Original Article

Iran J Pediatr
Sep 2009; Vol 19 (No 3), Pp:237-243

Assessment of Overall Prevalence of Undernutrition Using Composite Index of Anthropometric Failure (CIAF) among Preschool Children of West Bengal, India

Gopal Chandra Mandal[1,2] M.Sc, and Kaushik Bose*[2] Ph.D

1. Department of Anthropology, Bangabasi College, Kolkata, India
2. Department of Anthropology, Vidyasagar University, Midnapore, India

Received: *Nov 10, 2008*; Final Revision: Mar *08, 2009*; Accepted: *Apr 10, 2009*

Abstract

Objective: Under-nutrition continues to be a primary cause of ill-health and premature mortality among children in developing countries. Present study attempted to assess the overall prevalence of undernutrition using composite index of anthropometric failure (CIAF) among rural preschool children of Arambag, Hooghly District, West Bengal, India.

Methods: A total of 1012 rural children (498 boys; 514 girls) aged 2-6 years were measured. Three commonly used undernutrition indicators, ie, stunting, wasting and underweight, as well as the Composite Index of Anthropometric Failure (CIAF) were used to evaluate the nutritional status of the subjects following internationally accepted cut-off points. For assessing CIAF, Svedberg's model of six groups of children was used.

Findings: Among the studied children, 26.6%, 50.0% and 63.3% were stunted, wasted and under weight, respectively. The CIAF showed a higher prevalence of undernutrition of 73.1% of the studied children suffering from anthropometric failure, in comparison to other three indicators (stunting, underweight and wasting). Out of six subgroups of CIAF with undernourished children, group C (containing children who are wasted and underweight) is the highest (32.0%), more-or less one-third of the studied children and children of group F (stunted only) is the lowest (2.7%). Group B (wasting only) and Y (underweight only) show the same prevalence ie 7.2% and 7.1% respectively. Children who simultaneously have wasting, stunting and underweight (ie group D) account for 10.7%. There was no significant age group difference between no failure and CIAF.

Conclusion: We found that CIAF may be a better indicator of nutritional stress as compared to the traditional measures of stunting, underweight and wasting. The distinct advantage of the CIAF may be that it can highlight the seriousness and severity of overall undernutrition ie the actual load of undernutrition in a population.

Iranian Journal of Pediatrics, Volume 19 (Number 3), September 2009, Pages: 237-243

Key Words: Undernutrition; Stunting; Underweight; Wasting; Composite index of anthropometric failure; CIAF

*** Corresponding Author;**
Address: Department of Anthropology,Vidyasagar University, Midnapore – 721 102, West Bengal, India
E-mail: banda@vsnl.net

Introduction

Undernutrition continues to be a primary cause of ill-health and premature mortality among children in developing countries [1].

Since independence, one of the greatest problems facing India is malnutrition among under-5 children. As in other developing nations, malnourishment is a burden on considerable percentage of population, the most vulnerable being the youngest of this country[2].

One half of the children under the age of five years in India are moderately or severely malnourished, 30% of newborn children are significantly under weight and nearly 60% of women are anemic[3]. Malnutrition makes a child susceptible to infections and delays recovery, thus increasing mortality and morbidity[2]. It is therefore logical to direct increasing attention to the quality of survivors[4].

Three most commonly used internationally recommended indicators are stunting (low height-for-age), underweight (low weight-for-age) and wasting (low weight-for-height) [5, 6]. However, because they overlap, none is able to provide a comprehensive estimate of the number of undernourished children in a population; some children who are stunted will also have wasting and/or be underweight; some children who are underweight will also have wasting and/or be stunted; and some children who have wasting will also be stunted and/or underweight [1].

Development economist Peter Svedberg [7] has argued that conventional indices are not sufficient for measuring the overall prevalence of undernutrition among young children. He suggested that if children with wasting, stunting or who are underweight are all considered as undernourished, or to be in a state of *"anthropometric failure",* a new aggregate indicator is needed, one that incorporates all undernourished children, be they wasted and/or stunted and/or underweight and proposed the construction of a *Composite Index of Anthropometric Failure–CIAF.* Hiremath and his colleagues [8] have validated that CIAF and Disaggregated Anthropometric Indices (DI) are better markers of true nutritional failure at the country or regional level, and show a strong association with infection and poverty.

The Integrated Child Development Services (ICDS) scheme of Government of India is the largest national program for the promotion of mother and child health and their development in the world [9]. The beneficiaries include preschool children, pregnant and lactating mothers, and other women in the age group 15 to 44 years. The package of services provided by the ICDS scheme includes supplementary nutrition, immunization, health check-up, referral services, nutrition and health education, and preschool education[9]. The scheme services are rendered essentially through the *"Anganwadi"* worker at a village center called *"Anganwadi".*

In the study area, the ICDS centers are operational since 1980s. However, very few investigations have been done on the children of ICDS centers [10, 11, 12].

Subjects and Methods

The present study was undertaken during the period November 2005 to December 2006 at 20 ICDS centers in Bali Gram Panchayet, Arambag, Hooghly District of West Bengal, India. The study area consists of remote villages located approximately 100 km from Kolkata, the capital of West Bengal. At these centers, all children are given a daily food supplementation, in the form of porridge, consisting of approximately 60 grams of rice and 20 grams of lentils. They are also fed an egg per week. All children aged 2 years are enrolled in the ICDS center and when they cross 6 years of age their names get eliminated. A total of 1012 children (boys= 498; girls= 514) aged 2-6 years were measured. Age and ethnicity of the subjects were verified from official records. Height and weight measurements were taken on each subject by the first author following the standard techniques by Lohman et al[13].

Technical errors of measurements (TEM) were found to be within reference values [14] and thus not incorporated in statistical analyses.

Three commonly used undernutrition indicators, ie, stunting, underweight and wasting were used to evaluate the nutritional status of the subjects and CIAF for the total children. Internationally accepted the National Center for Health Statistics (NCHS)[15,16] age and sex specific– 2 z-scores were followed to define stunting, underweight and wasting.

For assessing the CIAF, Svedberg's model of six groups (stunted only, under-weight only, wasted only, wasting and underweight, stunted and under-weight and lastly stunted, wasted and under-weight) of children was used. These groups include children with height and weight appropriate for their age (ie who are not in anthropometric failure) and also children whose height and weight for their age are below the norm and thus are experiencing one or more forms of anthropometric failure [1]. These groups are defined more fully in Table 1. The CIAF excludes those children not in anthropometric failure (ie group A) and counts all children who have wasting, stunting, or are underweight (ie groups B to F). It therefore provides a single measure with which to estimate the overall prevalence of undernutrition. Svedberg originally suggested six subgroups of anthropometric failure (A to F). However, Nandy et al [1] identified an additional subgroup: one that includes children who are only underweight but not stunted or wasted (group Y). One-way ANOVA (Scheffe's Procedure) analyses were undertaken to test for age differences in mean height and weight. χ^2 tests were done to test significant age group difference between CIAF and no failure.

Findings

Table 2 presents the mean height, weight and rates of stunting, wasting and underweight among the studied Bengalee rural preschool children. It also shows the rate of undernutrition as measured by the CIAF. Out of total 1012 preschool children, 183 were of the age group 2 years, 230 were of 3 years, 241 were of 4 years, 240 were of 5 years and 118 were of 6 years. From this table, it is clear that the mean values for height and weight increased with age. In case of height, the mean values are increasing as the age increases ie 82.7 cm (6.0) in 2 years; 90.7 cm (5.9) in 3 years; 97.6 cm (5.0) in 4 years; 102.9 cm(4.8) in 5 years and 107.9 cm (5.2) in 6 years of aged children. There is significant mean difference between different age groups (F = 580.7; P<0.0001). The mean values of weight

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

Group name	Description	Wasting	Stunting	Underweight
A	**No failure**	No	No	No
B	**Wasting only**	Yes	No	Yes
C	**Wasting and 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

* Classification following Nandy et al, 2005.

Table 2: Mean height, weight and prevalence of undernutrition among the studied (ICDS) children aged 2-6 years

Category	Age in years					
	2 (n=183)	3 (n=230)	4 (n=241)	5 (n=240)	6 (n=118)	Total (n=1012)
Height* (cm) Mean (SD)	82.7 (6.0)	90.7 (5.9)	97.6 (5.0)	102.9 (4.8)	107.9 (5.2)	98.5 (9.8)
Weight (kg) Mean (SD)**	9.5 (1.5)	11.0 (1.6)	12.4 (1.5)	13.3 (1.6)	14.8 (1.7)	12.1 (2.3)
Stunted	25.7 %	26.4%	24.5%	27.65	30.5%	26.6%
Wasted	47.0%	48.1%	48.5%	57.7%	45.8%	50.0%
Underweight	65.5%	56.3%	63.5%	65.3%	69.5%	63.3%
CIAF	75.9%	67. 5%	72.6%	75.7%	75.4%	73.1%

* F= 580.7; *P*<0.0001
** F= 274.9; *P*<0.0001

are also increased with the increasing age of the children. The lowest value is noticed in the age of 2 years ie 9.5 kg (1.5) and the highest value 14.8 kg (1.7) is noticed in the children of 6 years of age and gradual increase in between the ages is traced. There is also significant mean difference between different ages (F= 274.9; *P*<0.0001). Among the studied children, 26.6%, 50.0% and 63.3% were stunted, wasted and underweight, respectively. The CIAF showed a higher prevalence of undernutrition, with 73.1% of the studied children suffering from anthropometric failure, in comparison to other three indicators (stunting, underweight and wasting). This higher prevalence was noticed in every age group.

The proportions of children in each of the subgroups are presented in Table 3. Out of six subgroups with undernourished children, group C (containing children who are wasted and underweight) is the highest (32.0%), more or less one-third of the studied children and children of group F (stunted only) is the lowest (2.7%). Group B (wasting only) and Y (underweight only) show the same prevalence ie 7.2% and 7.1% respectively. Children who simultaneously have wasting, stunting and underweight (ie group D) account for 10.7% whereas, children who are stunted and underweight simultaneously (ie group E), account for slightly higher (13.4%). There was no significant (χ^2 = 5.6, df 4) age group difference between no failure and CIAF.

Discussion

It must be pointed out here that except for the study which recommended the use of CIAF[1] for investigations dealing with undernutrition, only one[17] study has been reported from India which has dealt with CIAF. Thus, the importance of the present report lies herein.

In view of this, the present investigation was undertaken to evaluate the levels of stunting, underweight, wasting and specially to assess the overall prevalence of undernutrition by using CIAF among 2-6 year old ICDS children of Bengalee ethnicity from Arambag, Hooghly District, West Bengal, India.

The rate of stunting in the present study (26.6%) was slightly higher than reported (23.9%) in a study among the ICDS children aged 3-5 years of Chapra, Nadia District, West Bengal, India[12]. In case of wasting the rate (50.0%) was much higher than reported (9.4%) in the same study. Considering

Table 3: Subgroups of anthropometric failure among the studied children

Group	Number of children in age groups in years					
	2	3	4	5	6	Overall
A (no failure)	44(24.1)	75(32.5)	66(27.4)	58(24.3)	29(24.6)	272(26.9)
B (wasting only)	12(6.6)	14 (6.1)	18(7.5)	22(9.2)	7(5.9)	73(7.2)
C (wasting and underweight)	62(33.9)	71(30.7)	77(32.0)	83(34.7)	31(26.3)	324(32.0)
D (wasting, stunting and underweight)	12(6.6)	25(10.8)	22(9.1)	33(13.8)	16(13.6)	108(10.7)
E (stunting and underweight)	28(15.3)	25(10.8)	33(13.7)	30(12.6)	20(16.9)	136(13.4)
F (stunting only)	7(3.8)	12(5.2)	4(1.7)	4(1.7)	0(00.0)	27(2.7)
Y (underweight only)	18(9.8)	9(3.9)	21(8.7)	9(3.8)	15(12.7)	72(7.1)
Total (CIAF, B-Y)	139(75.9)	156(67.5)	175(72.6)	181(75.7)	89(75.4)	740(73.1)

* Figures in parentheses are percentages.
*χ^2 (df=4) = 5.6, no significant age group difference between no failure and CIAF.

underweight, the level (63.3%) was also very high as compared to 31.0%.

There is extensive literature that shows undernutrition is closely associated with a large proportion of child deaths[18,19] with undernourished children more likely to suffer ill-health than well nourished children[20,21]. Children of the present study came from the rural villages of Hooghly district and thus they had a high rate of CIAF.

This is because undernourished children are more likely to come from comparatively more poorer families where they do not get enough food and are exposed to poor living conditions, which in turn lead to further undernutrition[1]. Thus, it can be mentioned that the children who are simultaneously stunted, underweight and also wasted (group D) will have the greatest risk of illness and are also more likely to be from more deprived backgrounds[1]. It must be emphasized, however, that conventional indices reflect distinct biological processes and cannot be disregarded, but the CIAF merits further consideration as a policy and monitoring tool for planning purposes as has been suggested earlier[1].

The present study showed a higher prevalence (73.1%) of overall undernutrition (by CIAF) than the recent study (CIAF = 59.8%) done by Nandy and colleagues (2005) on a data from the 1998-99 National Family Health Survey (NFHS-2) for India with children aged below 3 years. The children less than 5 years of age residing the slums area of Coimbatore, Tamil Nadu, also showed the higher prevalence of undernutrition (68.6%) based on CIAF[17]. Most importantly, it must be noted here that, the present study as well as that of Nandy and Seetharaman have reported higher rates of CIAF compared to the other three (stunting, underweight and wasting) more conventional measures of undernutrition. This implied that these other three measures may actually underestimate the problem of overall undernutrition in a population. The distinct advantage of the CIAF may be that it can highlight the seriousness and severity of overall undernutrition in a population better that than these three conventional measures, especially among rural children in a population better than these three conventional measures, especially among rural children in developing countries like India.

There is a need to revise the current norms used in ICDS programs like increasing the amount of food supplementation. There is also an urgent requirement for considerable upward revision in governmental budgets for this to happen. Now might be appropriate time for this since it can be incorporated in the current 11th plan being undertaken by the government. Efforts should also be made to provide state wise data sets (based on NFHS 3 data) and goals for the 11th plan using WHO[22] criteria. Thus, it is expected that the present study will make a substantive contribution in the formulation of new effective policies for the 11th fifth year plan.

This is justified by the fact that, as there is no improvement in the child malnutrition for the last ten years, the government of India is going to restructure its program for nutritional intervention for children up to age of 6 years. The Prime Minister of India had, in a recent letter to the Women and Child Development (WCD) ministry, expressed concern over the poor implementation of the ICDS program pointing out that it had failed to curb child malnutrition. Therefore, the WCD ministry has recommended that the amount spent on supplementary nutrition for children between 6 months to 72 months will be increased from Indian Rupees (Rs.) 2/- to Rs. 4/-, while severely malnourished children in the same age group will get Rs. 6/- per child per day instead of Rs. 2.70 at present[23].

However, one of the limitations of the present study was limited sample size from one particular geographical area of India. These results may not be representative of the Indian scenario. To get a more comprehensive picture, we recommend that more studies dealing with CIAF are undertaken among preschool children from different parts of India.

Such investigations will allow us to not only to compare the rates of three conventional measures of undernutrition with CIAF, but also help to demonstrate the enhanced utility and effectiveness of the latter measure. Since the vast majority of the Indian population reside in rural areas where the rates of childhood undernutrition are very high, such studies should concentrate on rural preschool children. Effective health and nutritional promotion programs can be formulated based on the findings of these researches with the ultimate objective of reducing childhood nutrition in these areas.

Conclusion

We found that CIAF may be a better indicator of nutritional stress as compared to the traditional measures of stunting, underweight and wasting.

Acknowledgment

All subjects who participated in the study are gratefully acknowledged. Special thanks are due to the ICDS authorities of these centers. Gopal Chandra Mandal received financial assistance in the form of a Minor Research Project from the University Grants Commission, Government of India [PSW-046/03– 04 (ERO)].

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