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ASSESSMENT OF UNDER- NUTRITION USING COMPOSITE INDEX OF ANTHROPOMETRIC FAILURE (CIAF) AMONG THE SCHOOL CHILDREN OF NORTH 24 PARGANAS DISTRICT OF WEST BENGAL, INDIA

ABSTRACT: Malnutrition is a serious problem present in varying proportion in developing countries and is quite enhanced in Indian context. In spite of several initiatives and policy interventions being taken up by Government of India, the problem of under- nutrition is still persisting in Indian scenario. This problem of under -nutrition not only impedes the cognitive and psychological development of a child but stands to be an obstacle in the pathway of country's socio-economic development. Against this backdrop, the present study is an endeavour to evaluate the overall prevalence of under-nutrition among the school children (Government and private) using Composite Index of Anthropometric Failure (CIAF) of North 24 Parganas district of West Bengal, India. A total of 330 children (164 boys and 166 girls), aged 3 to 8 years were selected from both the schools. The children were classified as under - weight, stunting and wasting if their weight-for-age, height-for-age, and weight-for-height Z-scores were below -2SD (WHO, 2006). The results of the study revealed that the prevalence of under-weight, stunting and wasting (age and sex combined) was high (20.60%, 13.30%, and 33.30%) among the Government school children when compared with the children of the private school (14.50%, 6.10%, 17.60%). CIAF showed a higher prevalence of under-nutrition (44.81%) among the children of Government school compared to the children of private school (26.70%). Moreover, the children also experienced multiple anthropometric failures. Thus, by disintegrating the undernourished children into different groups helps to identify children who are vulnerable and also proves to be worthy to identify the children suffering from single or multiple anthropometric failures. Various nutritional programmes are required to improve the overall nutritional status of the children. Nevertheless, the present study provides an open platform for further researches and instigates the policy makers to take necessary action as and when required.

KEY WORDS: Composite Index of Anthropometric Failure (CIAF) - Stunting - Under-nutrition - Underweight - Wasting - Z scores

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INTRODUCTION

Child under-nutrition is the major public health issue in many developing countries such as India. It also continues to be one of the principal causes of ill-health and premature mortality and morbidity among children of these countries (Black 2003, Nandy 2005, Pelleitier 1994, Sen *et al.* 2011). Among the low and middle income countries, which accounts for considerable proportion of under-nourished children in the world, the condition is found to be more worsened in case of Asian countries (WHO 1999). It has been estimated by World Health Organisation (WHO) that 60.0% of 10.9 million deaths that occur annually among children of less than five years of age in the developing nations are associated with under-nutrition (Sen *et al.* 2011, WHO 2002). It has been found that developing nations accounts for 98% of the world's undernourished people and two third of the developing countries' unprivileged people lives in Bangladesh, China, Democratic Republic of Congo, Ethiopia, India, Indonesia, Pakistan and China where India and china alone accounts for 40%, (Ramachandram 2012). It is well documented that about 46% of children below five years of age in South Asia is moderately or severely underweight (Ratan 1997). Half of the world's malnourished children are to be found in only three countries; India, Bangladesh and Pakistan (Ratan 1997)

In the last five decades, mortality rates have come down by 50% and the fertility rate by 40% but reduction in under-nutrition is only 20%. In spite of the relatively slow reduction in child under-nutrition in India, the country can still accelerate the rate of reduction in childhood under-nutrition and under five mortality rates by ensuing early detection and effective management of both under-nutrition and infections (WHO 1995, Lee 2003). Children are the future of our nation and therefore their health and nutritional condition is of utmost importance. India accounts for about 40% of under-nourished children in the world which contribute to high morbidity and mortality in the country (Levinson 1998). Inadequate diets and infections are associated with poor nutrition (NFHS-2, 1999). In India, children living in urban slums, those belonging to the socially backward group like schedule caste and tribal communities are highly susceptible to under-nutrition. The malnourished or under-nourished status of children is worst among the Scheduled tribe communities (Mitra *et al.* 2007). In India, one-half of the children under five years of age, are moderately to severely malnourished.20% of children under five years of age suffer from wasting due to acute under-nutrition, more than one third of the world's children who are wasted live in India (Levison 1998). 43% of Indian children under five years are underweight and 48% are stunted due to chronic under-nutrition (Levison 1998). India accounts for more than three out of every 10 stunted children in the world (Pande, Singru 2012). In the context of Indian scenario, considerable malnutrition has been found among the school going children. Several studies has accounted the variable rates of under-nutrition for the school going students, showing such proportion to be higher among the children of Government school (Rashmi 2015). Several initiatives has been taken by the Government to curb the problem of under-nutrition in school going children, but the increased morbidity among such children is still a matter of great concern (Joice *et al.* 2009). Child growth is the universalized tool to assessadequate nutrition, health and development ofindividual children, and to estimate overall nutritionalstatus and health of populations. Compared to otherhealth assessment tools, measuring child growth is arelatively inexpensive, easy to perform and non-invasiveprocess (Lee 2003, Goswami 2016).

Nutrition is a core pillar of human development and concrete large-scale programming not only can reduce the burden of under- nutrition and deprivation but also advances in the progress of the nation. (Pande, Singru 2012).The anthropometric measurements of height and weight along with age have been conventionally used to evaluate child under-nutrition (Sen *et al.* 2011, WHO 1995). For assessment of childhood nutrition, generally stunting (low height for age),underweight (low height for age) or wasting (low weight for height) following different internationally and regionally recommended standards were followed (WHO 1995). According to the World Health Organisation, these three indices reflect distinct biological processes and are useful for determining appropriate nutritional interventions (Sen *et al.* 2011, WHO 1995). However, in due course of time, these conventional indices are not found to be appropriate. Developmental economists Peter Svedberg found these indices to be insufficient for measuring the overall prevalence of under-nutrition among young children (Sverberg 2000). It has been stated that these conventional indices allow for the categorization of children into the general categories of under-nutrition and do not provide an opportunity to determine the overall prevalence of under-nutrition that is associated with

multiple failures (Berger 2008, Nandy *et al.* 2005, Svedberg 2000). Subsequently, the concept of Composite Index of Anthropometric Failure (CIAF) was opinedby Peter Svedbrg in the year 2000. The Composite Index of Anthropometric Failure (CIAF) is made up of typical anthropometric indicators and their combination is thus classified into seven categories. It thus proposes to be an additional measure to study malnutrition and as an alternative to the evaluation of stunting, wasting and underweight as separate measures (Bejarano 2014). Composite Index of Anthropometric Failure (CIAF) can be therefore regarded as a single anthropometric measurement, providing an overall estimate of undernourishment in children (Svedberg 2000, Nandy *et al.* 2005, Sen *et al.* 2011). The original model proposed by Svedberg in the year 2000, comprises of six sub-groups of anthropometric failures (Group A-F) later on in the year 2005 (Nandy *et al.* 2005) added one more subgroup (Group Y). The CIAF includes those children who experience stunting, classification under-weight, wasting and multiple failures (Group B-Y) and excludes those children who do not exhibit any anthropometric failure (Group A). The combination of "wasted and stunted" is not included in the CIAF classification as it is physically impossible for a child to simultaneously experience stunting and wasting and not be under-weight (Nandy *et al.* 2005, Sen *et al.* 2011).Thus, this Composite Index of Anthropometric Failure (CIAF) incorporates all undernourished children in a single category and highlights the severity of a population's overall under-nutrition more precisely than the three conventional measures discussed above (Goswami 2016).

The present study assessed the nutritional status and estimated the overall prevalence of under-nutrition (CIAF) among the school going children of North 24 Parganas district of West Bengal of a private English medium school and a Government Bengali medium school.

MATERIALS AND METHODS

The present study was conducted among 330 school children (164 boys and 166 girls) aged between 03-08 years belonging to a Private English medium school (165 children) and a Government Bengali medium school (165 children). The private school charges high monthly fees while Government school charges no fees for the students. The children coming to the private school mostly hails from the nearby locality and their parents are involved in Governmental or private services or business and the children attending the Government school are mostly slum - dwellers whose parents are either daily wage labourers or involved in small scale businesses. 84 boys and 81 girls selected out of 165 children were selected from the private school. 80 boys and 85 girls selected out of total 165 children from the Government school.

Data was collected after obtaining the consent from the school authorities. Anthropometric measurements like height and weight were taken following the standard procedure (Weiner, Lourie 1981). Height has been measured with the help of Martin's Anthropometer nearest to 0.1 cm. The weight of the children were measured using portable weighing scale nearest to 0.5 Kg. Children are thus considered to be underweight, stunted and wasted respectively when the z scores pertaining to weight-for-age, height-for-age, weight-for-height and were found to be less than -2SD. This was based on the conventional international guidelines provided by World Health Organisation (WHO 2006) which is shown in the *Table 1.* Thus, three commonly used under-nutrition indicators, i.e., underweight (low weight-for-age), stunting (low height-for-age), and wasting (low weight-for-height) were used to evaluate the CIAF of the total children.

TABLE 1: Anthropometric indices and Cut-off points for Children to Assess the Severity of Malnutrition (According to WHO 2006).

Indicator	Meaning	Cut-off points
Underweight	Low Weight-for-Age (WAZ)	<-2SD
Stunting	Low Height-for-Age (HAZ)	<-2SD
Wasting	Low Weight-for-height (WHZ)	<-2SD

The values of Z-scores determines the number of under - weight(WAZ<-2SD), stunted (HAZ<-2SD), and wasted (WHZ<-2SD) children. The children on the basis of Z scores were categorized as per the different sub groups of under-nutrition. *Table 2* represents the classification of children and the overall prevalence of under-nutrition using the Composite Index of Anthropometric Failure (CIAF). The CIAF excludes children who are not in anthropometric failure (Group A), i. e. children with height and weight appropriate for

their age andincludes children who have underweight, stunting or wasting and thus are found to experience one or more forms of anthropometric failures (group B to Y). The current study utilised the Z score system to evaluate the conventional indices of stunting, wasting and underweight and CIAF to estimate the overall prevalence of under-nutrition between the children of the two selected schools.

Various statistical test like t-test and Fischer exact test was done to determine the sex difference in mean height and weight and different age groups between no failure and CIAF among the private and Government school children. Fischer exact test was also performed to assess sex difference in the subgroups of the CIAF, that is, to check the homogeneity of the nutritional status among the subgroups. A p-value of less than 0.05 was considered as statistically significant.

TABLE 2: Classification of Children for the Assessment of Anthropometric Failure (CIAF) according to Nandy *et al.* (2005).

Group Name	Description	Wasting	Stunting	Underweight
A	No Failure	No	No	No
B	Wasting only	Yes	No	No
C	Wasting and underweight	Yes	No	Yes
D	Wasting, stunting and underweight	Yes	Yes	Yes
E	Stunting and under weight	No	Yes	Yes
F	Stunting only	No	Yes	No
Y	Underweight only	No	No	Yes

TABLE 3: Mean (SD) height and weight of the school children aged 03–08 years. Figures in parentheses are standard deviation. *t-test was done, †Sex differences in height and weight is found to be non-significant at $p<0.05$.

PRIVATE SCHOOL						
Age (years)	Boys (n=84)			Girls (n=81)		
	n	Height (cm)	Weight (kg)	n	Height (cm)	Weight (kg)
3	15	101.17(4.50)	14.90(5.08)	15	100.97(5.42)	14.23(4.32)
4	15	107.62(4.75)	17.23(4.54)	15	106.86(5.56)	17.06(4.56)
5	15	111.57(3.94)	21.06(3.97)	15	110.32(4.40)	20.56(6.84)
6	13	121.26(4.96)	25.07(4.27)	12	119.87(5.97)	24.71(7.66)
7	13	128.80(8.09)	26.81(5.20)	12	120.24(10.67)	26.58(5.72)
8	13	135.20(4.79)	29.20(5.40)	12	134.80(5.06)	34.40(6.75)
GOVERNMENT CHOOL						
Age (years)			Boys (n=80)			Girls (n=85)
	n	Height (cm)	Weight (kg)	n	Height (cm)	Weight (kg)
3	15	99.21(5.84)	9.93(1.99)	15	98.52(4.49)	9.63(1.26)
4	15	102.34(5.96)	11.73(4.58)	15	101.93(5.44)	12.43(2.56)
5	15	106.09(4.07)	15.50(2.63)	15	104.72(4.37)	16.33(4.36)
6	11	117.0(7.98)	19.68(20.21)	14	116.08(9.24)	20.21(4.51)
7	11	122.17(8.17)	20.21(4.68)	14	126.30(8.56)	25.76(5.75)
8	13	135.08(7.33)	28.04(3.31)	12	133.98(9.82)	29.86(7.28)

RESULTS

The mean height and weight of the children (boys and girls) of both (private and Government school) is presented in *Table 3*. It is evident from the table that the height of both boys and girls increases with increasing age. Similar trend is also observed in case of weight. The boys tend to be taller and heavier than girls but no significant sex difference were found between the boys and the girls.

Table 4 represents the rates of underweight, stunting and wasting among these children of private and Government school. The overall age and sex combined prevalence of underweight, stunting, wasting were 14.60%, 6.10%, and 17.60% respectively among the children of pre-school and 20.60%, 13.30%, 33.90% respectively among the Government school children (*Figure 1*). Among the school children, maximum prevalence of under- nutrition (underweight, stunting, and wasting) was observed among the girls of 06 years and 07 years (sex and age specific). Moreover, the prevalence of wasting was quite high (40.0%) among both the boys and girls of 03 years. But no reported case of stunting was found in the same age group. Similarly among the Government school children, maximum percentage of under- nutrition (underweight,

TABLE 4: Prevalence of under – nutrition among school children for age group 03–08 years. Figures in parentheses are percentages.

PRIVATE SCHOOL													
	Age in years												N=165
	03		04		05		06		07		08		
	Boys n=15	Girls n=15	Boys n=15	Girls n=15	Boys n=15	Girls n=15	Boys n=13	Girls n=12	Boys n=13	Girls n=12	Boys n=13	Girls n=12	Overall age and sex combined
underweight	5(3.34)	3(20.00)	4(2.67)	2(13.34)	1(6.6)7)	2(13.34)	3(23.07)	2(16.67)	0	0	2(15.38)	0	24(14.54)
Stunting	0	0	1(6.67)	2(13.34)	0	1(6.67)	1(7.69)	2(16.67)	0	2(16.67)	1(7.69)	0	10(6.06)
Wasting	6(40.0)	6(40.0)	4(2.67)	4(2.67)	1(6.67)	2(13.34)	1(7.69)	2(16.67)	0	1(8.34)	1(7.69)	1(8.34)	29(17.57)
GOVERNMENT SCHOOL													
	Age in years												Total (%)
	03		04		05		06		07		08		
	Boys n=15	Girls n=15	Boys n=15	Girls n=15	Boys n=15	Girls n=15	Boys n=11	Girls n=14	Boys n=11	Girls n=14	Boys n=13	Girls n=12	Overall age and sex combined
underweight	2(13.34)	1(6.67)	5(3.34)	1(6.67)	4(26.67)	6(6.66)	3(27.28)	3(27.28)	2(18.18)	3(21.42)	2(15.38)	2(16.67)	34(20.61)
Stunting	0	1(6.67)	2(13.34)	1(6.67)	2(13.34)	2(13.34)	2(18.18)	3(21.42)	2(18.18)	3(21.42)	2(15.38)	2(16.67)	22(13.33)
Wasting	9(60.0)	10(6.67)	5(3.34)	8(53.34)	5(3.34)	6(6.66)	3(27.78)	4(28.37)	1(9.09)	1(7.14)	3(23.070	1(8.33)	56(33.33)

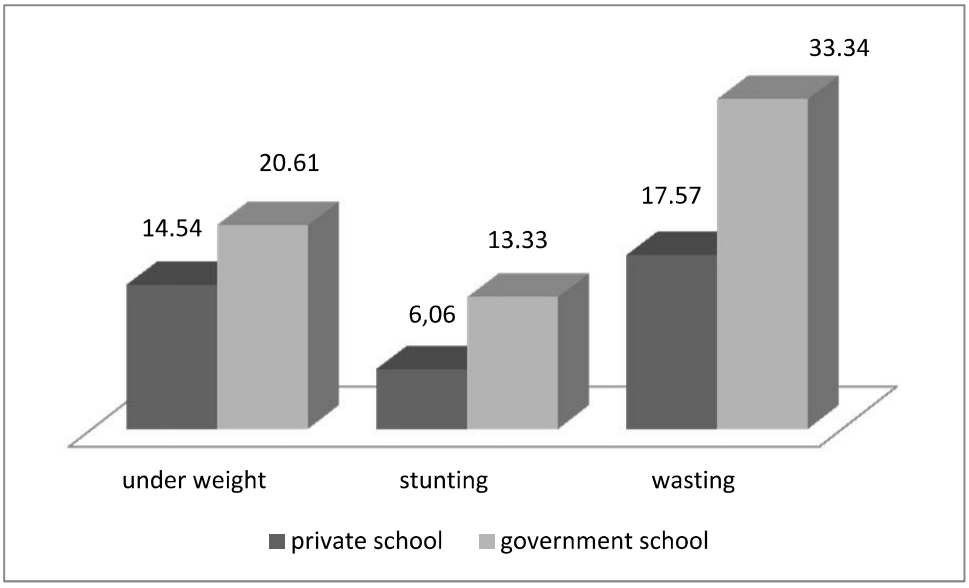

FIGURE 1: Prevalence of Under-nutrition (%) using different indicators.

stunting and wasting) was observed among the boys and girls of 06 years and 07 years. Prevalence of wasting was high among the girls (53.30%) of 04 years and boys (60.00%) of 03 years.

Tables 5a and *5b* represent the proportion of children (private and Government school) on each of the subgroups (B-Y) of anthropometric failure. Children who are only wasted (group-B) and wasting and underweight (group- C) showed higher prevalence among both the private school (9.10%, 7.30%) and Government school children (20.60%, 8.50%). However, prevalence of multiple anthropometric failure were also observed among the children of both the schools but more predominant among the children of Government school than the children of private school. The overall prevalence of under -nutrition on the basis of CIAF was 26.70% among the private school and 44.80% among the Government school children, i.e. 26.70% (private school) children and 44.80% Government school children are suffering from anthropometric failure in comparison to other three conventional indicators (underweight, stunting and wasting) as in *Figure 2*.

The results indicate that the overall prevalence of under-nutrition was found to be highest in group B of both the private and Government school children (private – 9.09%; Government – 20.60%) followed by group C (private – 7.27%; Government – 8.48%). The incidence of stunting only (Group F) and underweight only (Group Y) were 3.03% and 4.24% among the children of private school and the incidence of wasting, stunting and underweight (Group D) and stunting and underweight (Group E) were 6.67% and 4.84% respectively among the Government school children. Thus multiple anthropometric failures (Group D, E and C) are more pronounced among the children of Government school. It was further observed in case of age and sex, the girls were found to be more affected than their boys' counterpart. However, sex difference was not statistically significant ($p>0.05$) in the different age groups with respect to CIAF and no failure among the private school and Government school children.

The sex specific prevalence of the children suffering from single and multiple failures of the CIAF (groups B – Y) are depicted in *Table 6*. Using Fischer exact test analysis, sex differences were not statistically significant ($p>0.05$) when the data was split into different subgroups of CIAF (Group B-Y) among the private and Government school children.

DISCUSSIONS

Under -nutrition is acknowledged to play a major role in premature deaths of millions of children aged below five years in developing countries (Black *et al.* 2003). Malnutrition makes a child susceptible to infections and delays recovery, thus increasing

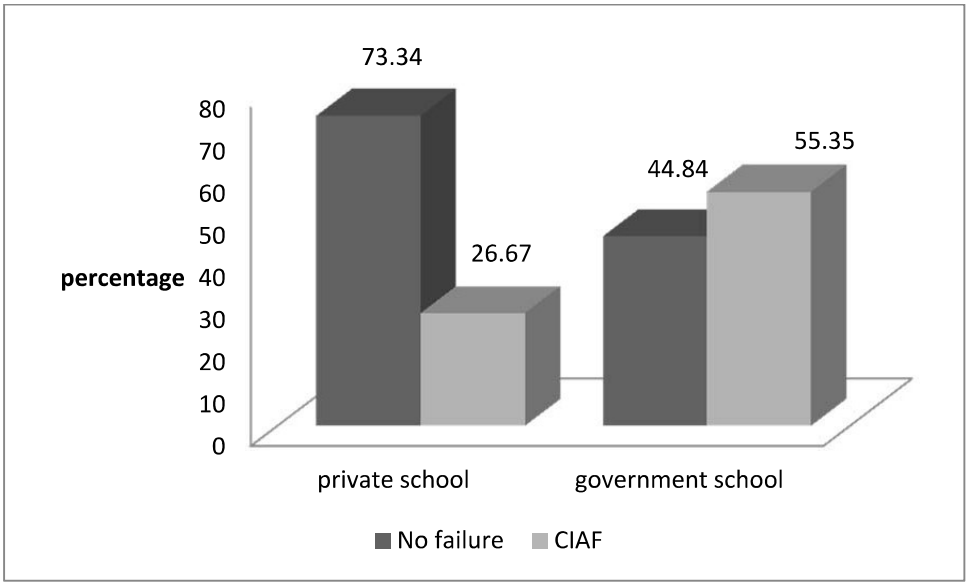

FIGURE 2: Prevalence of under – nutrition using Composite Index of Anthropometric Failure (CIAF).

TABLE 5a: Subgroups of Anthropometric Failure among the Studied Children of private school aged 03–08 years. Figures in parentheses are percentages. No statistically significant differences was found between boys and girls of the private school pertaining to each age for different subgroups of anthropometric failures.

Group	Age in years												Total (%)
	03		04		05		06		07		08		
	Boys n=15	Girls n=15	Boys n=15	Girls n=15	Boys n=15	Girls n=15	Boys n=13	Girls n=12	Boys n=13	Girls n=12	Boys n=13	Girls n=12	Overall age and sex combined (n-165)
Group A (No Failure)	7(46.67)	8(53.34)	9(60.00)	10(66.67)	14(93.34)	12(80.00)	9(69.23)	9(75.00)	13(100)	9(75.00)	10(76.92)	11(91.67)	121(73.34)
Group B (Wasting only)	3(20.00)	4(26.67)	1(6.67)	3(20.00)	_	1(6.67)	1(7.69)	_	_	1(8.34)	_	1(8.34)	15(9.09)
Group C (Wasting &Under weight)	3(20.00)	2(13.34)	3(20.00)	_	1(6.67)	1(6.67)	_	1(8.34)	_	_	1(7.69)	_	12(7.27)
Group D (Wasting, stunting &under weight)	_	_	_	1(6.67)	_	_	_	1(8.34)	_	_	_	_	2(1.21)
Group E (Stunting &Under weight)	_	_	_	1(6.67)	_	1(6.67)	1(7.69)	_	_	_	_	_	3(1.81)
Group F (Stunting only)	_	_	1(6.67)	_	_	_	_	1(8.34)	_	2(16.67)	1(7.69)	_	5(3.03)
Group Y (Underweight only)	2(13.34)	1(6.67)	1(6.67)	_	_	_	2(15.38)	_	_	_	1(7.69)	_	7(4.24)
CIAF	8(53.34)	7(46.67)	6(40.0)	5(33.34)	1(6.67)	3(20.0)	4(30.76)	3(25.00)	0	3(25.00)	3(23.07)	1(8.34)	44(26.67)

TABLE 5b: Subgroups of Anthropometric Failure among the Studied Children of Government School aged 03–08 years. Figures in parentheses are percentages. No statistically significant differences was found between boys and girls of the Government school pertaining to each age for different subgroups of anthropometric failures.

Group	Age in years												Total (%)
	03		04		05		06		07		08		
	Boys n=15	Girls n=15	Boys n=15	Girls n=15	Boys n=15	Girls n=15	Boys n=11	Girls n=14	Boys n=11	Girls n=14	Boys n=13	Girls n=12	Overall age and sex combined (n-165)
Group A (No Failure)	6(40.00)	4(2.67)	8(53.34)	6(40.00)	8(53.34)	7(46.67)	5(45.54)	9(64.28)	8(72.72)	11(78.57)	10(76.92)	9(75.00)	91(55.15)
Group B (Wasting only)	7(46.67)	9(60.00)	2(13.34)	7(46.67)	3(20.00)	2(13.34)	2(18.18)	1(7.14)	_	_	_	1(8.34)	34(20.60)
Group C (Wasting &Under weight)	2(13.34)	1(6.67)	3(20.00)	1(13.34)	1(6.67)	2(13.34)	1(9.09)	2(14.28)	1(9.09)	_	_	_	14(8.48)
Group D (Wasting, stunting &under weight)	_	1(6.67)	_	1(13.34)	1(6.67)	2(13.34)	1(9.09)	1(7.14)	_	1(7.14)	2(15.38)	1(8.34)	11(6.67)
Group E (Stunting &Under weight)	_	_	2(13.34)	_	1(6.67)	_	1(9.09)	_	1(9.09)	2(14.28)	_	1(8.34)	8(4.84)
Group F (Stunting only)	_	_	_	_	_	_	_	1(7.14)	1(9.09)	_	1(7.69)	_	3(1.81)
Group Y (Underweight only)	_	_	_	_	1(6.67)	2(13.34)	1(9.09)	_	_	_	_	_	4(2.42)
CIAF	9(60.00)	11(73.34)	7(46.67)	9(60.00)	7(46.67)	8(53.34)	6(54.45)	5(35.71)	3(27.27)	3(21.42)	3(23.07)	3(25.00)	74(44.84)

TABLE 6: Prevalence of under -nutrition using different categories of anthropometric failure (CIAF) among children of private and Government school. * Fisher exact test was done for sex difference. †No significant sex differences was found in the CIAF subgroups in case of both private and Government school.

Groups	Description	Private school			Government school		
		Boys (%)	Girls (%)	Total (%)	Boys(%)	Girls (%)	Total (%)
A	No Failure	62(51.23)	59(48.76)	121(100.00)	45(49.45)	46(50.54)	91(100.00)
B	Wasting only	5(33.34)	10(66.67)	15(100.00)	14(41.17)	20(58.82)	34(100.00)
C	Wasting & Under weight	8(66.67)	4(33.34)	12(100.00)	8(57.14)	6(42.85)	14(100.00)
D	Wasting, stunting & under weight	0(00.00)	2(100.00)	2(100.00)	4(36.36)	7(63.63)	11(100.00)
E	Stunting & Under weight	1(33.34)	2(66.67)	3(100.00)	5(62.50)	3(37.50)	8(100.00)
F	Stunting only	2(40.00)	3(60.00)	5(100.00)	2(66.67)	1(33.34)	3(100.00)
Y	Underweight only	5(71.42)	2(28.57)	7(100.00)	2(50.00)	2(50.00)	4(100.00)
CIAF		22(50.00)	22(50.00)	44(100.00)	35(47.29)	39(52.70)	74(100.00)

mortality and morbidity (Mandal 2009). Malnutrition in children especially under five years of age remains to be one of the most serious health problems in developing countries (Bharati *et al.* 2008, Goswami 2016). It has been reported that India has the highest incidence of childhood malnutrition in the world (Bamji 2003) and reports from World Bank of year 2005 has indicated that 47% of children below the age of five years were malnourished. Several studies reported that though the time trend of under nourished children in India is showing a decline pattern, but the pace of reduction is not matching the criterion set by United Nations Development Project (UNDP) under millennium development goals for India (Gupta *et al.* 2015, UNICEF 2014). Therefore, there is an increasing need to address the issue of under-nutrition in children.Only a handful of studies have been reported on the overall prevalence of under-nutrition among Indian children using CIAF (Bose 2009, Biswas *et al.* 2009, Das, Bose 2009, Mandal *et al.* 2011, Mukhopadhyay *et al.* 2009, Nandy *et al.* 2005, Seetharaman *et al.* 2007). But nutritional assessment using CIAF among the children of private and Government school was meagre. CIAF provides a single framework and serves to be an appropriate single measure to assess the magnitude of under-nutrition and identify susceptible groups in a population (Sen *et al.* 2011). The present study is an endeavour to evaluate the levels of underweight, stunting, wasting and also to assess the overall prevalence of under-nutrition by using CIAF among the private and Government school children of Kolkata.

The overall prevalence of underweight, stunting, and wasting was slightly better among the children of private school (underweight - 14.54%, stunting - 6.06%, wasting - 17.57%) than the children of Government school (underweight - 20.60%, stunting - 13.33%, wasting - 33.94%). The rate of under-nutrition among the children of private school is more or less consistent with the findings of Fazili *et al.* (2012) and Bandhopadhyay *et al.* (1998). The rate of under-nutrition was higher among the Governmentschool children that go in accordance with Goswami *et al.* (2016) and Gupta *et al.* (2015). However, the present study demonstrated better results compared to other studies from West Bengal (Bisai *et al.* 2009, Chowdhury *et al.* 2008, Giri *et al.* 2017, Sinha *et al.* 2012) and also in India (Ashok *et al.* 2014, Hassan *et al.* 2010, Mendhi *et al.* 2006, Mitra *et al.* 2007, Nigudgi *et al.* 2012, Nvaneethan *et al.* 2011, Sati, Dahiya 2012, Solanki *et al.* 2014) compared to the figures demonstrated for both the school in the given study. Moreover, in the present study the prevalence of underweight, stunting and wasting was less than the figures indicated in National Family Health Survey reports (NFHS-3) conducted in the year 2005-2006 (underweight - 34.60%, stunting - 45.70%, wasting - 17.30%). This may be due to the urban outset, awareness and facilities, improved lifestyle and better

TABLE 7: Prevalence of CIAF in children: A comparison from other studies from India as well as West Bengal.

	STUDIES FROM WEST BENGAL				
SL NO	SAMPLE SIZE(N)	AGE GROUPS (YEARS)	STUDY AREA	CIAF(%)	SOURCE
1.	1012	02-06	Hooghly district, West Bengal	73.10	Mondol, Bose 2009
2.	347	02-06	Puruliya, West Bengal	66.30	Das, Bose 2009
3.	256	01-03	Darjeeling, West Bengal	65.60	Mukhopadhyay *et al.* 2009
4.	2016	03-5.9	Nadia district, West Bengal	60.40	Biswas *et al.* 2009
6.	1143	01-04	Muslim Bengali population from North Bengal	57.60	Sen *et al.* 2011
7.	225	03-06	Purba Midnipur, West Bengal	50.20	Acharya *et al.* 2013
	STUDIES FROM INDIA (EXCEPT WEST BENGAL)				
8.	NFHS-2 (1998/199)	0-05	National Average	59.80	Nandy 2005
9.	405	0-05	Coimbature, Tamil Nadu	68.60	Seetharam *et al.* 2007
10.	372	0-05	Ahmedabad, Gujarat	60.50	Solanki *et al.* 2014
11.	602	0-03	Raipur, Chhattisgarh	62.10	Boregowda *et al.* 2015
12.	634	02-04	Slums in Mumbai, Maharashtra	47.80	Savanur, Ghugre 2015
13.	246	0-05	Slums of Nagpur, Maharashtra	58.59	Dhok, Thakre 2016
14.	136	01-06	Balasore, Odisha	54.40	Goswami 2016

employment opportunities which in turn enhance their socio-economic status which enables the individuals to provide better nutritious diet to the children. Report from UNICEF (2007), also further elaborated the fact that there has been declining trends in underweight between 1992 and 1998 and between 1998 and 2005 and numerous factors might have influenced this decline in stunting including the rapid economic growth India has experienced between 1990 and 2007. But despite of such declining trends, the absolute rates of under -nutrition in India continue to be higher than the majority of developing countries (UNICEF 2007, Giri *et al.* 2017).

Studies from West Bengal too reflected a higher percentage expressing the value of children suffering from anthropometric failures. These includes, studies conducted by Mondol and Bose (2009; 73.10%), Biswas and Bose (2009; 66.30%), Mukhopadhayay *et al.* (2009; 65.60%), Biswas *et al.* (2009; 60.40%), Sen *et al.* (2011; 57.60%), Mukhopadhayay and Biswas (2011; 69.10%), Acharya *et al.* (2013; 50.20%).Very few studies have been reported from India which has dealt with CIAF especially in school going children (Fazili *et al.* 2012). Several studies conducted in different states of India showed variable values of CIAF which is considerably higher than the findings from present study.These include Nandy *et al.* (2005; 59.8%), Seetharam *et al.* (2007; 68.6%), Solanki *et al.* (2014; 60.50%), Boregowda *et al.* (2015; 62.10%), Savanur and Ghugre (2015), Dhok and Thakre (2016; 58.59%), Goswami (2016; 54.40%). In contrary to all these studies, another recent study conducted among under-five children from Chennai, Tamil Nadu showed a lesser value for CIAF (37.00%) (Shanthi *et al.* 2017) compared to the findings from Government school. The present study shows that the overall prevalence of under-nutrition (by CIAF) was higher among the children of Government school (44.80%) compared to the children of private school (26.77%). The result of the private school children is in accordance with Fazili *et al.* (2012; 25.60%) and that of Government school children go with Savanur and Ghugre (2015; 47.80%).

It must be noted have that the findings of the present study are in congruence with those, who reported higher rates of CIAF compared to the other three (underweight, stunting and wasting) more conventional measures of under-nutrition (Bharati *et al.* 2008, Fazili *et al.* 2012). Although under-nutrition measured by CIAF is considerably lower than that recorded in other studies, but this scenario is extremely alarming (Biswas *et al.* 2009, Das, Bose 2009, Mukhopadhyay, Biswas 2011). The problem is much alarming for those children who are suffering multiple anthropometric failures and are more likely to experience ill-health and were at more risks of dying than those with single anthropometric failures (Goswami 2016). The findings of widespread prevalence of under-nutrition among the children of West Bengal and India is presented in *Table 7.*

Several studies are now being done worldwide which validates the utility of CIAF. These includes investigations from Kenya (Berger *et al.* 2008); South Asia and South Africa (Harttgen, Misselhorn 2006), China (Dang, Yan 2007), Botswana (Mahgoub *et al.* 2009), and Cameroon (Emina 2009).However all these studies found high rates of under-nutrition measured by CIAF. This situation seems to be very upsetting since childhood is the foundation for both physiological and psychological development. The present study is limited by its small sample size, being only from one area of North 24 Parganas, West Bengal, India. These results will not only allow us to compare the rates of three conventional means of under-nutrition with CIAF, but also establishes the effectiveness a use of CIAF.

CONCLUSION

The present study explicated the overall prevalence of under-nutrition using Z score & CIAF among the children (03 to 08 years) of a private school and a Government school. The study reveals that 26.70% Private instead of pre-school children and 44.80% of Government school children had some form of anthropometric failure and the children also experienced multiple anthropometric failure. The situation of Government school is more distressing in all respect. The present study by disintegrating the undernourished children into different groups helps to identify children who are vulnerable and thus proves to be worthy of recognising children who are suffering from single and multiple anthropometric failures. Therefore more and more studies are recommended not only from North 24 Parganas of West Bengal but also from different parts of India utilising the Composite Index of Anthropometric Failure (CIAF). This in the long run will provide a podium and leave impact on framing Governmental policies pertaining to nutritional supplementation programmes for children.

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