

ORIGINAL ARTICLE

Assessment of Under Nutrition with Composite Index of Anthropometric Failure (CIAF) Among Under-Five Children in a Rural Area of West Bengal

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Abstract

Background: Under-nutrition continues to be a major public health problem in India despite years of incessant preventive measures. Composite index of anthropometric failure (CIAF) provides the burden of under-nutrition as a single measure and helps in detection of children with multiple anthropometric failures. Research with multivariate modelling for various factors associated with CIAF is limited especially in rural West Bengal. **Methods:** This cross-sectional community based study was done in Singur block of West Bengal to determine the prevalence of under-nutrition among the under-five children and to find out the determinants of under-nutrition assessed by CIAF using multivariate analysis. WHO Z-score system and the composite index of anthropometric failure (CIAF) were used to estimate the magnitude of under-nutrition. **Results:** Out of 113 children, 37 (32.7%) were suffering from under-nutrition according to CIAF. Both underweight and wasting was present in 17.7% while stunting was prevalent in 15%. Multivariate logistic regression model showed that high birth order, low birth weight, lesser duration of breast-feeding, and low education level of mother were significantly associated with under-nutrition assessed by CIAF after adjusting for other variables. **Conclusion:** CIAF gives a better estimate of under-nutrition than the currently used weight-for-age Z score, hence we recommend the inclusion of height measurement in growth monitoring activities for calculating CIAF. The study also reinforces the importance of appropriate maternal care, proper infant and child feeding practices and family planning services in prevention of under-nutrition.

Key Words:

Under-nutrition; Composite Index of Anthropometric Failure; CIAF; Z-score; Multivariate analysis; Under-weight; Wasting; Stunting.

Introduction

Under-five children represent the vulnerable and the most important target group where malnutrition plays a pivotal role in their mortality and morbidity along with delayed mental and motor development during these formative years. In the long run, malnutrition decreases the educational achievement, labor productivity and economic growth of a country. The various risk factors identified for under-nutrition are related to the child, mother and largely their environment. Adequate nutrition during infancy and childhood is fundamental to a child's full developmental potential [1] while poor quality of infant and young child feeding practices plays the most important role in the causation of malnutrition among the under five children of any society. [2]

Worldwide, almost 7 million children die each year before they reach their fifth birthday [3] while India (24%) and Nigeria (11%) together account for more than one-third of all under-five deaths. Globally, under-nutrition is responsible, directly or indirectly, for at least 35% of deaths in children less than 5 years of age. [4] To eliminate the burden caused by this major public health problem, the global community has designated halving the prevalence of underweight children by 2015 as a key indicator of progress towards the Millennium Development Goal-1 (MDG-1) of eradicating extreme poverty and hunger and to reduce by two thirds, between 1990 and 2015, the under-five mortality rate for achievement of MDG-4 of reducing child mortality. [5]

The prevalence of underweight among children in India is amongst the highest in the world, and nearly double

that of Sub-Saharan Africa where approximately 60 million children are underweight. [6] One out of three malnourished children in the world lives in India. [7] In 1999, the National Family Health Survey (NFHS II) found that 43 % of all children under age of three were underweight with hardly any improvement in NFHS-3 (2006) where 40% of such children were underweight. [8] Apart from various other factors like high prevalence of infection and worm infestation, under-nutrition among the under five in India, results mostly because of inappropriate infant and young child feeding and caring practices. Again, India has implemented the largest child development Programme (ICDS) in the world, yet progress on malnutrition is limited. [6]

There are numerous methods of assessment of malnutrition among which CIAF is the most recent, relatively robust since it envisages all the parameters for estimation of nutritional status of a child. The current study uses the WHO Z-score system [9] and the composite index of anthropometric failure (CIAF) to estimate the magnitude of under nutrition. Although there are numerous studies regarding prevalence of under-nutrition among under-five children, not many researches were done in recent times in this part of the country especially rural West Bengal. Also determining the magnitude of malnutrition using a single parameter along with its determinants will help the health administrators and policy makers to work on all the modifiable factors for effective prevention and control of this malady among the under five children. With this background, a study was undertaken to estimate the prevalence of under-nutrition and determine its various risk factors among the under-five population in a village of West Bengal.

Aims & Objectives

1. To determine the prevalence of under-nutrition among the under-five children in a rural area of West Bengal.
2. To find out the determinants of under-nutrition assessed by CIAF using multivariate analysis.

Material and Methods

This was a cross-sectional, community based descriptive study on Under-5 children (study population) conducted from May 2012 to August 2012 in the area under Nasibpur Union Health Centre, Singur block of Hooghly district, West Bengal; the rural field practice area of All India Institute of Hygiene and Public Health, Kolkata. Ethical clearance was obtained from the Institutional Ethics Committee. All India Institute of Hygiene and Public Health (AIIPH) was established on 30th December, 1932 with a generous assistance from the Rockefeller Foundation and is devoted to teaching and research in various disciplines of public

health and to develop health manpower by providing post-graduate training facilities of the highest order. The rural field practice area of the institute (Rural Health Unit and Training Center- RHUTC) caters to the 64 villages of Hooghly district with a total population of 89,672 (census 2001). It provides comprehensive health care services to a population residing around 64 square km area through 2 union health centres, 4 sub-centres and 12 health units.

Inclusion criteria: All under-five children including neonates were included in the study.

Exclusion criteria: Children of unwilling mothers and children in the absence of their mother during data collection were excluded.

Sampling Design: Considering prevalence of malnutrition in West Bengal as 39% (NFHS 3 data) and allowable absolute error (precision) of 10%, the minimum required sample size was 95. Nasibpur Union Health Centre is one of the 2 union health centres which cater to beneficiaries of 12 villages. Dearah village was selected randomly for this study out of the 12 villages. Line listing of all under-five children in Dearah village was done and 122 such children were identified. 9 children were excluded according to the exclusion criteria. So, the final sample size came to be 113 under-five children.

Tools and Techniques: The interview was conducted with a pre-designed and pre-tested schedule after obtaining informed consent from mothers of the under-five children. The schedule was designed keeping in mind the objectives of the study. To ascertain reliability, objectivity, simplicity and to remove any ambiguity, necessary modifications were done. This schedule was judged by a group of experts of the institute where necessary corrections were made to enhance the face validity and content validity. Pretesting of the schedule was done by administering the questions to a small number of representative sample. Necessary modifications were made following their response. The schedule was then translated to Bengali. It was again translated back into English. The questions in retranslated English version were matched with the originally developed English schedule and again necessary modifications were made. This English schedule was then translated again into Bengali. Thus the final Bengali schedule was so constructed that it had semantic equivalence with the original English schedule. Also utmost care was taken to make the language as simple as possible so that the respondents, even if illiterate, could understand the questions easily.

Relevant data on the factors related to under-nutrition were obtained with the help of the schedule and review of health records. For assessing nutritional status, clinical examination and anthropometric

measurements were carried out following standard operating procedures. The data included were weight, recumbent length (if the child is not able to stand without support), standing height and mid upper arm circumference (for children above 12 months). Weight was measured to the nearest 0.1 Kg using a Salter weighing machine and standard weighing (bathroom) scale. Height was measured using a non-stretchable tape fixed to a vertical wall, with the participant standing on a firm/level surface and it was measured to the nearest 0.1 cm. Recumbent length was measured by using an infantometer. Each measurement was done twice, and the mean of the two readings was recorded. SPSS version 20 was used for statistical analysis. Firstly, a bivariate analysis was done to ascertain the relationship of under-nutrition assessed by CIAF with other variables. Only those found to be significant were entered into a multiple logistic model (Link Function=Logit). Diagnostic tests were done after modeling to assess goodness-of-fit and assumptions pertaining to logistic regression. Further exploratory analysis was done where it was thought to be necessary.

Definitions Used

1. Wasting (acute malnutrition) [9] is defined as a Weight for Height Z-score (WHZ) of < -2 . Severe wasting is considered if WHZ is < -3 OR if MUAC < 11.5 cm.
2. Stunting (chronic malnutrition) [9] is defined as a Height for Age Z-score (HAZ) of < -2 . Severe stunting is considered if HAZ is < -3 .
3. Underweight (mixed acute and chronic malnutrition)[9] is defined as Weight for Age Z-score (WAZ) of < -2 . Severe underweight is considered if WAZ is < -3 .
4. Composite Index of Anthropometric Failure (CIAF): The above mentioned indices only help in classification of children to various categories of under-nutrition but do not provide an estimate of overall prevalence of under-nutrition as a single measure. Moreover, the issue of multiple anthropometric failures was not addressed by these standard indices. Hence, Peter Svedberg [10] developed a model of six groups of children (A to F) to calculate Composite Index of Anthropometric Failure (CIAF). Nandy et al [11] later modified the Svedberg's model by identifying an additional subgroup (Group Y: children who are only underweight). The CIAF excludes those children not in anthropometric failure (group A) and includes all children who are wasted, stunted, or underweight, and their combinations (groups B–Y); see [Table 1](#). It therefore provides a single measure with which the overall prevalence of under-nutrition can be estimated.

Results

Data of 113 children were collected and analyzed. The mean age of the sample was 23.7 months (S.D - 17.4 months) and both sexes were almost equally distributed ([Table-2](#)) and prevalence of under-nutrition was also equally distributed among all age groups and both sexes (data not shown).

About 69 (61.1%), and 44 (38.9%) children were Hindu and Muslim by religion, respectively. Around two-third of the study population belonged to lower class (35.4%) and upper lower class (39.8%) according to modified Prasad scale (2012) and 55% of the sample were living in a joint family. It may be noted that both Wasting (including severe wasting) and Under-weight (including severe under-weight) were present in 17.7% of sample. Chronic malnutrition (Stunting) was present in 15% of the sample. Severe Wasting, Severe stunting, Severe underweight was present in 3, 4, and 2 children, respectively (not mutually exclusive). Total 7 children were suffering from one or more form of severe under-nutrition.

About 37 children (out of 113) were diagnosed with Anthropometric Failure (32.7%). Therefore, it is clear that standard anthropometric indices underestimate the prevalence of under-nutrition when compared to composite index of anthropometric failure. The prevalence according to each criterion is depicted in [Figure-1](#).

About 44% of the children in the sample were delivered by caesarian section and 84% of the total children had institutional delivery either in a government health facility (55%) or in a private nursing home (29%). Only 32% of the mothers were educated till middle school and above. Pre-lacteal feeding was given for 28% of the children with sweet water and honey being most commonly used. About 10 children were suffering from vitamin deficiency disorders, most common being angular stomatitis.

[Table 3](#) shows the association and its strength of factors which were significantly associated with under-nutrition assessed by CIAF. In the bivariate analysis, the significant factors associated with increased risk of under-nutrition were high birth order, low education level of mother, low birth weight of the baby, exclusive breast feeding of less than 6 months duration, absence of colostrum feeding, presence of overcrowding, and absence of sanitary latrine. Presence of Pallor and other vitamin deficiencies were also significantly associated with under-nutrition but cause-effect relationship cannot be ascertained as this was a cross-sectional study.

Variables like age, sex, religion, mother's occupation, education and occupation of father, socio-economic status, type of family, mode and place of delivery of the child, practice of prelacteal feeding, and presence of

separate kitchen were not significantly associated with under-nutrition assessed by CIAF in bivariate analysis (data not shown). The variables already found significant in bivariate analysis were entered into a Multivariate Logistic model (binary logistic: link function=Logit), by "Enter" method.

Strength of association of variables like duration of exclusive breast feeding, presence of overcrowding, sanitary latrine, and presence of vitamin deficiency and pallor was attenuated, when controlling for the other variables in the multivariate analysis. But other variables like birth order, birth weight, education level of the mother and colostrum feeding stayed significant in the multivariate analysis besides being significant in the bivariate analysis.

Only factors which had statistically significant (p value <0.05) association in bivariate analysis are shown and included for multivariate analysis

Discussion

In this study, prevalence of under-nutrition was much less when compared to NFHS 3 [8] data (See [Figure 2](#)). Only 17.7% of the sample were wasted and/or under-weight, when compared to 45.6% under-weight and 20.7% wasting in rural India (NFHS 3) [8]. Stunting was present only in 15%, while it was 50.7% in rural India. Although prevalence of under-nutrition among under-five children was less in rural West Bengal (wasting- 17.8%, underweight- 42.2%, stunting- 48.4%) when compared to national average even in NFHS 3 data, prevalence of under-nutrition has further gone down as indicated in this study. Similarly, the prevalence of under-nutrition using composite Index of Anthropometric Failure (CIAF) was 32.7% which is much less than one observed by Mandal et al [12] (73.1%) in Hooghly District of West Bengal, Mukhopadhyay et al [13](69.1%) and Shit et al [14] (80.3%) in Bankura district of West Bengal, Das et al [15] (66.3%) in Purulia District of West Bengal, Sen et al [16] (63.6%) in Darjeeling district of West Bengal, Anwar et al [17] (62.5%) in rural Varanasi, Brahmabhatt et al [18] (98.2%) in Dakshina Kannada region of Karnataka, Deshmukh et al [19] (59.6%) in rural Wardha, Seetharaman et al [20] (68.6%) in Tamilnadu. Anjum et al [21] observed a prevalence of 25.58% of CIAF in Kashmir which is less than that of the current study. Nandy et al [22] analyzed the NFHS-2 data (1998) and observed an overall prevalence of 59.8% anthropometric failure in our country. Prevalence of CIAF in other countries were 38.7% (Khan et al [23]) in Bahawalpur region of Pakistan, 33.3% (Berger et al [24]) in Nyanza Province of Kenya and 55.5% (Lekprichakul et al [25]) in Zambia.

In the current study, children who were colostrum deprived, with more number of siblings, low birth weight, or with less educated mothers were more likely

to have anthropometric failure. Shit et al [14] also observed similar findings regarding education level of mother and number of siblings in the family. According to Sen et al [16], Children aged 1–4 years, male children and children with higher family size had higher odds of anthropometric failure.

Conclusion

These findings reinforce the importance of proper infant and child feeding practices, family planning practices, appropriate maternal care, and female literacy in prevention of under-nutrition among under-five children. Accelerating the reduction in under-five mortality is possible by expanding effective preventive and curative interventions that target the main causes of under-nutrition.

Moreover, the composite index of anthropometric failure (CIAF) provides the burden of under-nutrition in the community as a single measure and also helps in detecting children with multiple anthropometric failures. Also, computation of CIAF requires only height of the child which can be easily measured by the health workers, in addition to weight-for-age parameter which is currently used for growth monitoring in ICDS programme.

Recommendation

The study recommends the inclusion of height measurement in the growth monitoring activities as it will not only enable the health system to compute CIAF but also facilitates in detecting the children with multiple anthropometric failures.

Authors Contribution

AD: Study concept, Study designing, Manuscript writing; RP: Literature search, Schedule preparation, Data collection, Analysis, Manuscript writing and review; RPV: Data collection, Manuscript editing and review; RB: Data collection, Manuscript editing and review. AG: Literature search, Schedule preparation, Statistical Analysis.

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Tables

TABLE NO. 1 CIAF CLASSIFICATION (B–Y) OF CHILDREN WITH “ANTHROPOMETRIC FAILURE” [NANDY ET AL¹¹]

Group	Description	Wasting	Stunting	Underweight
Anthropometric Failure	A	No failure	--	--
	B	Wasting only	√	--
	C	Wasting and underweight	√	--
	D	Wasting, stunting & underweight	√	√
	E	Stunting & underweight	--	√
	F	Stunting only	--	√

	Y	Underweight only	--	--	√
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TABLE NO. 2 SHOWING AGE AND SEX DISTRIBUTION OF THE SAMPLE POPULATION (N=113)

Age (in months)	Female Frequency (%)	Male Frequency (%)	Total Frequency (%)
0-6	14 (53.8)	12 (46.2)	26 (23)
7-12	4 (36.4)	7 (63.6)	11 (9.7)
13-36	18 (41.9)	25 (58.1)	43 (38.1)
37-59	20 (60.6)	13 (39.4)	33 (29.2)
Total	56 (49.6)	57 (50.4)	113 (100)

TABLE NO. 3 BIVARIATE AND MULTIVARIATE LOGISTIC REGRESSION MODEL OF VARIOUS FACTORS WITH UNDER-NUTRITION ASSESSED BY COMPOSITE INDEX OF ANTHROPOMETRIC FAILURE (CIAF)

INDEPENDENT VARIABLE (N)	CIAF n (%)	Odds Ratio (95% CI)	Adjusted Odds Ratio [†] (95% CI)
BIRTH ORDER 3 & above (37)	20 (54.1)	4.08 (1.75 - 9.47)	3.24 (1.03 - 10.23) [‡]
1 or 2 (76)	17 (22.4)	1	1
BIRTH WEIGHT Below 2.5 KG (57)	30 (52.6)	7.77 (3.01 - 20.05)	3.98 (1.20 - 13.19) [‡]
2.5 kg & Above (56)	7 (12.5)	1	1
MOTHER'S EDUCATION Primary & Below (77)	34 (44.2)	8.69 (2.45 - 30.80)	5.17 (1.18 - 22.60) [‡]
Middle and above (36)	3 (8.3)	1	1
EXCLUSIVE BREASTFEEDING* < 6 months (31)	18 (58.1)	4.12 (1.90 - 11.05)	2.09 (0.64 – 6.82)
= > 6 months (82)	19 (23.2)	1	1
COLOSTRUM Not Given (9)	6 (66.7)	4.71 (1.10 - 20.04)	7.02 (1.06 -46.09) [‡]
Given (104)	31 (29.8)	1	1
OVERCROWDING Yes (67)	30 (44.8)	4.51 (1.76 - 11.53)	2.10 (0.62 – 7.08)
No (46)	7 (15.2)	1	1
SANITARY LATRINE No (38)	18 (47.4)	2.65 (1.16 - 6.03)	1.42 (0.47 – 4.27)
Yes (75)	19 (25.3)	1	1
PALLOR Yes (26)	14 (53.8)	3.24 (1.31 - 8.03)	1.79 (0.54 – 5.99)
No (87)	23 (26.4)	1	1
VITAMIN DEFICIENCY Yes (10)	7 (70)	5.67 (1.37 - 23.43)	4.15 (0.72 – 23.85)
No (103)	30 (29.1)	1	1

Foot Notes:

N is the total number of samples in each sub-group, n is the number of samples with under-nutrition in each sub-group

** Age-adjusted odds ratio is calculated as there were children less than 6 months of age*

† Adjusted odds ratio in multivariate analysis for each variable is adjusted for age and all other variables in the model

‡ Significant variables in multivariate analysis

For the multivariate model, the Hosmer-Lemeshow test gave a Chi-square value of 7.537 (p=0.480, not significant) indicating good model fit

Nagelkerke R2 was 0.642 showing that the variables included in the model predicted 64.2% of Anthropometric Failure, though this parameter has got its own limitations in a logistic regression.

Figures

FIGURE NO. 1 PREVALENCE OF UNDER-NUTRITION ACCORDING TO EACH CRITERIA

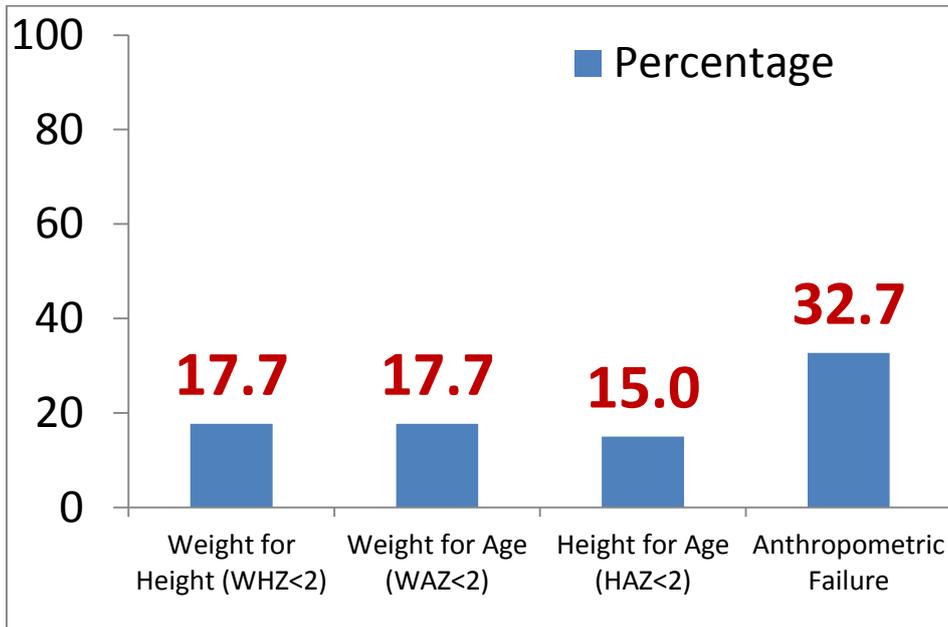


FIGURE NO. 2 COMPARISON OF UNDER-NUTRITION WITH NFHS 3 DATA

