

SHORT ARTICLE

Assessment of undernutrition among children below 5, using Composite Index of Anthropometric Failure (CIAF)

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Abstract

Background: SDG 2.2 aims to end all forms of malnutrition by 2030. Weight for age estimate misses out chronic and acute on chronic malnutrition. An aggregate indicator-the Composite Index of Anthropometric Failure (CIAF) can help in addressing this concern. **Aim & Objective:** To assess the nutritional status of under five children using CIAF and compare it with other indices. **Material & Methods:** A cross-sectional, descriptive study was conducted in a resettlement colony of Delhi, between June to July 2015. Anthropometric measurements were taken using standard operative procedures. Mothers of the study children were interviewed to obtain relevant information. Z scores were calculated using WHO-ANTHRO software. Nutritional status indicators were determined as per the World Health Organization 2006 child growth standards. **Results:** A total of 100 under-5 children were assessed. The prevalence of CIAF was 62% in our study. 35% of children were found to be underweight, 25% were wasted and 43% stunted. Mid Upper Arm Circumference detected 58.5% as undernourished. Using weight-for-age criterion for identifying undernourished children led to underestimation of the prevalence by 27%. **Conclusion:** CIAF can be used to provide a single, aggregated assessment of undernutrition. Use of this tool by field level workers will improve the diagnosis of undernutrition and help in early initiation of treatment.

Keywords

CIAF; Malnutrition; Mid Upper Arm Circumference; Wasting; Stunting; Underweight.

Introduction

Nutrition is of paramount importance for human well-being and productivity. Target 2.2 aims to end all forms of malnutrition by 2030. Undernutrition is conventionally determined through anthropometric measurements and reported separately for wasting, stunting and underweight. However, children can experience multiple deficits concurrently. (1)

The current WHO recommendation is to use the Z-Score or Standard Deviation system to grade undernutrition. Children with a Z-Score of less than -2 are considered to be undernourished and those with a Z-Score of less than -3 are considered to be severely undernourished.(2) None of the three indices are individually able to provide a comprehensive estimate of undernutrition in the community

For a comprehensive measure of the overall prevalence of undernutrition, a single aggregate indicator that incorporates all undernourished children.

An aggregate indicator CIAF i.e. Composite Index of Anthropometric Failure was proposed by development economist Peter Svedberg in 2000. (3) He suggested that children with wasting, stunting or underweight are all undernourished and in a state of anthropometric failure. Nandy *et al* have proposed a modification by adding the subgroup Y, which represents children who are only underweight. (3) This study uses the WHO Z-score system and CIAF to assess the nutritional status in under-5 children living in resettlement colonies.

Aims & Objectives

To assess the nutritional status of under-5 children using CIAF and compare it with other indices.

Material & Methods

Study Settings: The study was conducted in a primary health care centre, Tikri Khurd, Delhi, India, where the health-care services are provided by department of community medicine under the purview of University College of Medical Sciences, Delhi.

Definition of terms and classification system under CIAF -

A. Nutritional status of under-5 children was assessed using different indices of growth:

1. The anthropometric measurements, that is, height, weight and mid upper arm circumference of each subject, were taken. Z scores were calculated using WHO-ANTHRO software v3.2.2.
 - Weight for age (WZA): Underweight for age is defined as Z-score < -2.0 SD of the WHO (2006) reference standards.
 - Height for age (HFA): Stunting is defined as Z-score < -2.0 SD of the WHO (2006) reference standards.
 - Weight for height (WFH): Wasting is defined as Z-score < -2.0 SD of the WHO (2006) reference standards.
 - Mid upper arm circumference (MUAC): The cut-off points for MUAC of 12.5 cm was used for identifying children with undernutrition, a MUAC of between 12.5 and 11.5 cm denoted moderate undernutrition, and less than 11.5 cm denoted severe undernutrition.

2. For measuring prevalence of malnutrition in children, CIAF was followed. According to CIAF classification children can be divided into following seven groups:

- Group A: No failure
- Group B: Wasting only
- Group C: Wasting and underweight
- Group D: Wasting, stunting, and underweight.
- Group E: Stunting and underweight
- Group F: Stunting only
- Group Y: Underweight only

B. Morbidity profile of under-5 children- It was assessed by enquiring about the episode of diarrhoea and Upper respiratory tract infection in past 1 month from day of data collection

C. Biological factors (age of mother during the child birth; birth order of the child; birth weight of the child; and gestational age of the child at birth)

Sample Size: Considering the prevalence of CIAF as 59.8% as per the study conducted by Nandy *et al* (3), with 10% relative precision, 95% confidence level, the sample size was calculated to be 92 using Epi Info 7 software, which was later rounded off to 100.

Study Population: Under-5 children visiting primary health care centre, Tikri Khurd.

Study Tools:

1. Predesigned pretested Questionnaire
2. Portable weighing machine (properly calibrated)
3. Baby weighing machine (properly calibrated)
4. Non-stretchable measuring tape
5. Infantometer

Method of Data Collection: The mothers of these children were interviewed with the help of a predesigned, pretested, semi-structured questionnaire after obtaining consent from the mothers who were assured of anonymity and confidentiality of information collected. Information was obtained regarding different demographic, socioeconomic, and biological factors of children and their family. For assessing nutritional status, clinical examination and anthropometric measurements were carried out following standard operating procedures. The data included were weight, recumbent length /standing height, and MUAC. Weight was measured to the nearest 0.1 kg using a Salter weighing machine and standard weighing (bathroom) scale. Height was measured using a nonstretchable 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 using an infantometer. Data thus collected were analyzed by simple frequency distribution tables, mean, standard deviation (SD), and multivariate analysis using SPSS software, version 20.

Results

Mean (SD) age of the under-5 children in the study was 22.2 months (± 16.7), of which 53% were males and 47% were females. Mean age of mother was 24.6 years (± 2.6)

47% of the study participants were girls, 59% were living in a joint family. Maximum number of children were in the age group of 0-11 months. 19% of the children were having low birth weight at the time of birth whereas birth weight was not known for 42%. Majority (90%) of the mothers of study participants practiced exclusive breast feeding (EBF).

Anthropometric Indices:

About 62% children were diagnosed with undernutrition according to CIAF whereas with standard anthropometric indices such as WZA, WHZ, HAZ, and MUAC prevalence of malnutrition was found to be lower, that is, 35% (underweight), 25% (wasting), 43% (stunting), and 58.5% (undernutrition), respectively. [Figure 1](#) shows the comparison between CIAF and other indices used to measure malnutrition. It can be concluded that an aggregate index like CIAF predicts undernutrition better than the conventional indices.

More than half of the children had an episode of diarrhoea (58%) and ARI (57%).

[Table 3](#) shows the prevalence of undernutrition as measured by CIAF among children under 5 years of age based on the age groups. Maximum prevalence (21%) was observed in the age group 0-11 months followed by children in age group 12-23 months (13%).

[Figure 2](#) depicts age wise distribution of undernourishment as measured by different indices. As can be observed that CIAF being a composite indicator, measures prevalence of undernutrition better as compared to other conventional indices.

Discussion

The present study showed that around two third children were undernourished (assessed by CIAF) which is similar to previous reports (3,4,5). Though the study of Dasgupta *et al* reports lower rate of 32.7% (6). Results showed that the prevalence of

stunting representing past or chronic malnutrition was 43% while underweight and wasting representing acute malnutrition were 35% and 25% respectively. These rates were consistent with other studies (7,8,9). The National Family Health survey (NFHS)-4 showed that at national level the rates of under-nutrition for children younger than five years of age were 35.7% for underweight, 38.4% for stunting and 21.0% for wasting (10). For the National Capital Territory(NCT) Delhi, 32.3% of children under the age of five years are stunted, 17.1% are wasted and 27% are underweight (11). Rapid Survey on Children (RSoc) reports 38.7% stunting, 29.4% underweight and 15.1% wasting amongst children aged 0-59 months and the corresponding values for Delhi were 29.1% stunted, 19.4% underweight and 14.3% wasted. Currently at the anganwadi centres classification is based on weight-for-age under the Integrated Child Development Services (ICDS). This system fails to identify 27% of undernourished children.

The results of this study indicated that gender differences in childhood nutrition were not observed. The risk of undernutrition increases with age. Children in the youngest age group (0-11 months) had a higher risk of being undernourished. Children were also assessed for anthropometric failure using CIAF, which permits us disaggregation of the undernourished children in to different subgroups for further analyses. In [Table 2](#) we observe that 62% of the children were sufferings from one or other form of anthropometric failure. By using low weight for age (underweight) as the sole criterion for undernutrition we can identify 35% children from subgroups C, D, E and Y, but will be missing those in subgroups B and F children who were stunted and wasted but not underweight in the present study. Therefore 17% such children would be missed out as not undernourished. Similarly, stunting misses groups B, C and Y (20% of children); and wasting misses those children in groups E, F and Y (37% of children). It demonstrates that large number of undernourished children are not identified by using current methods.

In a global comparison, the present CIAF is higher than Nepal (56.5%), Tanzania (45.9%), Zimbabwe (35.8%), Bolivia (26.6%) and Peru (23.8%) (12)

Conclusion

This study provides a comprehensive picture of childhood malnutrition measurement. The findings

reveal that malnutrition is a critical issue that needs to be managed in a holistic approach. Currently the measures of undernutrition do not provide a complete estimate of the overall number of undernourished children in a population. CIAF as an indicator addresses this issue. Results of the present study concluded that the conventional measures of undernutrition may be missing out a considerable proportion of undernourished children present in the population.

Under the ICDS severely undernourished children are a beneficiary for receiving additional nutritional supplementation. Therefore, an underestimation of severely undernourished children might prevent them from the benefits of the extra supplementation.

CIAF classifies children in subgroups which allows the researcher to further examine the relationship between various combinations of sub-groups of undernutrition and factors affecting malnutrition in under-5 children and predictors of morbidity/mortality along with undernutrition.

Recommendation

CIAF can be used in place of the weight for age measure currently being used under ICDS scheme to assess the true level of undernutrition among under five children.

Limitation of the study

Limitations of the present study were that it was conducted in a primary health care setting, there are chances of low external validity and none of the indices can be termed as “The Gold Standard” as sensitivity and specificity of the tools was not assessed.

Relevance of the study

The current study is the first study done among under five children residing in resettlement colony of Delhi for assessment of nutritional status using CIAF.

Authors Contribution

All the three authors have contributed equally in the preparation of the manuscript of this article.

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Tables

TABLE 1 BACKGROUND INFORMATION OF THE STUDY POPULATION (N=100)

Variables	Frequency
Age (months)	
0-11	36
12-23	22
24-35	12

36-47	17
48-59	13
Gender	
Male	53
Female	47
Type of family	
Nuclear	41
Joint	59
Education of mother	
Illiterate	34
Primary (1-5)	22
Middle (6-8)	28
Senior (9-12)	11
Graduate	5
Birth wt. (in Kg)	
≤ 2.5	19
>2.5	39
Not known	42
Birth order	
1	42
2	35
3	16
4	7
Feeding practice in first 6 months	
EBF	90
Mixed	10

TABLE 2 ASSESSMENT OF NUTRITIONAL STATUS OF CHILDREN ACCORDING TO DIFFERENT ANTHROPOMETRIC INDICES (N = 100)

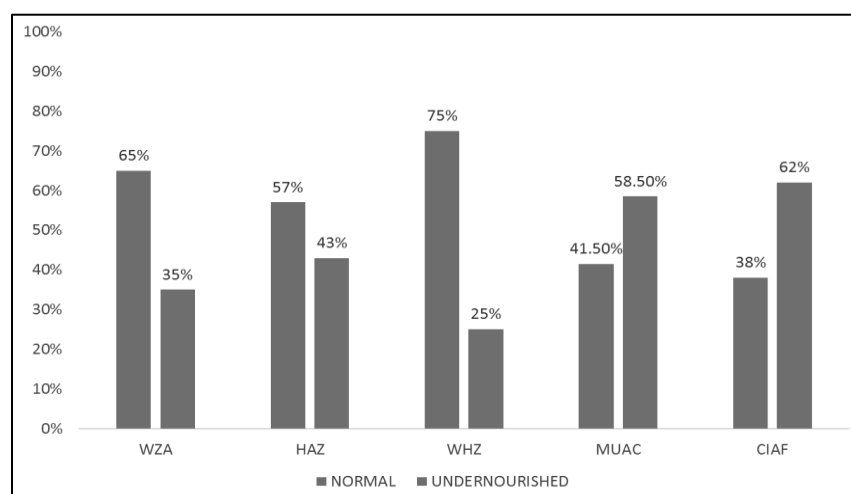
ANTHROPOMETRIC INDICES	Percentages (%)
WZA	
Normal	65
Underweight (< -2SD)	24
Severely underweight (< -3SD)	11
HAZ	
Normal	57
Stunted (< -2SD)	21
Severely stunted (< -3SD)	22
WHZ	
Normal	75
Wasted (<-2SD)	12
Severely wasted (< -3SD)	13
MUAC*	
Normal	41.5
Moderate undernutrition (< -2SD)	36.5
Severe undernutrition (<-3 SD)	22.0
CIAF	
Group A (No failure)	38
Group B (Wasting only)	8
Group C (Wasting and underweight)	11
Group D (Wasting, stunting and underweight)	6
Group E (Stunting and underweight)	17
Group F (Stunting only)	19
Group Y (Underweight only)	1

* n=82 (MUAC is considered for children 6 months and above)

TABLE 3 PREVALENCE OF UNDERNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE BASED ON THE AGE GROUPS

AGE (MONTHS)	A	B	C	D	E	F	Y	CIAF (B-Y)	TOTAL
0-11	15	3	4	1	7	5	1	21	36
12-23	9	1	4	1	2	5	0	13	22
24-35	3	1	0	1	3	4	0	9	12
36-47	7	0	3	1	4	2	0	10	17
48-60	4	3	0	2	1	3	0	9	13
TOTAL	38	8	11	6	17	19	1	62	100

Figures

FIGURE 1 COMPARISON BETWEEN CIAF AND OTHER INDICES**FIGURE 2 DEPICTS AGE WISE DISTRIBUTION OF UNDERNOURISHMENT AS MEASURED BY DIFFERENT INDICES**