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Nutritional Assessment by Composite Index of Anthropometric Failure among School Going Children of Purba Medinipur, West Bengal, India

P. Khanra[1], S. Biswas[2] and K. Bose*[3]

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[1]Pikli Khanra, Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, INDIA. Email: pikli2011@gmail.com

[2]Dr. Sadaruddin Biswas, Department of Anthropology and Tribal Studies, Sidho-Kanho-Birsha University, P.O. – Purulia Sainik School, Ranchi Road, Purulia -723104, West Bengal. Email: sadarbiswas@gmail.com

[3]Prof. Kaushik Bose, Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, INDIA. Email: kaushikbose@cantab.net.

*Corresponding author: Prof. Kaushik Bose, Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, INDIA. Email: kaushikbose@cantab.net

ABSTRACT:

Aim*: This study was carried out to determine the prevalence of undernutrition among Bengalee children of Purba Medinipur. Stunting, wasting and underweight were used to assess the prevalence of under-nutrition among children. However, these indices were not properly determined appropriate prevalence due to overlapping condition, but Composite Index of Anthropometric Failure (CIAF) is a single measure to assess the prevalence of under-nutrition which is better than other indices for the determination of undernutrition among children.*

Methods: *This cross-sectional study was conducted among school going Bengalee children of Desopran block and Haldia municipality of Purba Medinipur district, West Bengal, India. Total no. of participants were 622 aged 6 to 10 years. Among them 307 and 315 were boys and girls, respectively. Age and sex specific nutritional status of the subjects was assessed using height-for-age, weight-for-height, and weight-for-age as per NCHS guidelines and CIAF (Composite Index of Anthropometric Failure) was also computed as per standard methodology.* ***Results****: Boys were taller and heavier than girls. Significant age variations were noticed in anthropometric variables. Prevalence of wasting, stunting and underweight were 21.0%, 31.0%, and 41.9%, respectively. Moreover, prevalence of CIAF was 55.3% among the studied children. Result also revealed that rate of CIAF was much higher than the other three conventional indicators.* ***Conclusion****: It can be concluded that undernutrition among the school going children was very high and might be treated as a serious health problem. Appropriate authorities should take immediate remedial measures to reduce the rate of undernutrition. Similar studies should also be conducted from other regions of West Bengal.*

Keywords: - Children, School, CIAF, Undernutrition, West Bengal, India.

INTRODUCTION:

Malnutrition, as the main cause of morbidity and mortality in infants and children under five years of age, accounts for at least half of all childhood death worldwide (Demissie et al., 2013, Meshram et al., 2012). Malnutrition results from the interaction of poor-quality diets and poor-quality health and care, environments and behaviors, which are shaped in part by a host of underlying factors, such as political instability, poor economic development, conflict, inequality, and some dimensions of globalization (Global Nutrition Report, 2016). Child undernutrition is an important issue of public health problem in many developing countries such as India (Pelletier 1994 and Dobe et al., 2005). India has the highest incidence of childhood undernutrition in the world (Bamji, 2003). India has diverse argo-climatic regions, ethnic multiplicities, socio-cultural practices and life styles that are vary between states as well as districts. Requirement of proper care of health and nutrition of school going children is very important at this stage and majority of children suffered from different type of malnutrition (WHO, 2005). Therefore, adequate nutrition is essential for growth and development of children. Poor nutrition leads to risk of illness and it is responsible to directly and indirectly, for child mortality (WHO, 2009). 160 countries, 89% reported having some type of school health and nutrition programme for under nutritional children. School health and nutrition programmes are actually "double duty actions" that can address both undernutrition and overweight and obesity (WHO, 2018). Even after six decades of independence, India has several health care services. Objective of the services, to provide adequate nutrition, to improve their health, nutritional status of children and developed their physical and mental ability, to reduce child mortality due to malnutrition and disease, to increase the enrolment in school, but now school children are still facing a serious under nutritional problem in India. In India 35.7%, 38.4% and 28.5% children are underweight, stunted and wasted respectively (NFHS-4). National Family Health Survey reported that (NFHS-4 of 2015-2016) 28% and 34.0% stunted, 16.7% and 21.6% wasted, 26.2% and 33.6% underweight among children aged under 5 years in urban and rural area respectively particularly in West Bengal.

Childhood is an important stage of human life, which is associated with human growth and development. Growth proceeds rapidly in early life and slows down in middle childhood (Bartolo, 2014). In respect of growing age, there is physical and psychomotor maturation, which influence activity, body composition, feeding skill and food choices (Geissler, 2011). Chronic under nutrition in school going children is closely related with their intellectual development. In later period, malnutrition reduces their quality of life and economic productivity (Scrimshaw, 1996). There is a two type of malnutrition i.e. over nutrition and under nutrition. Under nutrition includes stunting, wasting and under weight, which is result of lack of essential nutrient. Over nutrition includes overweight and obesity, which is result of excess of nutrition. This depends on genetic and environmental factors. Among children under nutrition is defined by following measurements Stunting (Low height for Age), under weight (Low weight for Age), Wasting (Low Weight for Height), Thinness (Low BMI for age) and Leanness (Low Skin Fold for Age) (WHO, 1995 & WHO, 2006). Stunting, wasting and underweight do not provide appropriate prevalence of undernutrition due to overlapping condition. Undernourished children may be suffered from

multiple categories of anthropometric failure. Composite Index of Anthropometric Failure (CIAF) has been used to determined single and multiple anthropometric failure condition in one measure. Overall prevalence of undernutrition is determined by CIAF, which is proposed by (Nandy et al.,2005). The original model, proposed by Svedberg 2000, proposed six categories (Group A-F) of undernutrition. Nandy et al 2005 combined another sub-group 'Y'. The CIAF includes group 'B-Y', indicate stunting, wasting, under-weight and multiple failure. Sub-group 'A' indicates those children who are not anthropometric failure. There are several studies on nutritional assessment, using the indices of stunting, wasting and underweight (Fazili et al 2012, Ray et al., 2013, Hooshmand et al., 2014, Yadav et al 2016, Eze et al., 2017) among school children. Some studies have been used CIAF to assessment of undernutrition among children aged less than 6 years (Das et al., 2011, Acharya et al 2013, Gupta et al 2017, Biswas et al 2018). Another study Sen et al., 2011, proposed a study on Bengalee Muslim Population aged 5 years to 11 years. CIAF and three indices were used to assess nutritional status among children aged 6 years to 10 years in the present study.

Objective:

The objective of the present study was to evaluate age and sex specific prevalence of undernutrition among school going children and also assess the severity of undernutrition by Composite Index of Anthropometric Failure (CIAF).

MATERIAL AND METHODS:

Study Area: This cross-sectional study was undertaken at Desopran block and Haldia Municipality of Purba Medinipur district, West Bengal, India. The study area is situated across the river Haldi. The district has long costal line of 65.5 km. along its southern and south eastern boundaries. There are major rivers situated in the south eastern side such as Haldi, Rupnarayan, Rosulpur, Bagui and Keleghai. The district of Purba Medinipur has a population of 5,094,238 and the literacy rate is 87.66% (2011 census). This District has 219,794 and 32,965 primary and middle school going children, respectively. Prior to commencement of study necessary ethical and administrative approval were taken from the appropriate authorities.

Sample Size: - The data were collected on the basis of the opportunity sampling method. The required sample size was calculated using the standard formula, i.e. $n = \frac{(Z\alpha)2 \times p \times q}{d2}$. It was assumed that prevalence of malnutrition in school going children to be 50%, with 10% degree of precision and α error of 5%. Thus, the largest required number was calculated as 400. Total participants of the study were 622 children aged 6-10 years (307 boys; 315 girls). Participants were selected through door to door visits. Age of the subjects was ascertained on the basis of birth certificate.

Anthropometric measurements: Data were collected for the study during the period December 2014 to April 2016. A trained investigator (PK) recorded all anthropometric measurements. Height (cm) and weight (kg) were measured using Martin anthopometer and spring balance weigh machine, respectively. Height and weight were recorded to nearest 0.1 cm and 0.5 kg, respectively.

All anthropometric measurements were taken according to standard procedure (Lohman et al., 1988).

Assessment of nutritional status:

Undernutrition:

Nutritional status was assessed using internationally accepted growth reference value of the National Centers for Health Statistics (NCHS, 1983).

Z-score = X – Median of NCHS / Standard deviation of NCHS

X is an individual value.

Three types of Z scores were calculated: Height-for-age Z-score (HAZ), Weight-for-age Z-score (WAZ) and Weight-for-height (WHZ). These represented stunting (HAZ), under-weight (WAZ) and wasting (WHZ). According to WHO, (1995), undernutrition was defined as Stunting (HAZ) = < -2SD; Underweight (WAZ) = < -2 and wasting (WHZ) = <-2.

Composite Index of Anthropometric Failure (CIAF):

Furthermore, after assessing of nutritional status of the subjects, the degree of severity of undernutrition was determined by Composite Index of Anthropometric Failure (CIAF**).** It was formulated on the basis of seven groups of categories (Nandy et al., 2005). The CIAF consists of those children were not in anthropometric failure (i.e. group A) and also included all the children who were wasted, stunted, or underweight (i.e. group B to F). Therefore, it gives us a single measure to assess the overall rate of undernutrition. Svedberg originally suggested six sub-groups of anthropometric failure (A to F). However, Nandy et al. (2005) identified an additional subgroup: one that includes children who are only underweight but are not stunted or wasted (Group – Y). Thus, ***Table 1*** represents the classification of children with CIAF. Another theoretical combination would be "wasted and stunted" but this is physically not possible since a child cannot simultaneously experience stunting and wasting and not being underweight (Nandy et al., 2005).

Statistical Analysis: -All statistical analyses were undertaken using SPSS-16 software. One Way ANOVA was performed to determine age variations in anthropometric variables. Student's t test was used to determine the sex differences in anthropometric characteristics.

RESULTS:

Anthropometric characteristics of subjects are presented in ***Table 2***. Generally, boys were taller and heavier than girls. Significant age variations in mean height and weight were observed. Height showed maximum age variations among girls ($F = 57.09$, $p < 0.001$) and boys ($F = 69.32$, $p < 0.001$). Boys aged 9 year were significantly taller ($t = 2.29$, $p < 0.05$) and heavier ($t = 2.53$, $p < 0.01$) than girls.

Overall, the prevalence of stunting, wasting and underweight among studied children were 31.0%, 21.7% and 41.9%, respectively (***Table 3***). Age specific maximum rates of stunting were

observed among boys (42.6%) and girls (41.9%) at the age of 7 and 9 years, respectively. The youngest group (6 years) of studied children showed maximum rate of wasting (boys: 33.3 %; girls: 30.6%). More than half (57.1%) of the boys at the age of 7 year were underweight. Similarly, half of the girls at the age of 9 year failed to achieve their normal weight with age (underweight).

The CIAF showed a different scenario in terms of undernutrition (***Table 3***). It was found that CIAF showed higher rates of undernutrition compared to the other three conventional undernutrition markers (stunting, wasting and underweight). Overall the prevalence of undernutrition based CIAF was similar in both sexes (boys = 54.1%; girls = 56.5%).

There were seven groups of anthropometric failure represented in ***Table 4***. Overall, 45.9% boys and 43.5% girls were indentified as having no failure which implied that these children did not possess any kind of undernutrition problems. Moreover, 6.2% of boys and 10.5% of girls were classified as wasted only. Among these children, 21.6 % suffered from both conditions of undeweight and stunting.

DISCUSSION:

The present study provides us information on nutritional status in a group of school going children of Purba Medinipur. Undernutrition is a major health problem in developing countries (Victora et al., 1986) like India. Composite Index of Anthropometric Failure is represent three indicators (stunting, wasting and underweight) of undernutrition in single measures. For nutritional assessment, CIAF is an important tool to identify the overall undernourished children. Undernutrition is closely associated with high rate of mortality and morbidity (Rice et al., 2000 and Collins, 2007) and undernourished children suffer from different type illness more than well-nourished children (Pelletier et al., 1995, Cunha, 2000).

Nandy et al., (2005) reported that 59.8% children were suffering from CIAF. Several investigations have reported the prevalence of CIAF among children of different states of India. Seetharaman et al. (2007) reported that 68.6% of Tamil children were undernourished, children from Uttar Pradesh (Agarwal et al., 2015), Jammu (Dewan et al., 2015) and Delhi (Gupta et al 2017) showed more or less similar prevalence of undernutrition based on CIAF. However, Kashmiri (Fazili et al., 2012) children showed lower rate undernutrition compared to the previous mentioned studies.

The present study was conducted among children aged 6 to 10 years. High rate of undernutrition was observed (55.3%) among these children. Prevalence of CIAF was higher than the other three conventional undernutrition markers. Over all prevalence of anthropometric failure and others three indices was 20.48% (stunting), 21.1% (wasting), 41.9% (underweight) and 55.3% (CIAF). 55.3% children were showed single and multiple anthropometric failures.

Recently some studies have reported the district specific rates of CIAF of West Bengal. Biswas et al., (2009) reported that 60.4 % preschool children of Chapra Block of Nadia district suffered from CIAF. Preschool children of Purulia district (Das and Bose, 2009) displayed a rate

of 66.3 %. Sinha and Maiti, (2014) reported that the prevalence of undermatron was 58.2 % among children from Midnapore town. Children from Singur of Hooghly district (Dasgupta et al., 2015) had an undernutrition rate of 32.7%. The children from Bankura town showed the highest prevalence of undernutrition (80.3%) based on CIAF (Shit at al., 2012). Another recent study in West Bengal has reported that 61.3% preschool going children suffered from CIAF (Biswas et al., 2018). Sen et al., (2011) reported that prevalence of CIAF was 57.6 % among Bengalee Muslim children aged 5 to 11 years old of Darjeeling district, West Bengal.

Based on these previous studies, it can be concluded that the rates of total undernutrition in India based on CIAF is very high. This situation is not only unsatisfactory but also very adverse since childhood is the foundation of both physiological and motor development.

There are some limitations of the present like small sample size and being only from two areas of Purba Medinipur district, West Bengal, India. Thus, these results may therefore only be representative of a small community and is not representative of the state or country. Therefore, to obtain a broader representation, more studies involving CIAF is to be undertaken among children of not only Purba Medinipur district but also from the different parts of West Bengal and India.

Conclusion: It may be concluded that the nutritional status of the subjects was unsatisfactory. Therefore nutritional supplements should be enhanced through Mid-Day meal programme to reduce the level of undernutrition. It also validated that the CIAF is a better index to asses nutritional status than traditional measures of stunting, wasting and underweight because it differentiates between overall and total anthropometric failure.

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Conflict of Interest:

We confirm that there are no known conflicts of interest associated with this publication.

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Table 1: Classification of children according to CIAF.

Group Name	Description	Wasting	Stunting	Underweight
A	No Failure	No	No	No
B	Wasting Only	Yes	No	No
C	Wasting & Underweight	Yes	No	Yes
D	Wasting, Stunting & Underweight	Yes	Yes	Yes
E	Stunting & Underweight	No	Yes	Yes
F	Stunting Only	No	Yes	No
Y	Underweight Only	No	No	Yes

Table 2: Sex-specific descriptive statistics of height and weight by age.

Age in Years	n		Height				t'	Weight				t'
	Boys	Girls	Boys		Girls			Boys		Girls		
			Mean	SD	Mean	SD		Mean	SD	Mean	SD	
6	63	62	113.44	5.06	112.34	4.92	**1.22**	17.8	2.78	17.05	2.97	**1.04**
7	61	61	115.94	5.69	115.20	6.13	**0.69**	18.47	3.02	18.12	3.54	**0.59**
8	61	63	122.22	6.84	120.84	7.71	**1.05**	20.69	3.07	20.23	3.91	**0.74**
9	60	62	126.99	8.21	123.52	8.49	**2.29***	23.80	4.43	21.72	4.63	**2.53****
10	62	67	131.64	8.91	129.69	8.60	**1.26**	25.75	5.78	25.05	6.03	**0.67**
			F = 69.32***		F = 57.09***			F = 46.67**		F = 34.29**		

* = p < 0.05, ** = p < 0.01, *** = p < 0.001

Table 3: Prevalence of undernutrition among the studied children.

Age in years	Stunting (%)			Wasting (%)			Underweight (%)			CIAF (%)		
	Boys	Girls	Sex combined	Boys	Girls	Sex combined	Boys	Girls	Sex combined	Boys	Girls	Sex combined
6	22.2	11.3	16.8	33.3	30.6	32.0	52.4	35.5	44.0	57.1	58.1	57.6
7	42.6	32.8	37.7	21.7	19.7	20.5	55.7	39.3	47.5	65.6	55.7	60.7
8	27.9	31.7	29.8	21.3	28.6	25.5	41.0	34.9	39.9	57.4	58.7	58.1
9	30.0	41.9	36.1	10.0	16.0	13.1	33.3	50.0	41.8	41.7	58.1	50.0
10	30.6	38.8	34.9	16.1	13.4	14.7	32.3	44.8	38.8	48.4	52.2	50.4
Overall	**30.66**	**6.132**	**31.0**	**20.48**	**21.66**	**21.1**	**42.94**	**40.9**	**41.96**	**54.04**	**56.56**	**55.30**

Table 4: Prevalence of undernutrition based on CIAF.

Group Name	Description	Boys	(%)	Girls	(%)	Sex Combined	(%)
A	**No Failure**	**141**	**45.9**	**137**	**43.5**	**278**	**44.7**
B	Wasting Only	19	6.2	33	10.5	52	8.4
C	Wasting & Underweight	34	11.1	16	5.1	50	8
D	Wasting, Stunting & Underweight	10	3.3	17	5.4	27	4.3
E	Stunting & Underweight	69	22.5	68	21.6	137	22
F	Stunting Only	17	5.5	13	4.1	30	4.8
Y	Underweight Only	17	5.5	31	9.8	48	7.7
CIAF (B to Y)		**166**	**54.1**	**178**	**56.5**	**344**	**55.3**
Total		**307**	**100**	**315**	**100**	**622**	**100**