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ORIGINAL ARTICLE

Socio-demographic Risk Factors of Child Undernutrition

Dinesh Kumar[1], Poonam C Mittal[2], Munesh K Sharma[1]

Abstract: Objectives: (1) To find the extent of undernutrition among under-five children in terms of stunting, wasting and underweight and also by composite index of anthropometric failure (CIAF). (2) To investigate some socio-demographic risk factors of child undernutrition. **Study Design**: Cross-sectional**. Methods**: A total of 371 under-five children from 816 households selected by stratified multi-stage random sampling technique. Collected information included weight, height, age, gender, social background, total calorie availability in the family, standard of living Index etc. Nutritional status was assessed by WHO criterion and CIAF. Statistical tests like Normal test of proportions, Chi-square test, Kolomogrov-Smirnov one sample test. Analysis of Variance (ANOVA) technique, Tukey's test and Multivariate Logistic Regression Model were used. **Results**: Proportions of underweight, stunting and wasting were found respectively 49.1%, 40.7% and 14.6% respectively. Children belonging to slum area and of low standard of living index were at significantly higher risk (P<0.001) of being underweight. Anthropometric failure was observed in 62.8% children. Mean TCA for urban area was significantly higher (P<0.001) than those for rural and slum areas. There were 57.1% children (72.3% in slums 71.3% from low SLI category) who were from TCA deficient families. About seventy five percent families of low standard of living, total calorie availability was below RDI and 73.1% children belonging to these families were having anthropometric failure. TCA deficiency was significantly associated (P<0.001) with both SLI and social background. Low standard of living comes out to be an important risk factor of anthropometric failure irrespective of social background **Conclusions:** Undernutrition among under-five children should also be assessed by using composite index of anthropometric failure in order to avoid overlapping of different subgroups formed on the basis of standard indices of stunting, wasting and underweight. Low SLI comes out to be a risk factor of child undernutrition irrespective of social background. Nutritional status of children can be improved through social development by raising standard of living of people.

Keywords: Anthropometric Failure; Composite Index of Anthropometric Failure (CIAF); Multivariate Logistic Regression Model Stratified Multistage Random Sampling Technique; Stunting, Standard of Living Index (SLI); Total Calorie Availability (TCA); Underweight, Wasting.

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Introduction

Undernutrition continues to be a primary cause of ill-health and premature mortality among children in developing countries. Out of 167 million underweight under-five-year old children in the world, 90 million live in South Asia [1].

Child mortality rates as well as the incidence of malnutrition among young children remain high in India. According to the Global Strategy for Infant and Young Child Feeding [2], "Malnutrition has been responsible, directly or indirectly, for 60 per cent of the 10.9 million deaths annually among children under five". About 25% of these deaths under-five occur in India alone. Despite global efforts for improving maternal and child health and specific efforts like Integrated Child Development Services (ICDS), desired outcomes could not be achieved in India. On this basis of indices derived from anthropometric data, World Health Organization (WHO) classifies children in terms of underweight, stunted, and wasted. The prevalence of stunting, underweight and wasting are reported to be 45%, 47% and 16% respectively in India by UNICEF [3]. NFHS-3 survey [4] reported 52% to be underweight, 56% stunted and 11% wasted among under-three children in Uttar Pradesh (UP). At National level these figures are reported to be 42.5%, 48% and 19.8% among fewer than five children. In a study [5] conducted by Institute of Applied Statistics and Development Studies (IASDS), prevalence rates of underweight, stunting and wasting among children under 5 years of age (referred as under-five children) to be 52%, 59% and 20% respectively in this state whereas in studied area i.e. Allahabad these percentages are reported to be 42.4%, 66.1% and 11.7% respectively in this study. About two-thirds of under-five children in UP are suffering from protein energy malnutrition [1]. The problem of malnutrition in this state shows a lot of regional variations, which may be due to its diversified geographical, socio-cultural and economic conditions. Social factors are among important determinants of young child undernutrition.

Undernutrition on the basis of standard indices, that is, stunting, underweight and wasting suggested by WHO have some shortcomings as they do not provide any comprehensive estimate of undernutrition and also have the disadvantage of overlapping [6,7]. They have suggested a composite index of anthropometric failure (CIAF) for assessing undernutrition classifying children into different subgroups of anthropometric failure. The CIAF based upon stunting, wasting and underweight, provides a single, aggregated figure of the number of undernourished children in a population.

Present study aims at assessing the problem of undernutrition using CIAF and also some socio-economic issues related with the problem of undernutrition. The study has specific objectives: (1) to find the extent of undernutrition among under-five children as measured by CIAF identifying the children into different subgroups of anthropometric failure. (2) To compare the CIAF to conventional indices of undernutrition in terms of stunting, wasting and underweight (3) To investigate some socio-demographic risk factors of anthropometric failure.

Material and Methods

The present cross- sectional study is a part of a detailed nutritional survey conducted at Centre of Food Technology, University of Allahabad (UP) during May – July 2005 in rural, urban and slum areas of Allahabad. A stratified multi-stage random sampling technique was used to select under-five children as study subjects. The whole study area was divided into three geographical strata: rural, urban, and urban slum. Within each stratum, two clusters (villages/urban wards) were selected at random as first stage units. Within each selected first stage unit, a random sample of households as secondary stage units was selected at random with proportional allocation. Optimum sample size of 369 children was calculated on the basis of 40% anticipated prevalence of undernutrition observed in the pilot survey and assuming 95% confidence level and assuming 5% permissible error. There were about 12% underfive children in the population with average household size 4 approximately. Design effect due to selection of underfive children within selected households by two stage random sampling came out to be 2.21. Accordingly, an optimum sample size was attained to be 816 households. Within selected 816 households, 371 under-five children were found and studied as study subjects in the present study.

Information on variables like weight, height, age, gender, social background, total calorie availability (TCA) per consumption unit (CU) per day in the family calculated from monthly food items procured, standard of living Index (SLI) based on several socio-economic variables (e.g. type of house, toilet facility, fuel used for cooking, ownership of durable goods, health assess etc.) as in National Family Health Survey [4] was collected. Data on anthropometric parameters (weight and height) was obtained on children included in the study using standard techniques [8] ensuring reliability as far as possible. Children who were not available for anthropometric measurements in spite of repeated efforts or whose parents were not willing to participate in the study were replaced by new ones on the basis of inclusion criterion.

The weight and height measurements were converted into three summary indices of nutritional status: weight-for-age, height-for-age and weight-for-height. Nutritional assessment was done using WHO criterion (SD-classification). According to WHO criterion based on standard deviation (SD) units (termed as Z-scores), children who were more than two standard deviations below the reference median on the basis of weight-for-age, height- for-age and weight-for-height indices were considered respectively to be underweight, stunted and wasted. Children were also assessed for anthropometric failures

TABLE – 1. SOCIO-DEMOGRAPHIC CHARACTERISTICS AND NUTRITIONAL STATUS BY WHO CRITERION (SD -CLASSIFICATION)

Characteristics	Underweight (<Md-2SD)	Stunting (<Md-2SD)	Wasting (<Md-2SD)	Total
Age in months				
0-12	10 (32.3)	11 (35.5)	3 (9.7)	**31 (8.3)**
13-24	38 (54.3)	25 (35.7)	11 (15.7)	**70 (18.9)**
25-36	63 (67.7)	33 (35.5)	16 (17.2)	**93 (25.1)**
37-48	25 (38.5)	17 (26.2)	10 (15.4)	**65 (17.5)**
49-60	31 (37.8)	43 (52.4)	11 (13.4)	**82 (22.1)**
61-72	15 (50.0)	22 (73.3)	3 (10.0)	**30 (8.1)**
χ^2	**27.87(p<0.001)**	**25.74 (p<0.001)**	**1.82 (p>0.20)**	
Gender				
Male	91 (45.3)	89 (44.3)	21 (10.4)	**201 (54.2)**
Female	91 (53.5)	62 (36.5)	33 (19.4)	**170 (45.8)**
χ^2	**2.07 (p>0.05)**	**2.32 (p>0.10)**	**5.94 (p<0.05)**	
Social				
Rural	55 (47.0)	58 (49.6)	14 (12.0)	**117 (31.5)**
Urban	45 (39.8)	25 (22.1)	16 (14.2)	**113 (30.5)**
Slum	82 (58.2)	68 (48.2)	24 (17.0)	**141 (38.0)**
χ^2	**6.20 (p<0.05)**	**23.28 (p<0.001)**	**1.33 (p>0.10)**	
SLI				
Low	123 (56.9)	107 (49.5)	33 (15.3)	216 (58.2)
Middle	31 (44.9)	23 (33.3)	10 (14.5)	69 (18.6)
High	28 (32.6)	21 (24.4)	11 (12.8)	86 (23.2)
χ^2	**13.13 (p<0.001)**	**17.98 (p<0.001)**	**0.30 (p>0.10)**	
Total	**182 (49.1)**	**151 (40.7)**	**54 (14.6)**	

by using CIAF [6,7] for comparing the estimates of undernutrition. TCA deficiency status was decided on the basis of recommendations for one consumption unit as recommended by ICMR.

Normal test of proportions (Z-test) was used to test the significance of difference between proportions undernourished children in different groups. Chi-square test was used for testing the association between different attributes. Kolomogrov-Smirnov one sample test was used for testing variability with respect to different anthropometric indices among different groups. Analysis of Variance (ANOVA) technique was used to test equality of means of TEA in different sub groups. Tukey's test /HSD Procedure [8] was used for making post-hoc comparisons in case significant variability was observed on the basis of ANOVA. Multivariate Logistic Regression Model was used for finding risk factors of undernutrition. Statistical significance was considered at 5% level of significance ($P<0.05$). SPSS, Version12 Software (SPSS Inc Chicago) was used for data analysis.

Results

Socio-demographic characteristics of surveyed children are shown in table-1. Selected children represented all age, social background and SLI categories. Proportion of children in the age group 25-36 months was maximum (25.1 %) followed by that in the age group 49-60 months (22.1%). Study included children of all social background: rural (31.5%), urban (30.5%) and slum (38.0%). Low SLI category contributed maximum (58.2%) study subjects whereas proportion from medium SLI category contributed minimum (18.6%) study subjects. There were more males (54.2%) as compared to females (45.8%). Out of all under-five children surveyed, there were 182 (49.1%) underweight (<2SD weight for age); 151 (40.7%), stunted (<2SD height for age) and 54 (14.6%) wasted (<2SD weight for height).

Proportion of underweight children increased with age up to 36 months and decreased thereafter whereas stunting was more among elderly children above 48 months of age. Highest proportion of underweight children was among children in the age group 25-36 months. Age was found to be significantly associated with underweight and stunting ($P<0.001$). Wasting was having an increasing trend up to age 36 months and decreasing trend thereafter. Wasting was found to be most prevalent (17.2%) in the age group 25-36 months. Age was significantly associated with undernutrition ($P<0.001$). Proportions of underweight and wasted children were more among children from slum areas whereas percentage of stunting was maximum (48.2%) among children from rural area. There were more male underweight children (53.5.0%) as compared to those of female children (45.3%) but the prevalence of stunting was more among females (44.3%) than that for males (36.5%). Gender was significantly associated with wasting ($P<0.05$) but not with underweight and stunting. Background was significantly associated with both being underweight ($P<0.05$) and stunted ($P<0.001$), but it was not significantly associated with being wasted ($P>0.10$). Proportions of all types of malnourished children by WHO criterion were found maximum within SLI category wherein, 56.9%, 49.5% and 15.3% children were found to be underweight,

TABLE – 2. ANTHROPOMETRIC FAILURES AMONG CHILDREN

CIAF CATEGORY	NUMBER (%)
No Failure	**138 (37.2)**
Wasting only	**9 (2.4)**
Wasting and Underweight	**23 (6.2)**
Wasting Underweight and Stunting	**22 (5.9)**
Stunting and Underweight	**87 (23.5)**
Stunting only	**42 (11.3)**
Underweight only	**50 (13.5)**
Total	**371 (100.0)**

stunted and wasted respectively. Association between SLI and malnourishment in terms of underweight and stunting was found to be highly significant (P<0.001). However, it was not significantly associated with stunting (P>0.10).

Children were also assessed for anthropometric failures using CIAF as given in table-2. The prevalence rate of anthropometric failure in the studied population was estimated to be 62.8% with 95% confidence interval of 57.8% to 67.7% Among all children, 138 (37.2%) were having no anthropometric failure. Among all study subjects, 22 (5.9%) children were having anthropometric failures in terms of all three combined: wasting, underweight and stunting. There were 50 (13.5%) children who were underweight only. Among all children 233 (62.8%) were having some forms of anthropometric failures.

Overall mean TCA was found to be 2346 ± 1046 K Cal per CU per day is given in table-3. Mean TCA was found minimum (2033 ± 799) in case of slum background and low SLI (1937 ± 790). Comparisons of Means of different TCA on the basis of ANOVA showed highly significant variability (P<0.001) according to social background and SLI. Tukey's test revealed mean TCA for urban area was significantly higher (P<0.001) than those for rural and slum areas. Also, it was significantly higher (P<0.01) for high SLI as compared to those for low and medium SLI. There were 212 (57.1%) children belonging to families deficient in terms of TCA. Proportions of such children were found to be maximum in case of slum (72.3%) and low SLI (71.3%) categories. Only 36 (31.8%) children from families belonging to urban area and 17 (19.8%) children belonging to families of high SLI were found to be deficient in terms of TCA. TCA deficiency was significantly associated (P<0.001) with both SLI and social background. Proportions of children having anthropometric failures were also found maximum in case of slum background (70.9%) and low SLI (73.1%). Both

TABLE – 3. ANTHROPOMETRIC FAILURE BY SOCIAL CHARACTERISTICS ALONGWITH MEAN TCA (cu/day), AND TCA DEFICIENCY

Social Characteristics	TCA (Mean ± SD)	TCA Deficient No. (%)	Anthropometric Failure No. (%age)
A. Background			
Rural (N=117)	2092 ± 842	74 (63.0)	76 (65.0)
Urban (N=113)	2938 ± 1206	36 (31.8)	57 (50.4)
Slum (N=141)	2033 ± 799	102 (72.3)	100 (70.9)
	(P<0.001)	(P<0.001)	(P<0.01)
B. SLI			
Low (N=216)	1937 ± 790	154 (71.3)	158 (73.1)
Medium (N=69)	2235 ± 806	41 (59.4)	37 (53.6)
High (N=86)	2865 ± 1211	17 (19.8)	38 (44.2)
	(P<0.001)	(P<0.001)	(P<.001)
Overall (N=371)	2346 ± 1046	212 (57.1)	**233 (62.8)**

background (P<0.01) as well as SLI (P<0.001) were significantly associated with anthropometric failure.

Logistic Regression Model (Table-4) was fitted by Forward Likelihood Ratio (LR) method, to predict the risk of anthropometric failure on the basis of binary regression variables Xi = 0, 1, ….., 5,

where Xi = 1, if risk factor is present, 0, if risk factor is absent.

Following risk factors were entered into binary logistic regression analysis:

X_0 = 1, a dummy variable

X_1 = 1, if Rural Background, 0, otherwise.

X_2 = 1, Slum Background 0, otherwise

X_3 = 1, if background is slum 0, otherwise

X_4 = 1, Low SLI 0, otherwise

X_5 = 1, Medium SLI 0, otherwise

No other risk factor except low SLI was found to be a significant risk factor for anthropometric failure. Relative risk estimate for low SLI was obtained to be 3.32 (table-4) which was highly significant (P<0.01) for anthropometric failure.

TABLE – 4. LOGISTIC REGRESSION ANALYSES OF RISK FACTORS OF ANTHROPOMETRIC FAILURE

Factor	Estimated Regression Coefficient (β)	SE of (β)	Odds Ratio (Exp β)	95%CI of Odds Ratio	P-Value
Constant	-0.235	0.219	0.790	(0.51,1.21)	P>0.20
Rural Background	0.000	0.376	1.00	(0.48,2.07)	P>0.20
Slum Background	0.067	0.386	1.07	(0.51,2.29)	P>0.20
Low SLI	1.20	0.396	3.32	(1.51,7.17)	P<0.01
Medium SLI	0.363	0.416	1.44	(0.63,3.25)	P>0.20

Results of logistic regression analysis and the logistic regression model fitted:

$$\text{Logistic Model Fitted : Log} \left(\frac{P}{1-P} \right) =$$

$-0.235 + 1.20\ X_4$,

where, $X_4 = 1$, in case of low SLI and zero otherwise and P is the proportion of children with anthropometric failure. Hosmer-Lemeshow goodness of fit test indicated that the fit was not good at the acceptance level (P<0.05) and only 56.5% anthropometric failures were correctly identified by the fitted logistic regression model. There may be other factors except SLI responsible for undernutrition among children.

Discussion

Present study assess the status of undernutrition among underfive children using WHO criterion and also by CIAF as an alternative index. It also investigates some socio-demographic concerns of anthropometric failure among them. The prevalence rates of underweight (<2SD weight for age); stunting (<2SD height for age) and wasting (<2SD weight for height), were found to be 49.1.7%, 40.7% and 14.6% respectively based on WHO criterion. The CIAF shows a higher prevalence of undernutrition, with 62.8% of children suffering from undernutrition. Proportion of under- five children having weights below median-2SD of NCHS Standards was found to be 42.4% in Allahabad district and 52.0% in UP in an earlier study [5]. In our recent another study [10] in Allahabad, the

percentages of underweight and stunting were found to be 36.4% and 51.6% respectively.

No earlier study reported anthropometric failure among children in the studied population. In the present study, overall prevalence rate of underweight is found to be 49.1% (45.3% among males and 53.5% among females) as compared to national figure of 42.5% (41.95 among males and 43.1% among females). Prevalence rates of underweight reached peak levels of 67.7% during 25-36 months of age and then it decreased gradually with increasing age. Wasting in the present study has been found to be 14.6% with gender differential (19.4% for males and 10.4% females) against 19.5% in UP (19.8% for males and 19.0 % for females) [5]. NFHS-3 survey reported prevalence of wasting to be 19.8% (20.5% for males and 19.1% for females). National estimate of wasted children has been reported to be 16.0% [3]. This study showed variability in underweight and stunting but not in wasting with respect to social background as found in NFHS-3 at National level.

Wasting describes a recent and severe process that has led to significant weight loss as a consequence of acute starvation and/or severe disease whereas stunting implies long-term malnutrition and poor health, and underweight implies linear–growth retardation. In case of low incidence of wasting in a community, weight-for-age and height-for-age both reflect the long-term health and nutritional experience of the population. Anthropometric failure measured by CIAF was found in about 63% children. Wasting alone was observed in only 2.4% children only whereas it was present in 12% children with other conditions of malnutrition either underweight or stunting. Stunting was also prevalent with some other conditions of undernutrition in large proportion of children. The study also indicates that there is considerable overlapping among different conditions of undernutrition as observed in earlier studies [6,7].

Children belonging to those families wherein TEA was low were more likely to suffer from anthropometric failure. Low standard of living comes out to be an important risk factor of anthropometric failure irrespective of social background. Proper nutrition of children leading to adequate growth and good health is the essential foundation of human development. Improving standard of living somehow will also result in food/calorie availability apart from other favorable situations for reducing the problem of undernutrition. Hence, raising standard of living of people can be an important step in the direction of combating problem of undernutrition. However, there may be some other factors also like lack of knowledge of nutritive values of food items among all subgroups of population responsible for undernutrition among children which should also be looked into for improving nutritional status of children. Nutrition no longer remains confined to the domain of health sector alone. It has become corner stone of socio-economic development.

Present study suffers some drawbacks in terms of selection bias and non- inclusion of some other important risk factors of undernutrition except standard of living. Children who were not available for anthropometric measurements are whose parents were not willing to participate in the

KEY MESSAGES

- We should not rely upon usual anthropometric indices for assessing undernutrition among under-five children and CIAF should also be used as a composite index.
- Child undernutrition can be reduced through social development by raising people's living standards

study in spite of repeated visits were replaced by new ones. Characteristics of non-respondents and reason of non responses could not be studied in the present study. Non-response was found comparatively more in case of female children. This may be the subject matter of further research.

Conclusions and Suggestions

The study concludes that status of undernutrition among under- five children should also be assessed by using composite index of anthropometric failure in order to avoid overlapping of different subgroups formed on the basis of standard indices of stunting, wasting and underweight. Low SLI comes out to be a risk factor of child undernutrition irrespective of social background. Nutritional status of children can be improved through social development by raising standard of living of people.

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