Short Communication

Are we Underestimating the Real Burden of Malnutrition? An Experience From Community-Based Study

Disha Agarwal, Sunil Kumar Misra, Shailendra Singh Chaudhary, Gyan Prakash

Department of Community Medicine, Sarojini Naidu Medical College, Agra, Uttar Pradesh, India

ABSTRACT

Background: Since the inception of childhood nutritional programs in India, underweight has been taken to judge the nutritional status of children; but is it a true indicator of overall prevalence of malnutrition in a community? Objective: To estimate the overall prevalence of malnutrition by using Composite Index of Anthropometric Failure (CIAF) and to assess its usefulness over various conventional anthropometric indicators among under 5 children residing in Agra city. Materials and Methods: A cross-sectional, community-based study was conducted among under 5 years age children, from June 2012 to July 2013 in an urban slum of Agra. Nutritional status was assessed using anthropometry and clinical examination, and classified as per World Health Organization (WHO) 2006 Growth Standards and CIAF. Results: Of the 458 children studied, 42.8% were underweight, 41.9% had stunting, while 22.7% had wasting. However, 60.04% of children were found to be malnourished as per the CIAF. Unlike three conventional anthropometric indicators of malnutrition, CIAF was observed to have a much consistent association with morbidity like diarrhea episodes in past 3 months (odds ratio (OR) = 2.09), acute respiratory tract infection (ARI) episode in past 3 months (OR = 1.58), and any illness requiring hospitalization (OR = 1.29). Conclusion: The CIAF should supplement the conventional indices of malnourishment, to provide a single, aggregated figure of actual number of undernourished children in a given population.

Keywords: Composite index of anthropometric failure (CIAF), malnutrition, stunting index (SI), stunting, underweight, underweight index (UI), wasting index (WI), wasting

Introduction

Inspite of the significant improvement in food production and advancement in science since independence, under nutrition continues to be a widespread problem in India. (1) The Government of India has initiated several large scale supplementary feeding programs in last 65 years; still one in three of world’s malnourished children live in India, which speaks volumes of the sorry state of the nutritional status of the supposed future of the nation. (2) As per National Family Health Survey (NFHS) 3 data (2005-2006); 48% of Indian children, less than 5 years of age were stunted, 43% were underweight, and 20% of children had wasting. (3) Although, these statistics speak a lot about the prevalence of various forms of malnourishment among under 5 children, still they fail to answer a simple question that at a given point of time “how many Indian children are malnourished?”

These conventional indicators of undernourishment, for example, underweight (i.e., low weight for age), stunting (i.e., low height for age), and wasting (i.e., low weight for height) used separately, do not reflect the holistic burden of malnourishment. This is because stunting reflects chronic malnourishment; on the other hand wasting describes acute malnourishment; whereas, underweight takes into account both acute and chronic

Address for correspondence:
Dr. Disha Agarwal, JR III, Department of Community Medicine, Sarojini Naidu Medical College, Agra - 282 002, Uttar Pradesh, India.
E-mail: agarwal@shasa.org
Received: 15-04-14, Accepted: 05-11-14
malnourishment, but misses out on stunted or wasted children whose weight is appropriate for their age.\(^{(3)}\)

Various indices have been tried time and again, to assess the holistic or the actual burden of malnutrition among under 5 children; one of them is Composite Index of Anthropometric Failure (CIAF) which has drawn the attention of nutrition scientists all over the world. CIAF incorporates all the three forms of malnourishment (i.e., underweight, stunting, and wasting) into one, and thus gives an overview of the total prevalence of malnourishment.

CIAF model was first developed by Peter Svedberg, a Swedish development economist, in year 2000.\(^{(4)}\) Lately, Nandy et al., (2005) modified and used the CIAF on Indian data and argued its usefulness over the three conventional anthropometric measurements (i.e., underweight, stunting, and wasting).\(^{(5,6)}\)

With the objective of using the CIAF model as proposed by Nandy et al.,\(^{(5)}\) following study was conducted to estimate the actual or true prevalence of malnutrition and to assess its usefulness over various conventional anthropometric indicators among under 5 children residing in Agra city.

**Materials and Methods**

The present study was a cross-sectional study carried out in the urban field practice area of Department of the Social and Preventive Medicine, S.N. Medical College, Agra from June 2012 to July 2013. Ethical approval was taken from Institutional Ethics Committee before commencing the study.

With prevalence of CIAF among under 5 Indian children as 60%, maximum allowable error of 8%, nonresponse error of 10%, a minimum sample size of 458 was calculated. Simple random sampling was done to achieve the desired sample size. Informal verbal consent was taken from the parents of the study subject. Subjects whose parents did not consent to being a part of the study, who were very sick or those who were unavailable at two consecutive visits were excluded from the study.

Information regarding pertinent variables to the child’s nutrition was recorded on a predesigned, pretested, semistructured questionnaire. Mother was chosen as the preferred responder; if mother was not available, grandmother or father or any elderly was chosen as the responder. The exact age in months of the child was computed from the child’s date of birth as told by respondent. When the exact date of birth was not known, the age as told by respondent was used, corrected to the nearest month. The respondents were asked for the relevant sociodemographic factors, any past history of illness of the child which required hospitalization, any history of acute respiratory tract infection (ARI) in the past 3 months, and any episode of diarrhea in the past 3 months, suffered by the child.

**Anthropometry**

Height and weight measurements were recorded following the standard techniques. Weight was measured using the weighing scale, especially for children under 5 years of age, supplied to the Aganwadi workers under Integrated Child Development Services (ICDS) by Government of India. Zero error was checked and adjusted for before every measurement. The weighing scale used could measure maximum 25 kg weight, closest to 100 g (Crown weighing machine, ISO certified 9001, marketed by Ramsons Surgical Company). The weighing scale was standardized after every 50 measurements by using known weights. Weight of the subjects was measured with minimal clothing and bare feet.

The supine length for children up to 2 years of age was recorded to the nearest of 0.1 cm using an infantometer. For children aged >2 years, height was measured by stadiometer.

**Assessment of nutritional status**

The nutritional status of the children was assessed by plotting the weight and height of the children on World Health Organization (WHO) 2006 Growth Standards growth charts using z-scores. Children falling below the −2 standard deviation (SD) cutoff were considered to be underweight (weight for age), stunted (height for age), and wasted (weight for height).

Further analysis of data was done and CIAF was calculated, which included all the study subjects who had any form or combination of any form of malnourishment.\(^{(6)}\) Combination of various forms of malnourishment was categorized as the following table: [Table 1].

Underweight index (UI), stunting index (SI), and wasting index (WI) were also calculated using the following formulae:\(^{(6)}\) [Table 2].

**Statistical analysis**

The data thus collected was analyzed by using Statistical Package for Social Sciences (SPSS) and Excel package. Significance of differences in the outcome variable between subgroups was tested by using appropriate statistical tests.
Results

The prevalence of underweight, stunting, and wasting was 42.8, 41.9, and 22.7%, respectively; however, an overall of 60.04% of the study subjects were found to be faltering on the CIAF. Prevalence of underweight and stunting peaked in the 36-47 months age group; whereas, wasting and CIAF were maximum in the 12-23 months age group [Figure 1]. The CIAF increased significantly from 32.9% in 0-11 months age group to 72.9% in 12-23 months age group. However, further on, the prevalence of CIAF attained a plateau, with no significant change in the subsequent age groups [Table 3].

The table shows that 60.04% of the study subjects were suffering from some or the other form of undernourishment (CIAF). Maximum subjects were in group E (underweight and stunting only, 22.7%), followed by 12% in group F (stunting only), and 10.3% in group C (underweight and wasting only). Prevalence of underweight, stunting and wasting combined (Group D) was 7.2%. Least prevalence of study subjects was in underweight only category Y (underweight only, 2.6%) [Figure 2 and Table 4].

UI which shows percent of the total malnourished subjects that were underweight, was 0.713, that is, 71.3% of the malnourished children were underweight. SI was 0.698, that is, 69.8% of the malnourished children were stunted. 37.8% of the malnourished study subjects had wasting, as the WI was 0.378 [Table 5].

Table 6 shows that study subjects detected by CIAF had consistent association, with morbidity indicators like illness requiring hospitalization, ARI episode in past 3 months, and diarrhea episodes in past 3 months; in comparison to the conventional indices of malnourishment like underweight, stunting, and wasting.

Discussion

The study shows that CIAF gives a better overview of the overall prevalence of malnutrition in the society. The conventional indicators of malnourishment like underweight, stunting, or wasting; when dealt with individually, miss out on many afflicted individuals who turn out to be apparently normal for that individual criterion. On the other hand, CIAF provides a better picture of childhood nutritional status as it incorporates all the three conventional indicators in unity and so describes the actual number of children suffering from any form of malnourishment. In present study, 60.04% of the children were observed to be undernourished as per CIAF. Various authors have found almost similar prevalence of malnutrition throughout India by using CIAF. Such as Anwar et al., (2013) in rural Varanasi, Nandy et al., (NFHS-3 national data; 2013) and Nandy and Miranda (NFHS-2 national data; 2008) reported prevalence of anthropometric failure as 62.5, 62, and 59.8%, respectively, among children under 3 years age. However, Bose and Mandal (2010) showed a higher

![Figure 1: Age-wise distribution of malnutrition among study subjects. CIAF: Composite Index of Anthropometric Failure](image1.png)

![Figure 2: Combination of various forms of malnourishment](image2.png)
Agarwal, et al.: Estimating the real burden of malnutrition

Table 3: Prevalence of malnutrition among study subjects

| Category | Age in months |
|----------|---------------|
|          | 0-11 (n = 88) | 12-23 (n = 118) | 24-35 (n = 85) | 36-47 (n = 88) | 48-60 (n = 79) | Total (n = 458) |
| Underweight | 17 (19.3) | 58 (49.2) | 39 (45.9) | 45 (51.1) | 37 (46.8) | 196 (42.8) |
| Stunted | 10 (11.4) | 55 (46.6) | 45 (52.9) | 50 (61.8) | 32 (40.5) | 192 (41.9) |
| Wasted | 21 (23.9) | 40 (33.9) | 17 (20.0) | 10 (11.4) | 16 (20.3) | 104 (22.7) |
| CIAF | 29 (32.9) | 86 (72.9) | 54 (63.5) | 56 (63.6) | 50 (63.3) | 275 (60.04) |

Table 4: Combination of various forms of malnourishment

| Group name | Description | N (%) |
|------------|-------------|-------|
| A | No failure | 183 (39.96) |
| B | Wasting only | 24 (52) |
| C | Underweight + wasting only | 47 (10.3) |
| D | Underweight + stunting + wasting | 33 (7.2) |
| E | Underweight + stunting only | 104 (22.7) |
| F | Stunting only | 55 (12) |
| Y | Underweight only | 12 (2.6) |
| B+C+D+E+F+Y | CIAF | 275 (60.04) |
| Total | | 458 (100) |

Table 5: Values of SI, UI, and WI among the studied children

| Index | Overall CIAF = 275 |
|-------|-------------------|
| Underweight index (UI) | 196/275 = 0.713 |
| Stunting index (SI) | 192/275 = 0.698 |
| Wasting index (WI) | 104/275 = 0.378 |

prevailence of under nutrition, that is, 73.1% of the studied children by using CIAF, which could be attributed to the rural setting in which the study was conducted. Seetharaman et al., (2007) also reported that higher, that is, 68.6% of the under 5 children were in a state of “anthropometric failure”.

Classifying malnutrition into groups like A, B, C, D, E, F, and Y as mentioned in the study, can help to estimate the gravity of malnourishment problem in the community, in a better way. Children falling in the subgroup D, had all three problems, that is, underweight, wasting, and stunting; giving clear indications of worst form of malnourishment, requiring intervention at the earliest.

In the present study, maximum subjects were in group E (underweight and stunting only, 22.7%), followed by 12% in group F (stunting only), and 10.3% in group C (underweight and wasting only). Prevalence of underweight, stunting, and wasting combined (Group D) was 7.2%. Similarly, Seetharaman et al., (2007) observed that maximum study subjects were in group E (stunting + underweight) accounting for 24.7%, closely followed by group F (stunting only) 19.3%. 11.9% of the children were in group C (wasting + underweight). Proportion of children in group D (underweight, stunting, and wasting combined) was 5.7%. However, Anwar et al., (2013) observed that of the six subgroups with undernourishment, group F (containing children who are stunted only) was the largest group, accounting for 16.1% children in the sample. Children who simultaneously have wasting, stunting, and underweight (i.e., those in group D) accounted for 12.4% of the children in the sample.

Present study showed that UI was 0.713, SI was 0.698, and WI was 0.378. Anwar et al., (2013) observed that sex-combined overall values of SI, UI, and WI were 0.689, 0.563, and 0.503, respectively. Nandy and Miranda (2008) reported in a sample of 24,396 children SI, UI, and WI as 0.756, 0.788, and 0.266, respectively. Bose and Mandal (2010) showed that overall values of SI, UI, and WI in his study, were 0.364, 0.866, and 0.684, respectively.

The present study also shows that malnourished subjects as detected by CIAF, had much consistent association with morbidity indicators like illness requiring hospitalization, ARI episode in past 3 months, and diarrhea episodes in past 3 months; in comparison to the conventional indices of malnourishment like underweight, stunting, and wasting which is in consistence with the well-established fact of the vicious cycle of morbidity and undernourishment.

Conclusion

As evident from the findings of the present study, if we continue to rely solely on the conventional indices of malnutrition, we might miss out on the real burden of malnourishment. We, as public health specialists, must realize the importance of estimating the actual burden of malnourishment, for proposing and making sure effective implementation of interventions. This proposed new model of CIAF is a promising tool to estimate the true prevalence of malnutrition in community. Other indices like UI, SI, and WI, give a better overview of the proportion of undernourished children suffering from underweight, stunting, or wasting, respectively, as compared to the traditional indicators. Having said that, the importance of the conventional indicators cannot be under estimated as they reflect distinct biological processes, but the new indices can surely supplement the information by providing a single, aggregated figure of the number of undernourished children in a population.
Table 6: Morbidity profile of study subjects using various malnutrition indices

| Category   | Illness requiring hospitalization | ARI episodes in past 3 months | Diarrhea episodes in past 3 months |
|------------|----------------------------------|-----------------------------|-------------------------------------|
|            | Odds ratio | 95% CI       | Odds ratio | 95% CI       | Odds ratio | 95% CI       |
| Underweight| 1.01        | 0.65-1.56    | 1.47       | 0.91-2.37    | 1.69       | 1.15-2.48    |
| Stunted    | 1.16        | 0.75-1.80    | 1.07       | 0.66-1.74    | 2.36       | 1.58-3.52    |
| Wasted     | 0.94        | 0.56-1.59    | 1.5        | 0.88-2.56    | 1.38       | 0.88-2.15    |
| CIAF       | 1.29        | 0.82-2.04    | 1.58       | 0.95-2.62    | 2.09       | 1.4-3.13     |

CIAF: Composite index of anthropometric failure, ARI: Acute respiratory tract infection, CI: Confidence interval

References

1. Park K. Textbook of Preventive and Social Medicine. 22nd ed. Jabalpur: M/s Banarsidas Bhanot. p. 563.
2. Kishore J. National Health Programs of India. 11th ed. India: Century Publications. p. 461.
3. National Family Health Survey: 2005-2006. p. 3.
4. Svedberg P. Poverty and Undernutrition; Theory, Measurement and Policy. New Delhi: Oxford India Paperbacks; 2000.
5. Nandy SM, Irving M, Gordon D, Subramanian SV, Davey Smith G. Poverty, child undernutrition and morbidity: New evidence from India. Bull World Health Organ 2005;83:210-6.
6. Nandy S, Miranda JJ. Overlooking undernutrition? Using a composite index of anthropometric failure to assess how underweight misses and misleads the assessment of undernutrition in young children. Soc Sci Med 2008;66:1963-6.
7. Bose K Jr, Mandal GC. Proposed New Anthropometric Indices of childhood Undernutrition. Mal J Nutr 2010;16:131-6.
8. Anwar F, Gupta MG, Prabh C, Srivastava RK. Malnutrition among rural Indian children: An assessment using web of indices. Int J Public Health Epidemiol 2013;2:78-84.
9. Seetharaman N, Chacko TV, Shankar SR, Mathew AC. Measuring malnutrition — the role of Z-scores and the Composite Index of Anthropometric Failure (CIAF). Indian J Commu Med 2007;32:35-9.

How to cite this article: Agarwal D, Misra SK, Chaudhary SS, Prakash G. Are we underestimating the real burden of malnutrition? An experience from community-based study. Indian J Community Med 2015;40:268-72.

Source of Support: Nil, Conflict of Interest: None declared.