

Overall burden of under-nutrition measured by a Composite Index in rural pre-school children in Purba Medinipur, West Bengal, India

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ABSTRACT: Malnutrition is a leading cause of child mortality in India. To counteract this problem, a nutrition supplementation programme has been operating under the Integrated Child Development Service (ICDS) scheme in India since 1975. Recently, the Composite Index of Anthropometric Failure (CIAF) has been implemented to measure the seriousness and severity of overall under-nutrition in a population. Since this index presents a more complete picture than the previous three conventional measures. CIAF is utilized in this study which focuses on the overall burden of under-nutrition determination in pre-school children in Purba Medinipur, West Bengal, India. Our study was conducted in 10 Integrated Child Development Service (ICDS) centres, commonly known as “Anganwadi”, in the villages of the Argoal Gram Panchayat at Patashpur – II block. The total sample of 225 Bengalee ethnic children aged between 3 and 6 years was composed of 115 girls and 110 boys. The overall age and gender-combined prevalence of stunting, underweight and wasting recorded was 30.7%, 42.7% and 12.0%, respectively, and these rates were considered high (30–39%), very high ($\geq 40\%$) and high (10–14%), respectively. CIAF results revealed the same trend, with 50.2% of these children affected by anthropometric failure, with the prevalence of underweight, wasting and CIAF higher in boys than in girls. This 50.2% CIAF result highlighted that approximately half the study children were undernourished. Since this figure is much higher than that estimated by any of the three conventional indicators, CIAF has thus proven a far better indicator in assessing the overall burden of under-nutrition in a population. The nutritional status of the children in this study requires serious remedial action.

KEY WORDS: under-nutrition, Composite Index of Anthropometric Failure, rural pre-school children, India

Introduction

Each country’s developmental status is increasingly judged world-wide on the nutritional status of its people; and the

future strength of a nation will be determined by the health and education of its people. Promoting optimum development in children is the responsibility of

every one (Lathia 1997; cited in Shah and Patel 2009), and here it is essential to recognize that a child's nutritional intake differs vastly from adults because their diet must provide not only for tissue replacement but also for growth (Kaushik 1997; cited in Shah and Patel 2009). Since children's health and nutritional status indicate national investment in the development of future manpower, national policies and schemes for children have assumed supreme importance in national development programmes. These must provide optimum conditions for balanced growth of the country's children, with the highest priority being placed on child health, in accordance with UNICEF (1990) objectives.

Malnutrition in children under five years of age is one of the most serious health problems in developing countries (Bharati et al. 2008), where this is the underlying cause of 3.5 million deaths and 35% of the disease burden in children in this age group (Black et al. 2008). Bryce et al. (2008) recorded that approximately 80% of the world's undernourished children live in just 20 countries in Africa, the Middle East, Asia and the Western Pacific. Malnutrition is also a major cause of child mortality in India, where the World Bank Report of 2005 confirmed that 47 percent of Indian children below the age of five were malnourished. Further evidence of the far-reaching scope of this problem is contained in the following research; (1) Bamji (2003) reported that India has the highest occurrence of childhood malnutrition in the world; (2). Mandal et al. (2010) noted that the scourge of under nutrition is most acute among rural children, and (3) Chatterjee and Saha (2008) determined that malnutrition not only increases a child's susceptibility to infections but also delays

recovery; thus increasing mortality and morbidity.

Nutrition supplement programmes were implemented on the 2nd of October 1975 by the Integrated Child Development Service (ICDS) in West Bengal and in the other states. This date coincided with the 106th anniversary of the birth of Mahatma Gandhi – the Father of the Nation. The scheme was launched to provide holistic development of children below 6 years of age and for adequate nutrition and health education of pregnant and lactating women. This programme expanded to include previously non-covered areas and is now universal throughout India. It encompasses almost all development blocks in India, where it adopts a multi-sectorial approach to child well-being. It incorporates health, education and nutrition interventions and is implemented at the community level by a network of "Anganwadi" centres. One ICDS centre now operates for approximately each 400–800 head of population. The anganwadi workers are locally called *Sebika*, and they form the most important part of the Anganwadi centre network (AWCs) providing the above services under the direction of the Ministry of Women and Child Development, Government of India, 2011.

Anthropometric parameters are utilized to determine the prevalence of under-nutrition in the studied populations. These provide a reliable method of assessing children's nutritional status (WHO 1995); with the following being the most commonly used and reliable indicators; *stunting* (low height-for-age), *underweight* (low weight-for-age) and *wasting* (low weight-for-height). These three indicators were used in the evaluation of our study subjects' nutritional status.

While stunting reflects a failure to reach linear growth potential due to sub-optimal health and or nutritional conditions, underweight indicates low body mass relative to chronological age influenced by both the child's height and weight, and wasting is an indicator of chronic under-nutrition resulting from prolonged food deprivation and or disease or illness. These three parameters have different clinical implications.

The developmental economist, Peter Svedberg (2000), initiated the term *anthropometric failure* as a new aggregate indicator of stunting, underweight and wasting. This parameter incorporates all undernourished children in a single category regardless of which of the three conditions, or combination of these conditions, affect them. This then led to construction of the *Composite Index of Anthropometric Failure* (CIAF) which has the distinct advantage that it highlights the absolute seriousness and severity of a population's overall under-nutrition more precisely than the three individual conventional measures (Mandal and Bose 2009). CIAF thus provides a composite estimate of the number of under-nourished children in a population not indicated by the conventional indices. Seetharaman et al. (2007) concurred that serious attempt at estimating the overall prevalence of under-nutrition in a population must integrate all categories in an aggregate index of under-nutrition. In addition, Das and Bose (2009) suggested that more studies involving CIAF among pre-school children from different parts of India should be undertaken to obtain a broader representation and a clearer picture of this nation's problems. Based on these precepts, this study focused on CIAF assessment of the overall burden of under-nutrition in rural pre-school

children in East-Medinipur, West Bengal, India.

Material and methods

Study area

This study was conducted in 10 Integrated Child Development Service (ICDS) (Anganwadi) centres in Argoal Gram Panchayat at Patashpur- II block villages in the Purba Medinipur district of West Bengal, India. The study covered all the ICDS centres of the Panchayat, comprising rural villages remotely located approximately 110 km from Kolkata, the state capital. These centres ran six days a week and catered for all inhabitants; 84.4% of whom were Hindus. In addition to pre-school education, the centres provided each child with food supplements in the form of 60 gms of rice and 20 gms of pulses each day and three eggs a week.

Study Participants

This was a cross-sectional study where subjects were chosen randomly by their presence at the centres on the survey day. The 115 girls and 110 boys, all of Bengalee ethnicity and aged between 3 and 6 years, provided the total sample of 225 subjects

Measurements

Following ethical permission obtained from Vidyasagar University Authorities, each subject's height in cm and weight in kg were recorded using Martin's anthropometer and the standard weighing machine, and following standard methodology (Lohman et al. 1988). This anthropometric data was collected during

March-April, 2008 by one of the authors (AA).

Questionnaire

In addition to these anthropometric measurements, information including age, gender and ethnicity was assembled from a pre-structured questionnaire. Additional information, for example, determined that participants were mostly from agricultural families with two or three children, including the participants.

Assessment of Nutritional Status

Stunting (low height-for-age), underweight (low weight-for-age) and wasting (low weight-for-height) were used to evaluate the Nutritional Status of Children as in the internationally accepted National Centre for Health Statistics (NCHS) age and gender specific – 2 Z-scores (Hamill et al. 1979).

$$Z\text{-score} = \frac{X - \text{Median of NCHS}}{\text{Standard deviation of NCHS}}$$

where X is an individual value.

Svedberg's model of the following six groups was employed to assess the children's CIAF; (1) stunted only, (2)

under-weight only, (3) wasted only, (4) wasting and underweight, (5) stunted and under-weight and (6) stunted, wasted and under-weight (Nandy et al. 2005). The results are listed in Table 1.

Statistical analysis

Following measurement and information collection, analysis was performed with the SPSS-PC package for social sciences (Version 7.5). The χ^2 value determined the significance of differences between genders in the studied pre-school children.

Results

Table 2 presents mean, standard deviation (SD) and Z-scores for height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ). The overall gender-combined mean (SD) HAZ, WAZ and WHZ were -1.53 (1.16), -1.79 (0.88) and -1.15 (0.87), respectively.

Table 3 shows the CIAF sub-groups of undernourished children; with 20.5% having single anthropometric failure (Groups B, F and Y) and 29.8% having multiple anthropometric failure (Groups C, D and E). After summation in Groups B-Y we found 50.2% of the children had a high prevalence of under-nutrition with

Table 1. Classification of children with anthropometric failure (CIAF)*

Group name	Description	Stunting	Underweight	Wasting
A	No failure	No	No	No
B	Wasting only	No	No	Yes
C	Wasting and underweight	No	Yes	Yes
D	Wasting, underweight and stunting	Yes	Yes	Yes
E	Stunting and underweight	Yes	Yes	No
F	Stunting only	Yes	No	No
Y	Underweight only	No	Yes	No

*Nandy et al., 2005

Another theoretical combination would be "wasted and stunted", but this is physically impossible because a child cannot simultaneously experience stunting and wasting and not be underweight.

Table 2. Mean and Standard Deviation WAZ, HAZ and WHZ Gender Scores

	HAZ	WAZ	WHZ
Boys (n=110)	-1.54 (1.03)*	-1.80 (0.85)	-1.19 (0.80)
Girls (n=115)	-1.42 (1.13)	-1.78 (0.95)	-1.21 (0.74)
Combined (n=225)	-1.53 (1.16)	-1.79 (0.88)	-1.15 (0.87)

*Standard Deviations are presented in parentheses

Table 3. Number and proportions (%) of Anthropometric Failure sub-groups

Categories	Boys (n=110)	Girls (n=115)	Combined (n=225)
A. Normal (No Failure)	52 (23.1)*	60 (26.7)	112 (49.8)
B. Wasting Only	2 (0.9)	0 (0.0)	2 (0.9)
C. Wasting and Underweight	10 (4.4)	3 (1.3)	13 (5.8)
D. Wasting, Stunting and Underweight	2 (0.9)	10 (4.4)	12 (5.3)
E. Stunting and Underweight	24 (10.7)	18 (8.0)	42 (18.7)
F. Stunting Only	7 (3.1)	8 (3.5)	15 (6.7)
Y. Underweight Only	13 (5.8)	16 (7.1)	29 (12.9)
Total CIAF (B+C+D+E+F+Y)	58 (25.8)	55 (24.4)	113 (50.2)

*Percentages are presented in parentheses and calculated on the total sample number; N=225.

some form of anthropometric failure, the table also indicates that the girl's nutritional status was slightly better than the boys.

The prevalence of stunting, underweight, wasting and CIAF for girls, boys and the combined genders is shown in Table 4. The overall age and gender-combined prevalence of stunting, underweight and wasting were 30.7%, 42.7% and 12.0%, respectively. These rates were high (30–39%), very high ($\geq 40\%$)

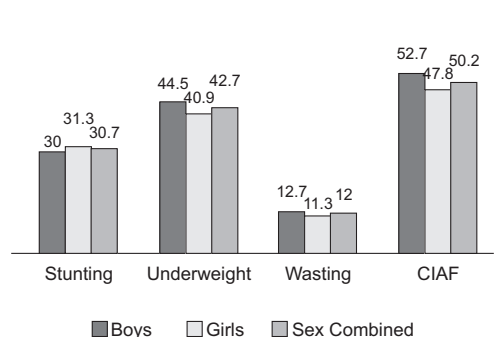


Fig. 1. Under-nutrition prevalence (%) using different indicators in the studied children

and high (10–14%), respectively, according to WHO (1995) classification of under-nutrition severity. The CIAF followed this trend with 50.2% children CIAF affected. Although the boys' prevalence of underweight, wasting and CIAF was higher than girls, and girls had a greater prevalence of stunting, there were no significant gender differences recorded in the studied children; stunting ($\chi^2=2.48$,

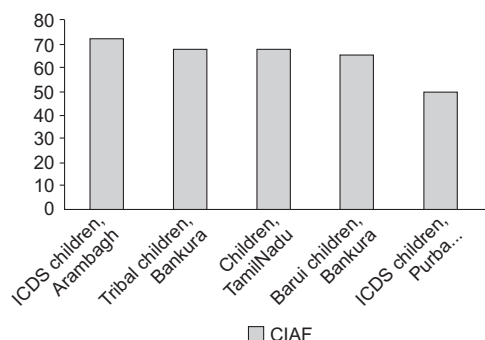


Fig. 2. CIAF prevalence (%); comparison with other studies

Table 4. Prevalence of under-nutrition in the subjects

Age Categories	Prevalence (%) of under-nutrition		
	Boys (N=110)	Girls (N=115)	Combined (N=225)
Stunted	30.0	31.3	30.7
Underweight	44.5	40.9	42.7
Wasted	12.7	11.3	12.0
CIAF	52.7	47.8	50.2

df=1), underweight ($\chi^2=0.31$, df=1) and wasting ($\chi^2=0.11$, df=1).

Discussion

Stunting, underweight and wasting are used as anthropometric indicators of under-nutrition in children. However, individually these three indicators can not adequately express the overall number or prevalence of undernourished children in a population, and they tend to conceal rather than reveal the real problem faced by a nation. Therefore, the newly constructed CIAF indicator is a current improvement in evaluating childhood population nutritional status.

The mean HAZ, WAZ and WHZ in this study had negative values. For WAZ this was approximately -2.0 (boys=1.80; girls=1.78), and WHZ values were generally lower than HAZ and WAZ, thus indicating poor current nutritional status. In contrast to WHZ, WAZ indicates current nutritional condition as opposed to low HAZ which indicates chronic nutritional stress). Overall figures revealed that 30.7% of the study children suffered from stunted growth, 42.7% were underweight and 12.0% were in a wasted condition. These figures were quite similar to the regional figures for West Bengal, where the overall prevalence of stunting, underweight and wasting were 38.7% 45.5% 13.5%, respectively. The overall prevalence of stunting, underweight and

wasting in the present study demonstrated slightly better results compared to the Indian situation (44.2%, 44.0% and 15.8% respectively- Bharati et al. 2008). The lack of significance in gender differences for the under-nutrition indicator may be due to the absence of gender bias in these rural inhabitants, and the higher prevalence in boy's underweight and wasting is presumed to result from their increased activity compared to the girls. This led to a greater loss of energy, so that the boys required higher caloric supplements.

Previous studies from West Bengal and India have recorded this nutritional burden. These include; Arambag, West Bengal (73.1%) (Mandal and Bose 2009), Bankura, West Bengal (69.1%) (Mukhopadhyay et al. 2011) and Coimbatore, Tamil Nadu (68.6%) (Seetharaman et al. 2007). All these studies found high rates of under-nutrition measured by CIAF. The total burden of malnutrition measured by CIAF in young Indian children is considerably higher at approximately 60%. This is in the country with the largest child population in the world (Svedberg 2011). The 1998–1999 NFHS-3 reported 60.8% of children suffered from CIAF and this figure is slightly lower than the 63.8% recorded in the 2005–2006 NFHS-2. An earlier study among Bauri caste children aged 2–6 years from the Bankura District in West Bengal revealed that 39.2%

were stunted, 51.2% were underweight and 26.6% suffered wasting. Here also, the CIAF showed a higher prevalence of under-nutrition, with a total of 66.3% (Das, Bose 2009).

The use of CIAF allowed us to establish that 50.2% of studied children were undernourished and 29.8% experienced multiple anthropometric failures. Although under-nutrition measured by CIAF is considerably lower than that recorded in other studies in West Bengal and also below the national average, this scenario is extremely alarming. Children with multiple anthropometric failures were more likely to experience ill-health and were at more risk of dying than those with single anthropometric failure (Nandy et al. 2005). A widely-held assumption is that childhood experiences set the stage for lifetime experiences, where childhood is the foundation for both physiological and psychological development and experiences therein define lifetime socio-economic potential. Thus, the capabilities that adults enjoy are strongly conditioned by their childhood experiences (Elankumaran 2003).

It is concluded that the children in this study had experienced both acute and chronic under-nutrition. This situation is not only distressing but very alarming, especially when the CIAF nutritional status of the 3-6 years ICDS children measured by stunting, underweight and wasting still proved unsatisfactory despite the Anganwadi centres' food supplementation programme. It was established herein that CIAF is a better indicator of nutritional status than traditional measures of stunting, underweight and wasting because it differentiates overall and total anthropometric failure. Realizing the comprehensive worsening situation of children in the ICDS centres highlight-

ed in this study, the Indian Government has now increased funding to these centres to improve the children's nutritional development. However, the aim of the government's interventions must not be only to increase the ICDS centre areas but also to improve the quality and quantity of food supplied in these centres.

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Author contribution

KB and GChM designed the work. AA collected the data. KB, GChM and AA analyzed the data and prepared the manuscript.

Conflict of interests

The authors declare that there is no conflict of interests.

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