Research Article

Measuring undernutrition by composite index of anthropometric failure (CIAF): a community-based study in a slum of Nagpur city

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Abstract

Background: In any community, under-five children constitute one of the most vulnerable groups for nutritional deficiencies. The estimation of growth in children is vital for screening health status, identifying divergences from normality, and evaluating the efficiency of interventions. Composite index of anthropometric failure (CIAF) offers a single number to the overall evaluation of malnourished children in a population, which no other conventional indicators do.

Objective: To estimate the overall prevalence of undernutrition among under-five children in an urban slum using CIAF and study some covariates associated with undernutrition.

Materials and Methods: This community based cross-sectional study was conducted in an urban slum area of Nagpur city. Study subjects were under-five children residing in the slum, and respondents were their mothers. Data collection was done by conducting house-to-house survey, and information was recorded in predesigned pretested questionnaire. Anthropometric measurements were recorded using standard techniques. Overall prevalence of undernutrition was estimated using CIAF.

Result: The overall prevalence of undernutrition by CIAF among under-five children in urban slum area was found to be 58.59%. Covariates found to be significantly associated with undernutrition were lower socioeconomic status, illiteracy of mother, low birth weight, birth order, narrow birth interval, exclusive breastfeeding, immunization status, and childhood morbidities.

Conclusion: The overall prevalence of undernutrition among under-five children was found to be 58.59%, which was higher than that estimated by conventional measures of undernutrition (underweight, stunting, and wasting). An aggregate and comprehensive measure of the total magnitude of undernutrition such as CIAF is a useful tool to quantify undernutrition, especially to identify children with multiple anthropometric failures.

KEY WORDS: Composite index of anthropometric failure (CIAF), conventional measures, undernutrition, covariates, morbidities

Introduction

Nutritious food during early ages of life is a vital input for human capital structure, an essential component for sustainable and evenhanded economic growth. Any huge divergence in the nutrient consumption in either quality or quantity from its necessity can affect growth in several ways. This is particularly so during the period of growth.[1] Adequate nutrition is essential for achieving Millennium Development Goal (MDG) 1, which is to eradicate extreme poverty and hunger, and MDGs 4 and 5, which are to reduce child mortality and improve maternal health.[2]

In any community, under-five children constitute one of the most vulnerable groups for nutritional deficiencies, owing to many factors ranging from low birth weight to maternal ill health to socioeconomic and various environmental factors.[3] Childhood malnutrition is an underlying cause in an estimated

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35% of all deaths among under-five children and 21% of total global disability adjusted life years lost among under-five children.[4]

The estimation of growth in children is vital for screening health status, identifying divergences from normality, and evaluating the efficiency of interventions.[5] The World Health Organization (WHO) Child Growth Standards (2006) are a vital instrument for diagnosing and screening both undernutrition and overweight, thereby tackling the dual burden of undernourishment disturbing populations worldwide.[6] WHO has recommended use of three indicators for assessment of undernutrition: i.e., underweight (low weight-for-age), stunting (low height-for-age), and wasting (low weight-for-height).

The three indices stunting, wasting, and underweight reveal different biological processes, and their use is obligatory for shaping suitable interventions.[5] First, all these three indices cannot offer a complete estimate of the total number of malnourished children in a community, and second, as they overlap, addition of these three indices to obtain the overall prevalence is not possible.[7] Therefore, a comprehensive measure of undernutrition is required to estimate the overall prevalence of undernutrition to include all undernourished children whether they are underweight and/or stunted and/or wasted.

Measurement of undernutrition can be achieved through such an aggregate indicator—the composite index of anthropometric failure (CIAF)—proposed by Svedberg.[8] Six subgroups of anthropometric failure (labeled A–F) were proposed by the basic model, to which Nandy et al. added one more subgroup (labeled Y).[9] The sum of the children in groups B to F provides the CIAF. CIAF as a single tool offers a single number to the overall evaluation of malnourished children in a population, which no other conventional indicators do.[7]

This study was conducted to estimate the overall prevalence of undernutrition among under-five children of urban slum area using CIAF and to study some covariates associated with undernutrition.

Materials and Methods

This community-based cross-sectional study was conducted in an urban field practice area of a tertiary-care institute in Nagpur. Study was conducted in the duration of November 2013 to May 2014. Approval from the Institutional Ethics Committee was sought before the start of the study.

Sampling and Sample Size

According to NFHS-3 report, prevalence of undernutrition (underweight for height, i.e., wasting) among under-five children was 20%. Considering the lowest prevalence of undernutrition, i.e., wasting to be 20%, sample size was calculated using the equation $4pq/L^2$ [where p is the prevalence, q is $1-p$, and L is the allowable error (5%)]. The sample size was found to be 246. However, it was decided to include all under-five children residing the slum area in the study. A pilot study was conducted on 50 under-five children to assess the feasibility, test the proforma, and get an idea about the prevalence of under nutrition in under-five children.

Data collection was done by conducting house-to-house survey. Anganwadi workers' help was sought to seek cooperation from the respondents. All under-five children residing in the slum were included in the study by consecutive house visits. Under-five children who could not be contacted even after three consecutive visits at convenient time were excluded from the study. The timing of the study was adjusted to suit the convenience of the study subjects and ensure their availability in their home. Moreover, under-five children of mothers who did not consent to participate in the study were excluded. Purpose and nature of the study was explained to the parents/guardians of the study subjects, and then, their consent was taken before the start of the study. Information was collected by interview technique, using predesigned and pretested proforma. The respondents were the mothers of the under-five children. The structured proforma covered information on sociodemographic variables, infant and young child feeding practices, and immunization status of study subjects. Birth weight was taken as per the records available at home. The structured questionnaire also covered information on acute childhood morbidities such as acute respiratory infection (ARI), diarrhea, measles, or any other illnesses in the 2 weeks preceding the data collection. The two-week recall period was considered to be most appropriate for confirming that there will be a sufficient number of cases to analyze and that recall errors will not be too severe.

Anthropometric measurement, i.e., height and weight, were taken as per WHO standard techniques.[10] The median weight-for-age, height-for-age, and weight-for-height of the WHO Growth Standards[11] were used as the reference anthropometric indices for this study. Underweight was defined as weight-for-age < 2 standard deviation (SD) below the median weight-for-age. Stunted was defined as height-for-age < 2 SD below the median height-for-age. Wasted was defined as weight for height < 2 SD below the median weight-for-height. Study subjects were classified as underweight, stunted, and wasted accordingly.

For measuring prevalence of undernutrition in children, CIAF was followed. According to CIAF classification,[8] children can be divided into the following seven groups:

I. Group A: no failure;
II. Group B: wasting only;
III. Group C: wasting and underweight;
IV. Group D: wasting, stunting, and underweight;
V. Group E: stunting and underweight;
VI. Group F: stunting only; and
VII. Group Y: underweight only.[9]

From the abovementioned classification, total prevalence of undernutrition is measured by summation of all the groups except group A.

Study subjects requiring immediate health care/attention were referred to the pediatric department of parent institution.

Statistical Analysis

Descriptive statistics such as percentages, mean, SD, and range were used to summarize baseline characteristics of the study subjects. Association between two categorical variables was analyzed by using odds ratio along with 95% confidence interval (CI). *P* value < 0.05 was considered to be statistically significant. Data were analyzed using STATA 10.1 statistical software.

Results

The study population comprised 256 under-five children from purposively selected slum of Nagpur city of central India, of which 144 (56.25%) were boys and 112 (43.75%) girls. According to modified Kuppuswamy socioeconomic status scale, majority [170 (66.41%)] of study subjects were from upper lower socioeconomic class, 56 (21.87%) belonged to lower middle socioeconomic class, and 30 (11.72%) were from lower socioeconomic class. No study subject belonged to upper socioeconomic class. Illiteracy rate among fathers and mothers of the study subjects was 6.25% and 8.20%, respectively. Majority [178 (69.54%)] of the study subjects suffered no illness in past 14 days of the data collection, whereas 53 (20.70%) study subjects showed ARI, 18 (7.03%) diarrhea, and 7 (2.73%) worm infestation.

Age-and gender-wise distribution of study subjects is shown in Table 1. Overall mean (±SD) age of the study subject was 29.42 (±16.29) months, and the range was 1–58 months. However, for boys, mean (±SD) age was 27.79 (±17.12) months, and for girls, it was 31.51 (±14.98) months. Range for boys and girls were 1–58 months and 3–56 months, respectively.

Table 2 shows classification of children with anthropometric failure. CIAF shows disaggregation of the malnourished children into different subgroups. Overall, 106 (41.41%) of under-five children studied were anthropometrically normal. CIAF (sum of study subjects in groups B–Y) was found to be 58.59%, i.e., 156 (58.59%) of the children showed one or the other form of anthropometric failure. Of 256 study subjects, 7 (2.73%) showed wasting only, 27 (10.55%) stunting only, and 33 (12.89%) underweight only. Only 11 (4.3%) showed wasting, stunting, and underweight. Wasting and underweight was found in 21 (8.2%), whereas stunting and underweight was found in 51 (19.92%) of the under-five children. Prevalence of underweight, stunting, and wasting was observed to be 45.31%, 34.77%, and 15.23%, respectively, as shown in Figure 1.

Table 3 shows distribution of children by anthropometric failure and variables. On bivariate analysis, lower socioeconomic status, illiteracy of mother, low birth weight, birth order ≥ three, narrow birth interval (<3 years), immunization not appropriate for age, and presence of childhood morbidities were found to be significantly ($P < 0.05$) associated with anthropometric failure. Exclusive breastfeeding for 6 months was found to be a protective factor against anthropometric failure with OR = 0.25 (95% CI: 0.09–0.58). Gender was not found to be significantly associated with anthropometric failure ($P = 0.87$). Strength of association was found to be highest with lower socioeconomic status [OR = 14.69 (95% CI: 6.31–37.79)] and lowest with narrow birth interval [OR = 2.67 (95% CI: 1.09–6.48)].

Discussion

This community-based cross-sectional study was carried out in an urban slum area to estimate overall prevalence of undernutrition among under-five children of urban slum area using CIAF and to study some covariates associated with undernutrition. Undernutrition is one of the most common causes of morbidity and mortality among children throughout the world and more so in developing nations.[12]

This study found overall prevalence of undernutrition by CIAF to be 58.59%, i.e., 156 of 256 under-five children showed one or the other form of anthropometric failure. Sen and Mondal,[13] Dasgupta et al.,[14] and Seetharaman et al.[7] also showed similar findings, whereas it differed from other studies.[15–18]

Prevalence of underweight was found to be 45.31%. This result is consistent with studies conducted by Seetharaman et al.[7] and Dasgupta et al.[14] But, it varied from the prevalence of underweight in Maharashtra[19] and findings from other studies.[13,15,17,18] Prevalence of stunting was found to be 34.77% in this study. NFHS-3[19] reported 44% stunting in the state of Maharashtra. The current study reported higher prevalence of stunting than those reported in other studies conducted by Dasgupta et al.[17] and Mandal and Bose[15] Stunting being an indicator of chronic malnutrition, it is a result of prolonged food deprivation and/or illness. As this study was conducted in a slum area, this situation persists more often, resulting in higher prevalence of stunting.

In this study, prevalence of wasting was observed to be 15.23%, which was more or less similar to NFHS-3[19] findings in state of Maharashtra (17%) and studies conducted by Seetharaman et al.,[7] Dasgupta et al.,[17] and Savanur and Ghugre,[18] but differed from studies conducted by other researchers.[13–15] This may be because wasting, which is an indicator of acute nutritional deficiency, reportedly occurs owing to recent illnesses (e.g., diarrhea and febrile sickness) or weight loss related to seasonal differences.[20]

It was found that 8.2% of the study subjects belonged to both wasting and underweight, 19.92% to stunting and underweight, and 4.3% to all the three types of undernutrition, i.e., underweight, wasting, and stunting. Moreover, 2.73%, 10.55%, and 12.89% experienced wasting only, stunting only, and underweight only, respectively. It is evident that, if conventional measures of undernutriton are used, a considerable proportion of undernourished children may be missed out.

It is noteworthy that this study and those by other researches[7,13–15] have revealed higher rates of CIAF compared with the other three (stunting, underweight, and wasting) conventional measures of undernutrition individually. Therefore, it is implied that other three measures may actually underestimate

Table 1: Age- and gender-wise distribution of study subjects

Age group (months)	Gender		Total, *N* (%)
	Male, *N* (%)	Female, *N* (%)	
0–6	19 (13.19)	10 (8.93)	29 (11.33)
7–12	21 (14.58)	4 (3.57)	25 (9.77)
13–24	27 (18.75)	22 (19.64)	49 (19.14)
25–36	32 (22.22)	32 (28.57)	64 (25.00)
37–48	17 (11.81)	25 (22.32)	42 (16.41)
49 to <60	28 (19.45)	19 (16.97)	47 (18.35)
Total	144 (100.00)	112 (100.00)	256 (100.00)

Table 2: Classification of children with anthropometric failure (*n* = 256)

Group	Anthropometric status	No. of children (%)
A	No failure	106 (41.41)
B	Wasting only	7 (2.73)
C	Wasting + underweight	21 (8.2)
D	Wasting + stunting + underweight	11 (4.3)
E	Stunting + underweight	51 (19.92)
F	Stunting only	27 (10.55)
Y	Underweight only	33 (12.89)

Table 3: Distribution of children by anthropometric failure and variables (*n* = 256)

Variables	Total	CIAF, *N* (%)	OR (95% CI)	*P*
Male	144	85 (59.03)	1.04 (0.63–1.72)	0.87
Female	112	65 (58.04)		
Lower socioeconomic status	200	142 (71.00)	14.69 (6.31–37.79)	0.0001
Higher socioeconomic status	56	8 (14.28)		
Illiterate mother	21	19 (90.48)	7.54 (1.74–67.85)	0.002
Literate mother	235	131 (55.74)		
Low birth weight[a]	43	34 (79.07)	3.69 (1.59–9.25)	0.0008
Normal birth weight[a]	168	85 (50.6)		
Birth order ≥ 3	31	26 (83.87)	4.16 (1.54–11.22)	0.0023
Birth order ≤ 2	225	125 (55.11)		
Narrow birth interval (<3 years)	91	64 (70.33)	2.67 (1.09–6.48)	0.0159
Birth interval (≥ 3 years)	34	16 (47.06)		
Exclusively breast fed for 6 months	177	100 (56.50)	0.25 (0.09–0.58)	0.0161
Not exclusively breast fed for 6 months	50	42 (84.00)		
Immunization not appropriate for age	40	35 (87.50)	6.15 (2.27–20.75)	0.0001
Immunization appropriate for age	216	115 (53.24)		
Childhood morbidities	78	71 (91.03)	12.71 (5.4–34.29)	0.0001
No childhood morbidities	178	79 (44.38)		

[a]There was no documented evidence of birth weight in 45 study subjects. Hence, they were excluded from final analysis.

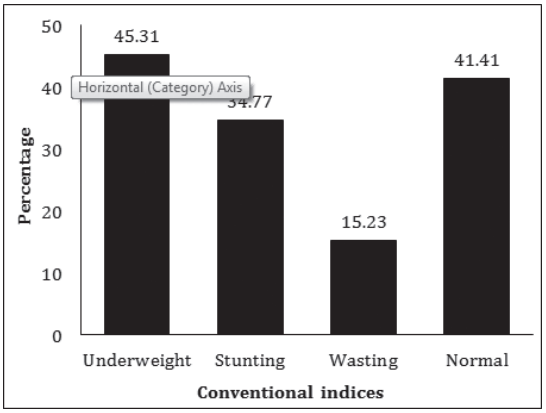

Figure 1: Nutritional status of study subjects by conventional indices.

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.[15] This could be a tool of considerable interest to health planners and policymakers—especially considering the fact that, to compute the CIAF, the only additional data that needs to be collected is the height of the child.[7]

The current study shows a significant association of anthropometric failure with lower socioeconomic status, illiteracy of mother, low birth weight, birth order, narrow birth interval, exclusive breastfeeding, immunization status, and childhood morbidities. Dasgupta et al.[14,17] also found association of anthropometric failure with mothers' literacy status, birth weight, birth order, presence of morbidities, and exclusive breastfeeding. Shit et al.[16] also found association with mothers' education. Bhavsar et al.[21] found significant association of undernutrition with birth order, exclusive breastfeeding, and immunization status.

Strengths of this study are that it is a community-based study and all standard techniques were used to measure anthropometric indices. This study experienced certain limitations: information about birth was not available for 45 study subjects and, hence excluded from final analysis. Recall bias could not be averted.

The results of the current study indicate that the prevalence of undernutrition is considerably high in the study area as estimated by CIAF and is still an important problem among under-five children of urban slum. As low birth weight, exclusive breastfeeding, and immunization status revealed significant effect on undernutrition, more emphasis should be given on nutrition education during pregnancy, optimal infant feeding practices, and immunization of children.

An aggregate and comprehensive measure of the total magnitude of undernutrition such as CIAF is a useful tool to quantify undernutriton, especially to identify children with multiple anthropometric failures. Therefore, the study recommends incorporation of CIAF—a comprehensive measure to estimate overall load of undernutrition so that the children with multiple anthropometric failures are detected.

Conclusion

The overall prevalence of undernutrition among under-five children was found to be 58.59%, which was higher than that estimated by conventional measures of undernutrition (underweight, stunting, and wasting). An aggregate and comprehensive measure of the total magnitude of undernutrition such as CIAF is a useful tool to quantify undernutriton, especially to identify children with multiple anthropometric failures.

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