0	0	11 (16.4%)	0	0	0
	7	132	68 (51.5%)	0	0	0	25 (18.9%)	0	0	0
	8	141	56 (39.7%)	0	0	0	37 (26.2%)	0	0	0
	9	187	41 (20.9%)	0	0	0	15 (8.0%)	0	0	0

**Table 6. Comparison of prevalence of under nutrition of children according to weight for age on the basis of IAP and NCHS reference value**

Sex	Age (year)	n	IAP				NCHS			
			Grade-0	Grade-1	Grade-2	Grade-3	Grade-0	Grade-1	Grade-2	Grade-3
Female	6	67	13 (19.4%)	33(49.3%)	5 (7.5%)	0	7 (10.5%)	29 (43.3%)	22 (32.8%)	0
	7	99	21 (21.2%)	39 (39.4%)	6 (6.1%)	0	13 (13.1%)	37 (37.4%)	43 (43.4%)	0
	8	230	35 (15.2%)	50 (21.8%)	16 (7.0%)	0	34 (14.8%)	67 (29.1%)	61 (26.5%)	6 (2.6%)
	9	213	42 (19.7%)	62 (29.1%)	13 (6.1%)	4 (1.9%)	17 (8.0%)	56 (26.3%)	62 (29.1%)	18 (8.5%)
Male	6	67	8 (11.9%)	34(50.7%)	10 (14.9%)	4 (6.0%)	5 (7.5%)	17 (25.4%)	28 (41.8%)	3 (4.5%)
	7	132	22 (16.7%)	46 (34.8%)	12 (9.1%)	1(0.8%)	16 (12.1%)	47 (35.6%)	31 (23.5%)	4(3.0%)
	8	141	20 (14.2%)	53 (37.6%)	29(20.6%)	4 (2.8%)	18 (12.8%)	39 (27.7%)	55 (39.0%)	15 (10.6%)
	9	187	39 (20.9%)	70 (37.4%)	26 (13.9%)	4 (2.1%)	9 (4.8%)	68 (36.4%)	70 (37.4%)	11 (5.9%)

**Table 7. Comparison of prevalence of over nutrition of children according to weight for age on the basis of IAP and NCHS reference value**

Sex	Age (year)	n	IAP				NCHS			
			Grade-0	Grade-1	Grade-2	Grade-3	Grade-0	Grade-1	Grade-2	Grade-3
Female	6	67	7 (10.4%)	1 (1.5%)	7(10.4%)	1(1.5%)	1(1.5%)	7(10.4%)	1(1.5%)	0
	7	99	27 (27.3%)	0	6 (6.1%)	0	0	6 (6.1%)	0	0
	8	230	32 (13.9%)	31 (13.5%)	18 (7.8%)	38 (16.5%)	20 (8.7%)	17 (7.3%)	7 (3.0%)	18 (7.8%)
	9	213	15 (7.0%)	26 (12.2%)	20 (9.4%)	30 (14.1%)	21 (9.9%)	16 (7.5%)	12 (5.6%)	10 (4.7)
Male	6	67	2 (3.0%)	2 (3.0%)	0	7 (10.5%)	4 (6.0%)	0	2(3.0%)	5 (7.5%)
	7	132	8 (6.1%)	15 (11.4%)	9 (6.8%)	8 (6.1%)	5 (3.8%)	9 (6.8%)	2 (1.5%)	8 (6.1%)
	8	141	15 (10.6%)	6 (4.3%)	7 (5.0%)	7 (5.0%)	3 (2.1%)	7 (5.0%)	5 (3.5%)	2 (1.4%)
	9	187	24 (12.8%)	10 (5.3%)	12 (6.4%)	5 (2.7%)	17 (9.1%)	8 (4.3%)	1 (0.5%)	3 (1.6%)

**Table 8. Comparison of prevalence of undernutrition of children according to BMI for age on the basis of IAP and NCHS reference value**

Sex	Age	n	IAP				NCHS			
			Grade-0	Grade-1	Grade-2	Grade-3	Grade-0	Grade-1	Grade-2	Grade-3
Female	6	67	17 (25.3%)	32 (47.8%)	0	0	24 (35.8%)	32 (47.8%)	3 (4.5%)	0
	7	99	33 (33.3%)	45 (45.5%)	0	0	18 (18.2%)	63 (63.6%)	5 (5.0%)	0
	118	230	39 (17.0%)	81 (35.2%)	3 (1.0%)	0	43 (18.7%)	97 (42.2%)	18 (7.8%)	0
	9	213	54 (25.4%)	56 (26.3%)	5 (2.3%)	0	29 (13.6%)	92 (43.2%)	14 (6.6%)	0
Male	6	67	14 (20.9%)	41 (61.2%)	1 (1.5%)	0	8 (11.9%)	43 (64.2%)	7 (10.4%)	0
	7	132	42 (31.8%)	45 (34.1%)	3 (2.3%)	0	26 (19.7%)	64 (48.5%)	9 (6.8%)	0
	118	141	5 (3.5%)	51 (36.2%)	5 (3.5%)	0	24 (17.0%)	82 (58.2%)	13 (9.2%)	0
	9	187	74 (39.6%)	56 (29.9%)	3 (1.6%)	0	48 (25.7%)	93 (49.7%)	14 (7.5%)	0

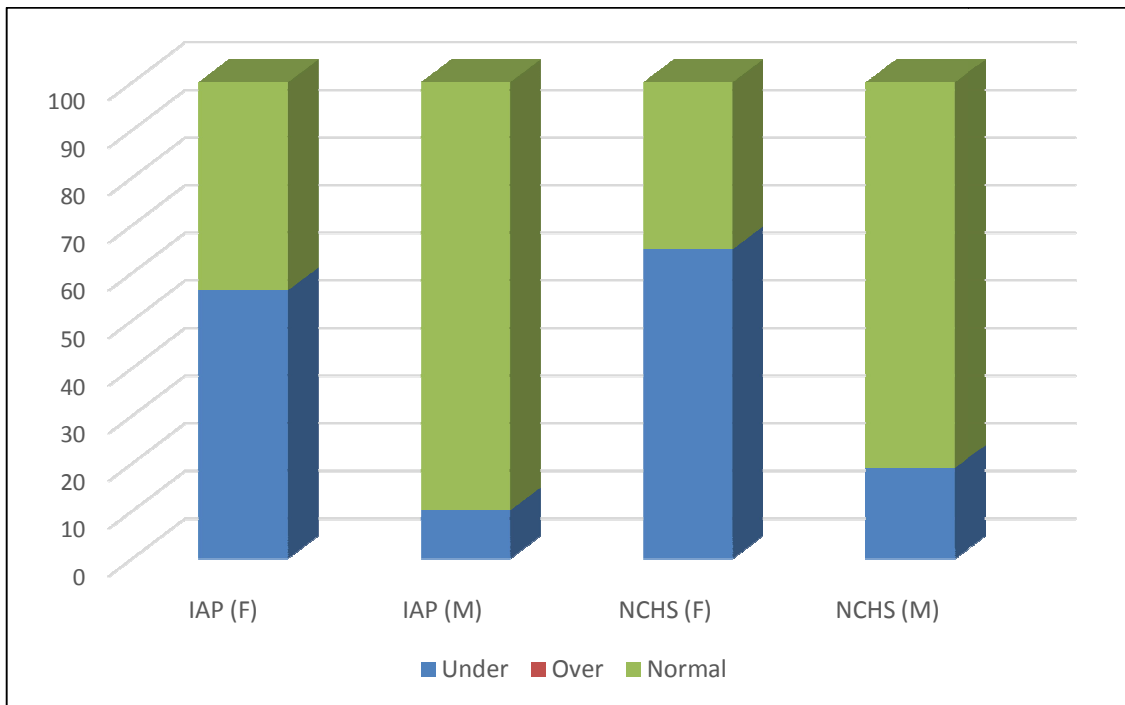
**Table 9. Comparison of prevalence of over nutrition of children according to BMI for age on the basis of IAP and NCHS reference value**

Sex	Age	n	IAP				NCHS			
			Grade-0	Grade-1	Grade-2	Grade-3	Grade-0	Grade-1	Grade-2	Grade-3
Female	6	67	11 (16.4%)	6 (9.0%)	0	0	4 (6.0%)	3 (94.5%)	1 (1.5%)	0
	7	99	9 (9.1%)	11 (11.1%)	1 (1.0%)	0	11 (11.1%)	2 (2.0%)	0	0
	8	230	44 (19.1%)	28 (12.2%)	19 (8.3%)	16 (7.0%)	25 (10.9%)	26 (11.3%)	11 (4.8%)	10 (4.3%)
	9	213	26 (12.2%)	35 (16.4%)	22 (10.3%)	14 (6.6%)	44 (20.7%)	27 (12.7%)	12 (5.6%)	4 (1.9%)
Male	6	67	2 (3.0%)	2 (3.0%)	2 (3.0%)	5 (7.5%)	1(1.5%)	3 (4.5%)	0	5 (7.5%)
	7	132	17 (12.9%)	10 (7.6%)	10 (7.6%)	5 (3.8%)	15 (11.4%)	9(6.8%)	5 (3.8%)	4 (3.0%)
	8	141	3 (2.2%)	10 (7.1%)	7 (5.0%)	4 (2.8%)	17 (12.1%)	7 (5.0%)	6 (4.3%)	2 (1.4%)
	9	187	27 (14.4%)	15 (8.0%)	6 (3.2%)	6 (3.2%)	16 (8.6%)	9 (4.8%)	3 (1.6%)	4 (2.1%)

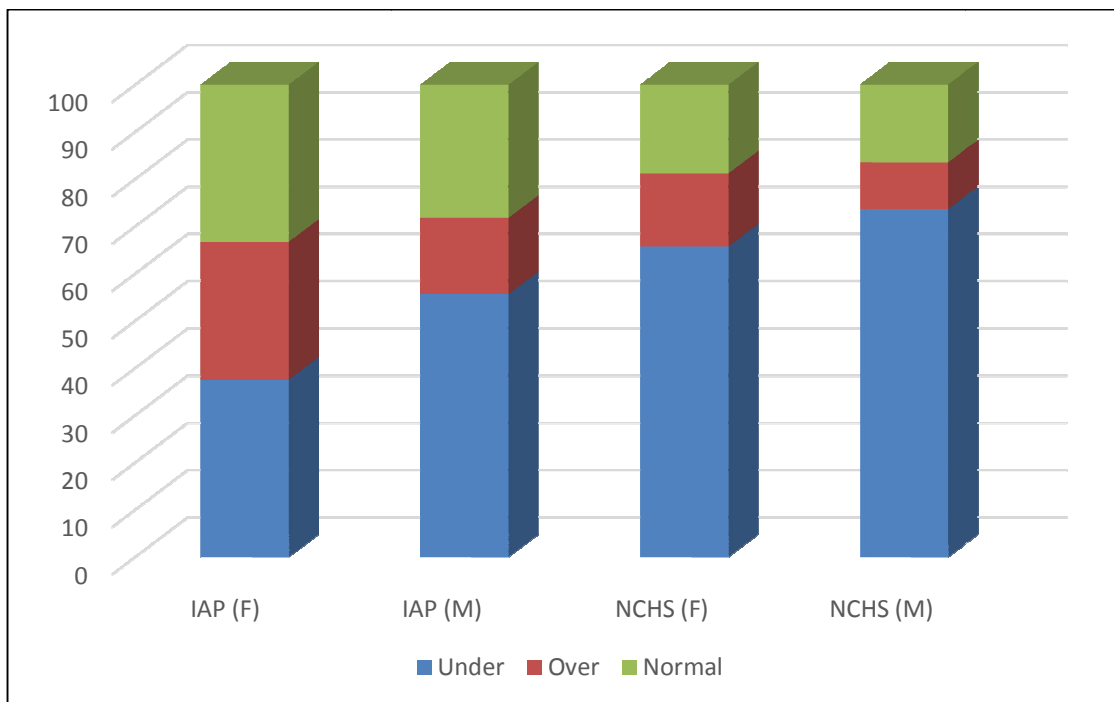
**Table 10. Health status of children according to Rohrer Index**

Sex	Age (year)	n	Rohrer Index				
			≤1.12 (Very low)	1.13-1.19 (Low)	1.20-1.32 (Middle)	1.33-1.39 (High)	≥1.40 (Very high)
Female	6	67	25 (37.3%)	14 (20.9%)	7 (10.5%)	16 (23.9%)	5 (7.5%)
	7	99	44 (44.4%)	24 (24.2%)	16 (16.2%)	8 (8.1%)	7 (7.1%)
	8	230	91(39.6%)	34 (14.8%)	44 (19.1%)	13 (5.7%)	48 (20.9%)
	9	213	85 (39.9%)	32 (15.0%)	48 (22.5%)	16 (7.5%)	32 (15.0%)
Male	6	67	27 (40.3%)	11(16.4%)	19 (28.4%)	0	10 (14.9%)
	7	132	46 (34.8%)	37 (28.0%)	23 (17.4%)	8 (6.1%)	18 (13.6%)
	8	141	65 (46.1%)	36 (25.5%)	19 (13.5%)	7 (5.0%)	14 (9.9%)
	9	187	86 (46.0%)	39 (20.9%)	39(20.9%)	8 (4.3%)	15 (8.0%)

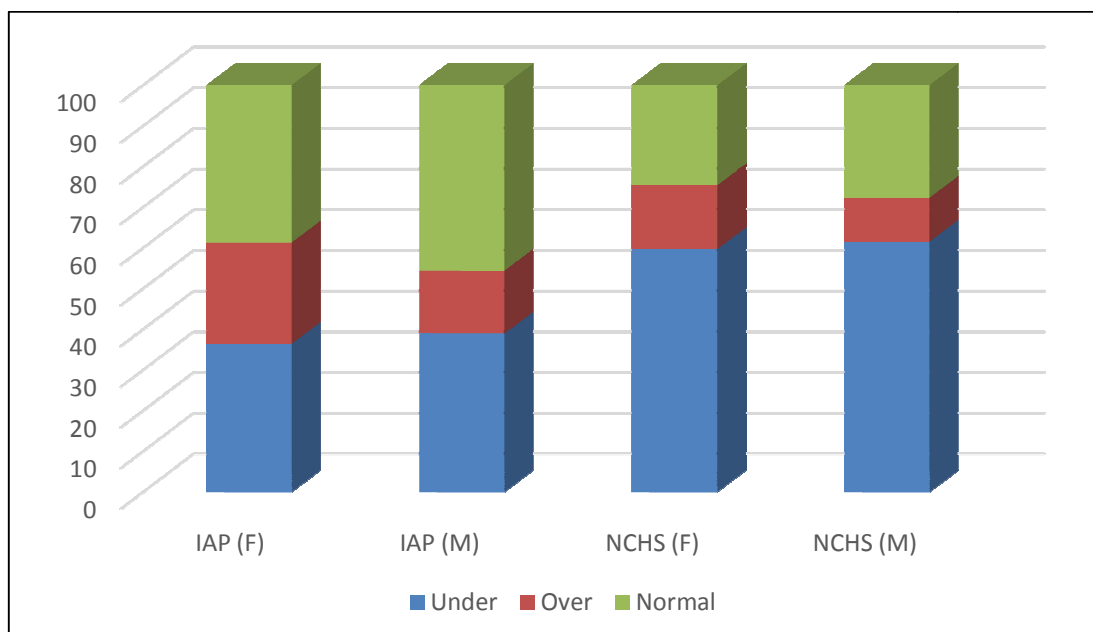




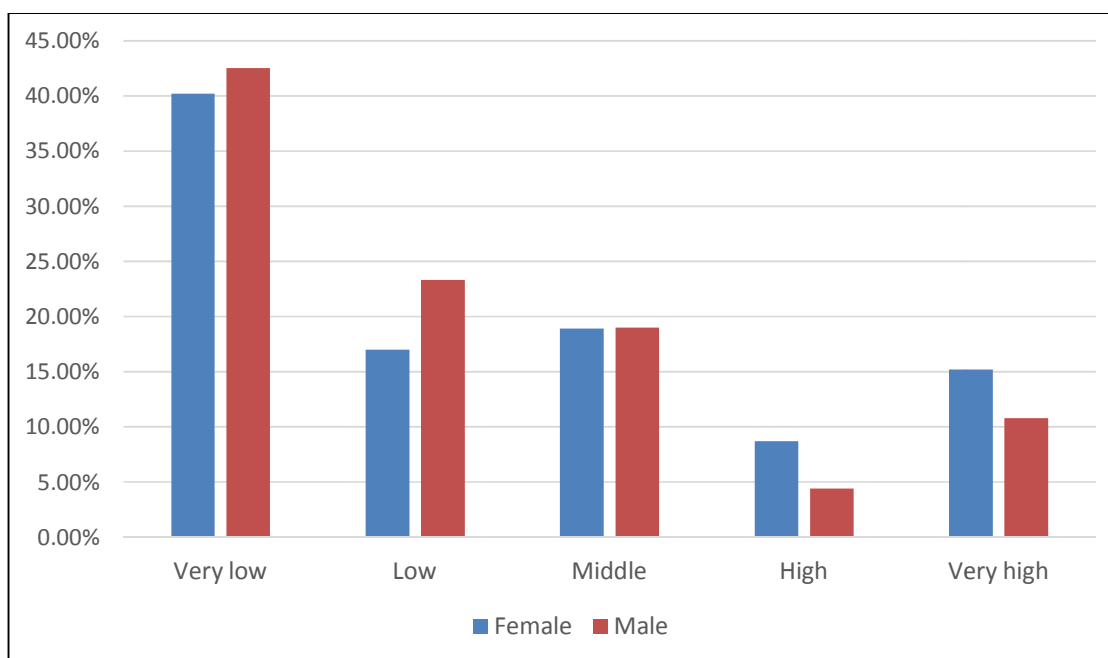
**Fig. 1. Comparison of nutritional status of male and female children in respect to height for age**



**Fig. 2. Comparison of nutritional status of male and female children in respect to weight for age**



**Fig. 3. Comparison of nutritional status of male and female children in respect to BMI for age**



**Fig. 4. Comparison of nutritional status of male and female children on the basis of Rohrer index**

## 5. LIMITATION

This study was conducted with cross sectional study design so it does not show cause and effect relationship.

## 6. CONCLUSION

The present study highlights the nutritional status of primary school going children having age limit 6 and 9 years of suburban area of West Bengal,

India. It shows coexistence of both undernutrition and over nutrition i.e., double burden of malnutrition. The prevalence of malnutrition in boys is more than girls and may be due to economic status of parents and family, lack of knowledge on nutritional importance and poor dietary habits among school boys.

The recommendation to improve health status of school-age children are as follows:

- School need take initiative to improve knowledge and awareness of personal hygiene and nutrition.
- Health education should be included as a part of curriculum apart from regular educational activities.
- Policy makers should take steps for alleviation of poverty by creation of facilities to improve economic status of population in the study area.
- Creation of awareness for local production of healthy and hygienic fresh foods.
- Avoids junk foods.

## CONSENT

This study was non-invasive. The prior written permission of the school authority was taken. Written consent from the parents of the students experimented in this study was obtained.

## ETHICAL APPROVAL

Ethical clearance was obtained from Institutional Ethical Committee for Research on Human Participants, Hooghly Mohsin College, Chinsurah, Hooghly, West Bengal.

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## COMPETING INTERESTS

Author has declared that no competing interests exist.

## REFERENCES

1. UNICEF: Global Nutritional Database, Based on multiple indicator Cluster

- Surveys (MICS), Demographic and Health Surveys (DHS) and other national Surveys; 2012.
2. Krishnan L. Nutritional status of children in tribal communities of Wayanad, Dissertation Achutha Menon centre for Health Science Studies, Sree Chitra Tirunal Institute for Medical Sciences and Technology. Thiruvananthapuram, Kerala, India; 2004.
  3. DeOnis M, MonterionC, Akre J, Clugston G. The worldwide magnitude of protein-energy malnutrition: An overview from the WHO Global database on child growth. *Bulletin of the World Health Organization*. 1993;71(6):703-712.
  4. Waterlow John C, Buzina R, Keller W, Lane MJ, Nichaman MZ, James MT. The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. *Bulletin of the WHO*. 1977;55(4): 489-498.
  5. Kanade AN, Joshi SB, Rao S. Undernutrition and adolescent growth among rural Indian boys. *Indian Pediatr*. 1999;36:145-156.
  6. Sing N, Mishra CP. Nutritional status of adolescent girls of a slum community of Varanasi. *Indian J Pub Health*. 2001;45: 128-134.
  7. Basu SK, Datta Banik S. Anthropometric assessment of health and nutritional status of the adolescent Bhutia boys and girls at Gangtok, Sikkim. *Indian J multidisciplinary Res*. 2006;2:149-160.
  8. Pramanik P, Bose Banerjee S, Dey S. Prevalence of undernutrition and poor health status among primary school children in Burdwan, West Bengal. 2015; 3(5A):1851-1857.
  9. United Nations Administrative Committee. Nutrition for improved development outcomes, 5<sup>th</sup> report on the world nutrition status, United Nations Administrative Committee on Coordination/Standing Committee on nutrition, Geneva, Switzerland; 2004.
  10. Smith LC, Ruel MT, Ndiaye A. Why is child malnutrition lower in urban than in rural areas? Evidence from 36 developing countries. *World Development*. 2005;33 (8):1285-1305.
  11. Mendez MA, Monteiro CA, Popkin BM. Overweight exceed underweight among women in most developing countries. *Am. J Clin Nutr*. 2005;81(3):714-721.

12. Srihari G, Eilander A, Mathayya S, Kurpad AV, Seshadri S. Nutritional status of affluent Indian school children: What and how much do we know. *Indian Pediatr.* 2007;44(3):204-213.
13. Goswami AK, Kalaivani M, Gupta SK, Nongkynrih B, Pandav CS. Usefulness of mid upper arm circumference in the assessment of nutritional status of elderly persons in urban India. *Int J Med Public Health.* 2018;8(1):34-37.
14. DeAlmeida CAN, Ricco RG, Nogueira MPC, Ciampo LAD, Mucillo G. Comparison of four anthropometric methods of nutritional assessment and evaluation of the agreement between two reference populations. *J Tropical Pediatrics.* 1999; 45:345-349.
15. Receiver Operating Characteristic (ROC) curves to identify anthropometric indices to predict nutritional status of the Hill Korwa children of Sarguja District, Chhattisgarh. *Int J Pharmacy Biol Sci.* 2019;9(1):283-288.
16. Sichieri R, Taddei JA, Everhart JE. Influence of parental height and sociodemographic factors on adolescent height. *J Adolescent Health.* 2000;26:414-419.
17. De-Onis M, Blossner M, Borghi E. Prevalence and trends of stunting among preschool children 1991-2020. *Pub Health Nutr.* 2012;15:142-148.
18. Abdel Wahed WY, Hassan SK, Eldessouki R. Malnutrition and its associated factors among rural school children in Fayoum Governorate, Egypt. *J Env Pub Health;* 2017. Available:<https://doi.org/10.1155/2017/4783791>.
19. Kapoor SK, Anand K. Nutritional transition: a public health challenge in developing countries. *J Epidemiol Commun Health.* 2002;56(11):804-805.
20. Caleyachetty R, Rudnicka AR, Echouffo-Tcheugui JB, Siegel KR, Richardson N, Whincup PH. Prevalence of overweight, obesity and thinness in 9-10 years old children in Mauritius. *Globalization Health.* 2012;8:28.
21. Sasikala P. Assessment of nutritional status of boys and girls in Government school children in Rompicherla, Mandal, Andhra Pradesh, India. *J Edu Prac.* 2016;7(10): 140-144.

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