Determinants of Undernutrition among Under-Five Children: A Community-Based Study from Eastern India

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ABSTRACT

Backgrounds: Children are prone to undernutrition which adversely affects their health status. Nutritional status of under-five children is a sensitive indicator of nutrition and child health. Hence, the present study is undertaken to assess the prevalence and determinants of undernutrition among under-five children in a rural area of West Bengal, India. **Methods:** A community-based cross-sectional study was conducted among 1680 under-five children who were selected by 30 cluster sampling technique to assess the prevalence and determinants of undernutrition. Nutritional status was assessed by means of weight-for-age, height-for-age, weight-for-height and mid-upper arm circumference-for-age criteria based on World Health Organization's child growth standards. **Results:** The prevalence of underweight, stunting, and wasting among under-five children was found to be 33.7%, 34.8%, and 21.6%, respectively. Moreover, 39.4% of the studied children had low mid-upper arm circumference-for-age. After adjustment for possible confounders, maternal illiteracy, lower socio-economic status, presence of anemia and any childhood morbidity were found significant determinants of undernutrition. **Conclusions:** Widespread prevalence of undernutrition among under-five children with anemia and childhood morbidity as important determinants highlights a need for multi-disciplinary integrated approach towards improving the child health and nutrition. Long term measures like improvement of maternal education and poverty alleviation should also be considered in future plans.

Keywords: *Under-five children; Undernutrition; Nutritional status; Anthropometry*

Introduction

Health and nutrition of under-five children is of paramount importance because the foundation for lifetime, strength, and intellectual vitality is laid during that period. Under-five children are considered as one of the most vulnerable segments of any community. Children in this age group are prone to undernutrition due to various reasons like lack of adequate calories and

protein, faulty feeding practices, lack of mothers' knowledge regarding a balanced diet, impaired utilization of nutrients due to infections, and parasitic infestations (Jood *et al.*, 2000). Apart from under-nutrition, micronutrient deficiencies are very common in this age group, which adversely affect their health status. The vicious cycle of malnutrition and infection also cannot be ignored, and the effects of undernutrition have long-term implications for children's live who constitute 10.7% of India's population (Registrar General and Census Commissioner India, 2011).

We are still far from a world without undernutrition. Globally, near 149.2 million under-five children (one in four children) were stunted and over 45.4 million were wasted with a prevalence rate of 22% and 6.7% respectively. In addition, two out of five stunted children live in South Asia (World Health Organization *et al.*, 2021).

In spite of nutritional transition, undernutrition, especially among under-five children, still remains a major public health problem in India. In the state of West Bengal, the prevalence rate of underweight, stunting, and wasting among under-five children was 31.5%, 32.5% and 20.3%, respectively (International Institute for Population Sciences (IIPS), 2017).

Nutritional status of the children is not only a sensitive indicator of nutrition and child health but also reflects the accessibility and utilization of health care services and community health. Considering those facts in mind, the present study was conducted to identify the prevalence and determinants of undernutrition among under-five children in the study area.

Materials and Methods

Study design, study setting and participants

A community based cross-sectional study was carried out among under-five children in Salboni Block of Paschim Medinipur district of West Bengal, India. The total population of the block was 1, 91,705 as per 2011 census(Registrar General and Census Commissioner India, 2011).

The study area was a socially-backward tribal block of West Bengal, India, known as the 'Jungal Mahal' due to the presence of a wide range of dense forest. Illiteracy, poverty, and under-nutrition are very common in the area. The present study was conducted in 117 villages out of a total 411 villages in Salboni Block which constitutes the rural field practice area of the Midnapore Medical College, Paschim Medinipur, West Bengal, India. The study was undertaken from May 2019 to November 2020.

Sample size and sampling technique

The desired sample size with 10% relative permissible error, 95% confidence interval, and design effect of 2 was estimated to be 1674 using the formula: $n = Z_\alpha^2 * p * q / l^2 *$ design effect (S. K. Lwanga and S Lemeshow, 1991).[where n= desired sample size, p=prevalence, q=1-p, l=permissible error, and Z_α= 1.96 where α was 0.05 and the design effect was 2]. The sample size was calculated based on the reported prevalence of 31.5% under-weight under-five children in West Bengal (National Family Health Survey (International Institute for Population Sciences (IIPS), 2017).

The study participants were selected using the 30 cluster sampling technique; the clusters were chosen using the population proportional to the size (PPS) method. In each cluster, 56 under-five children were selected for the study purpose to achieve the desired sample. In case of non-availability of the desired number of under-five children in any cluster, they were chosen from the adjoining village. Thus, all the 1680 under-five children were covered in the present study.

117 villages in the study area (field practice area of the Midnapore Medical College, West Bengal formed the sampling frame. The present study considered villages as the sampling unit in households where any under-five children present as the study unit and under-five children as the study participants.

Data collection and measurements

After obtaining informed consents from the respondents, a group of trained medical experts

paid house-to-house visits and interviewed the mothers of the under-five children. The study considered only mothers as the sole respondents. Data were collected regarding selected socio-demographic and socio-economic characteristics, birth history, feeding practices, and immunization status of the children, etc., using a pre-designed and pre-tested semi-structured questionnaire. Furthermore, the type of ration card was considered an indicator of socio-economic status. Anemia was detected by means of cyanmethemoglobin method.

Physical examination of the children was also carried out which included anthropometry and clinical examination. In anthropometry, weight, length/height, and mid-upper arm circumference (MUAC) were measured using standard techniques (World Health Organization, 1995).

Nutritional status of under-five children was assessed using weight-for-age, height-for-age, weight-for-height, and MUAC-for-age criteria of the new "Multi-center Growth Reference Standards (MGRS) developed by the World Health Organization (WHO) and expressed in terms of z score (World Health Organization, 2006). Weight-for age, height-for-age, and weight-for-height values with standard deviation below 2 were considered underweight, stunted, and wasted respectively, while standard deviations below 3 were considered severe underweight, severe stunting, and severe wasting. In case of MUAC-for-age, it was considered low (standard deviation below 2) and very low (standard deviation below 3). As an age independent indicator among 12-59 months children, MUAC of more than 13.5 am was considered normal, between 12.5 to 13.5 cm was considered moderately low, and less than 12.5 cm was severely low.

Ethical considerations

The study was approved by Institutional Ethics Committee of Midnapore Medical College, Paschim Medinipur, West Bengal. The purpose, methods, and proposed outcome of the study were explained to either the head of the households or mother of the under-five children, and written informed consent was obtained from each respondent. The severe undernourished children were sent to the nearest 'Salboni Nutritional Rehabilitation Centre' for further management.

Data analysis

After a through verification, data were entered and analyzed using the SPSS (Statistical Package for Social Sciences; version 22) software, and 'Anthro 2005'software was used for analysis and interpretation of anthropometric data (World Health Organization, 2011).The categorical variables were expressed in terms of numbers and percentages. Associations between undernutrition (expressed in terms of underweight, stunting, and wasting) and risk factors were evaluated by calculating crude and adjusted odds ratio (OR) along with their 95% confidence interval by means of multi-variate logistic regression. To calculate OR, the indictors of undernutrition were taken as dependent variables with dichotomous outcome (yes/no), while the children's age group, sex, caste, and their mothers' education, and occupation, type of family, socio-economic status, immunization status of the children, presence of anemia, vitamin-A supplementation in the last 6 months, and a history of any morbidity in the last fortnight were taken as independent variables. For all statistical tests, P-value<0.05 was considered as the level of significance.

Results

Socio-demographic and socio-cultural profile

In the present study, 8.9% of the under-five children were under 6 months of age. Among the studied children, 51.1% were male and the remaining 48.9% were female. Nearly one-fifth of the children belonged to the socially-vulnerable castes (scheduled caste: 20.8% and scheduled tribe: 19.2%). Around half (50.5%) of the mothers had secondary level education while nearly one-third of them (32.7%) were illiterate. The majority of the mothers were homemakers (42.3%), followed by unskilled manual labour (36.8%). Only 7.3% of the mothers were engaged either in

service or business. The majority of under-five children belonged to joint family (61.1%). According to socio-economic status, more than one-fourth (28.7%) of the studied children belonged to below poverty line (BPL) family, while the remaining 71.3% were above poverty line (APL, **Table 1**).
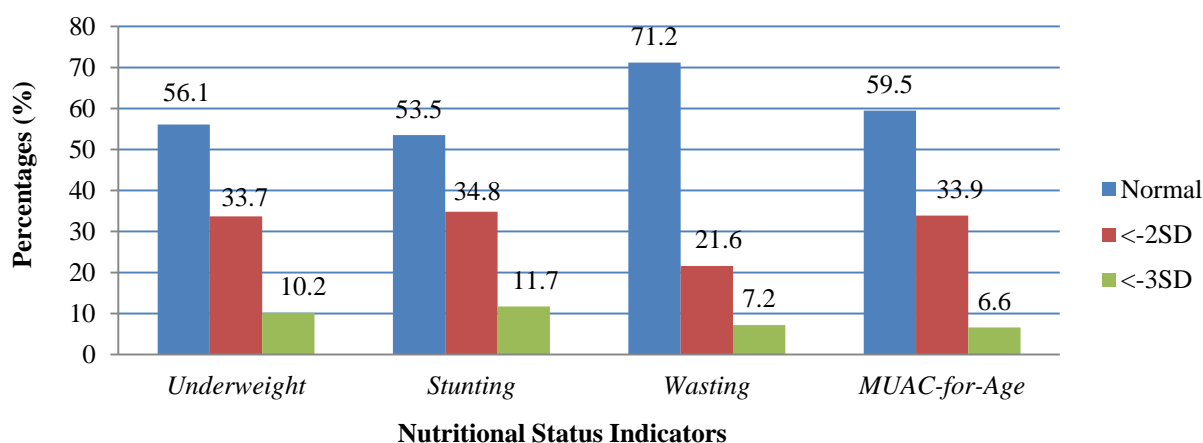
Nutritional status

In the study area, the nutritional status of under-five children by means of various anthropometric indicators was shown in **Figure 1**. In the present study, the prevalence of wasting, stunting, and underweight among under-five children was estimated as 13.8%, 44.8% and 33.7%, respectively. Also, 39.4% of the children had low MUAC-for-age. 1.7%, 18%, 10.2% and 5.3% of the under-five children were considered severely (<-3SD) wasted, stunted, underweight and with very low MUAC-for-age (<-3 SD), respectively (**Figure 1**).

MUAC can be used as an age independent indicator of nutritional status among 12-59 months children. Among the 1330 children aged 12-59 months, 58.5% (778/1330) had normal MUAC (>13.5 cm); 29.8% (396/1330) had low MUAC (≤ 13.5 cm), and 11.7% (156/1330) had severely low MUAC (<12.5 cm, **Table 2**).

Table 1. Socio-demographic and socio-economic profile of the study participants (n-1680).

Variables	Number	%
Age groups (month)		
0-6	149	8.9
7-11	201	11.9
12-35	679	40.4
36-59	651	38.8
Gender		
Boys	859	51.1
Girls	821	48.9
Caste		
General	1009	60.0
Scheduled caste	349	20.8
Scheduled tribe	322	19.2
Mothers' education		
>10th class	283	16.8
1-10th class	848	50.5
Illiterate	549	32.7
Mothers' occupation		
Home maker	711	42.3
Service or business	122	7.3
Unskilled manual labor	618	36.8
Skilled work	229	13.6
Type of family		
Nuclear	653	38.9
Joint	1027	61.1
Socio-economic status (based on ration card)	1198	71.3
Above poverty line		
Below poverty line	482	28.7

Figure 1. Nutritional status of the under-five children (n=1680)
MUAC**:** Mid-upper arm circumference; SD: Standard deviation; Normal: > -2 SD, Low: < -2 SD, and severely low: < - 3SD of the new WHO standard

Table 2. Determinants of undernutrition by logistic regression analysis (n=1680)

Variables	Number	Underweight OR (95% CI)	Stunting OR (95% CI)	Wasting OR (95% CI)
Age groups(years)				
0-1	350	1	1	1
1-3	679	2.1 (1.6-3.4)[a]	3.7 (1.8-5.2)[a]	1.4 (1.1-2.7)[a]
3-5	651	1.9(1.4-3.2)[a]	2.7(1.4-4.8)[a]	1.1(0.7-1.9)
Gender				
Boys	821	1	1	1
Girls	859	1.6(1.1-2.8)[a]	2.6(1.6-4.1)[a]	1.4(1.1-2.6)[a]
Caste				
General	1009	1	1	1
Scheduled caste	349	0.9(0.6-1.3)	1.1(0.7-1.9)	1.1(0.8-1.9)
Scheduled tribe	322	1.2(0.8-2.3)	1.6 (1.2-2.7)[a]	1.2(0.7-2.3)
Mothers' education				
>10th class	283	1	1	1
1-10th class	848	1.2(0.8-2.7)	1.3(0.7-2.6)	1.3(0.8-3.5)
Illiterate	549	2.7(1.7-3.8)[a]	2.1(1.2-3.2)[a]	1.6 (1.1-2.6)[a]
Mothers' occupation				
Home maker	711	1	1	1
Service/ business	122	0.9(0.6-1.9)	0.8(0.5-1.4)	0.8(0.6-1.6)
Unskilled labor	618	1.6(1.1-3.2)[a]	1.4(1.1-2.8)[a]	1.3(0.8-2.7)
Skilled work	229	1.1(0.7-2.1)	0.9(0.6-1.9)	0.9(0.5-1.7)
Type of family				
Nuclear	653	1	1	1
Joint	1027	1.2 (0.7-1.9)	1.1(0.7-1.8)	0.9(0.6-1.7)
Socio-economic status				
Above poverty line	1198	1	1	1
Below poverty line	482	1.7(1.4-3.2)[a]	3.1(2.4-6.2)[a]	2.8(1.9-4.1)[a]
Immunization status				
Age appropriate	1458	1	1	1
Not appropriate	222	1.1(0.7-1.9)	0.9(0.6-1.8)	1.2(0.8-2.6)
Vitamin A in the last 6 months[b]				
Received	1094	1	1	1
Not received	461	0.8(0.6-1.6)	0.9(0.6-2.1)	0.8(0.5-1.7)
Anemia[c]				
No	609	1	1	1
Yes	874	1.9(1.3-4.3)[a]	3.6(1.8-5.2)[a]	1.8(1.1-3.9)[a]
History of any morbidity[d]				
Present	718	1	1	1
Absent	962	1.7(1.1-2.8)[a]	1.2(0.9-2.6)	1.6(1.1-2.3)[a]

[a]: $P< 0.05$; [b]: 9-59 months children eligible for vitamin A supplementation; [c]: Anemia assessed among 6-59 months children only; [d] Any morbidity during preceding fortnight.

Determinants of nutritional status

The determinants of nutritional status of under-five children were shown in **Table 2**. The odds of being underweight, stunting, and wasting were the highest in the age group of 1-3-year-old children followed by 3-5 ones compared with 0-1-year olds. It was 2.1, 3.7, and 1.2 times higher respectively among children aged 1-3 , and1.9, 2.7 and 1.1 times higher respectively among the children aged

3-5. Except for wasting regarding the children aged 3-5, all the indicators of undernutrition were found significantly higher (*P*<0.05) among children of 1-3 and 3-5 compared with those under 1 year of age. The prevalence of underweight, stunting, and wasting was found significantly higher (*P*<0.05) among male children compared with female ones. Children belonging to the scheduled caste and tribe were similarly at risk of underweight, stunting, and

wasting as that of the children from higher castes such as general and other backward class (OBC) except stunting among the scheduled tribe children which was found significantly higher [OR=1.6 (95% CI= 1.2-2.7); *P*<0.05] compared with general and OBC children. Children whose mothers were illiterate had significantly higher odds (*P*<0.05) of being underweight [OR=2.7(95% CI=1.7-3.8)], being stunted [OR=2.1(95% CI=1.2-3.2)] and wasted [OR=1.6(95% CI=1.1-2.6)] compared with children whose parents had more than 10th class education. Similarly, significantly higher relative odds (*P*<0.05) of underweight [OR=1.7(95% CI=1.4-3.2)], stunting [OR=3.1(95% CI=2.4-6.2)] and wasting [OR= 2.8(95% CI=1.9-4.1)] were observed among children belonging to BPL families compared with that of APL families. No significant association was found between nutritional status of children and the type of family.

Moreover, no significant relationship (*P*>0.05) was found between nutritional status of under-five children as evidenced by different indictors (underweight, stunting and wasting) and their immunization status as well as the status of vitamin-A supplementations in last 6 months. Children having anemia had significantly higher odds (*P*<0.05) of being underweight [OR=1.9 (95% CI=1.3-4.3)], stunted [OR=3.6 (95% CI=1.8-5.2)] and wasted [OR=1.8 (95% CI=1.1-3.9)] compared with children who did not have anemia. Similarly, children who suffered any morbidity in 2 weeks preceding the survey were significantly (*P*<0.05) more underweight [OR=1.7 (95% CI=1.1-2.8)] and wasted [OR=1.6 (95% CI=1.1-2.3)] than children who did not suffer from any morbidity.

Discussion

In the present study, the prevalence of underweight, stunting, and wasting among under-five-children was found to be 33.7%, 34.8% and 21.6%, respectively. In addition, 39.4% of the under-five children had low MUAC-for-age and 41.5% 12-59 months children had low MUAC (≤13.5 cm) in the study area. Similar findings

(underweight-31.5%, stunting-32.5% and wasting-20.3%) were reported by the national level survey from West Bengal. At national level, the reported prevalence was found slightly at higher level (underweight-35.7%, stunting-8.4% and wasting-21%) (International Institute for Population Sciences (IIPS), 2017). The findings of the few other Indian studies were not much in line with the findings of the present study (Mandal *et al.*, 2014, Reddy *et al.*, 2016, Senthilkumar *et al.*, 2018). A study from slums area of Kanpur, India reported a 31.3% rate of underweight and a 14.6% rate of wasting among under-five children (Gautam *et al.*, 2018). A multi-center study from 9 states of India among tribal <5 children reported a much higher prevalence of underweight (49%) and stunting (51%) but a similar proportion (22%) of wasting (Meshram *et al.*, 2012). Higher prevalence (underweight-46.6% and stunting-69.8%) was also reported by a study from rural West-Bengal (Ray *et al.*, 2001). Another Indian study reported that the prevalence of underweight, stunting, and wasting among pre-school children was 61.6%, 51.2%, and 32.9% respectively (Rao *et al.*, 2005). A study from West Bengal reported a 41.6% rate of underweight and 80.3% rate of any anthropometric failure among under-five children dwelling in slums (Shit *et al.*, 2012). Few other Indian studies also reported much higher prevalence of undernutrition among under-five children (Manjunath *et al.*, 2014, Purohit *et al.*, 2017). Some studies reported a lower prevalence of undernutrition among under-five children as compared to the findings of this study (Hadju *et al.*, 2017, Radhamani and Rajeev, 2017) .

Very few Indian studies considered MUAC for assessing nutritional status of under-five years children. In the present study, the authors discovered that 29.8% of the children aged 12-59 months had low (≤13.5 cm) MUAC, and another 11.7% had a severely low (<12.5 cm) MUAC. A study from rural West Bengal also reported 18.9% of the children aged 12-49 months had a low MUAC (Ray *et al.*, 2001). Another study from Varanasi suggested that 23.9% children aged 12-59 months had a low MUAC (Mridula *et al.*, 2004).

The study by Mandal *et al*. reported a 20.3% prevalence rate of moderately low MUAC (12.5-13.5 cm) among 1-5-year-old children (Mandal *et al.*, 2014).

The varied prevalence of undernutrition among under-five children as reflected by different nutritional indicators in several studies across India were due to different socio-cultural practices in different study settings, difference in the criteria used for undernutrition and different timing of carrying out the studies, as Onis *et al*. reported that malnutrition was decreasing in Asia (De Onis *et al.*, 2004).

In the present study, undernutrition was significantly more prevalent among the children aged 1-3 year, male children, children whose mothers were illiterate, children from BPL families, those with anemia and any morbidity in the last fortnight preceding the survey. The study also revealed that under-five years children whose mothers were unskilled manual labor were significantly more underweight and stunted. No significant association was found between undernutrition and caste except stunting which was found more prevalent among the scheduled tribes. In the present study, the type of family was not found to be an important determinant of undernutrition. Several studies also reported the highest prevalence of undernutrition among children in the age group of 1-3 (Meshram *et al.*, 2012, Purohit *et al.*, 2017, Swami *et al.*, 2000). In the present study, male children were found significantly more undernourished compared to the female ones. Several other studies reported similar finding (Deshmukh *et al.*, 2013, Hadju *et al.*, 2017, Meshram *et al.*, 2012). Male children need more energy and nutrients for sufficient growth and development compared with females. Thus, availability and accessibility of foods along with the amount of feeding must be higher in case of boys compared with girls. This may be one of the explanations. Opposite findings reported by other studies may be due to gender inequality (Dey and Chaudhuri, 2008, Radhamani and Rajeev, 2017).

The present study revealed that undernutrition among under 5 years children was the most prevalent among illiterate mothers. Most of the studies found similar and significant reciprocal relationship between literacy status of mother and undernourished child (Deshmukh *et al.*, 2013, Hadju *et al.*, 2017, Meshram *et al.*, 2012). A time trend analysis using national level data regarding child undernutrition in India concluded that mother's educational status was the only variable which influenced child nutrition (Sen *et al.*, 2011).

The present study found children whose mothers were unskilled manual labor were significantly more underweight and stunted. Several studies reported similar positive associations, i.e. undernutrition among under-five years children were found more common among working mothers (Deshmukh *et al.*, 2013, International Institute for Population Sciences (IIPS), 2017, Srivastava *et al.*, 2012). However, some studies also reported that a child's undernutrition was significantly more prevalent among nonworking mothers (Gautam *et al.*, 2018, Ray *et al.*, 2001, Senthilkumar *et al.*, 2018, Tigga *et al.*, 2015). Children from low socio-economic status (BPL families) were significantly more undernourished in the present study. Several Indian studies also reported similar findings (Mandal *et al.*, 2014, Senthilkumar *et al.*, 2018, Swami *et al.*, 2000).

In the present study, immunization status and vitamin-A supplementation in the last 6 months were not considered important determinants of undernutrition among under-five children. But a study from Bankura,West Bengal demonstrated that unimmunized children were more likely to be undernourished (Shit *et al.*, 2012). Another study in central part of India reported that vitamin-A supplementation in the last 6 months was an important determinant of stunting among under-three children. But, the study also reported that stunting did not differ significantly regarding immunization status which was similar to the findings of this study (Deshmukh *et al.*, 2013). Anemia and any childhood morbidity in the preceding fortnight were found to be significant determinants of undernutrition in this study. Similar associations were reported by other studies. A large scale study involving 9 states of India among tribal

under-five children reported that morbidities during preceding fortnight had a 1.3 times higher risk of underweight and wasting (Meshram *et al.*, 2012). The study by Mandal *et al.* also reported children with any illness in the past 2 weeks were 6.8 times more undernourished (Mandal *et al.*, 2014). A study reported anemic children had 1.9 times higher odds of being stunted than children who were not anemic (Deshmukh *et al.*, 2013).

Community based study setting and large sample size were the main strengths of the present study. Majority of the studies not considered common childhood morbidities and anemia as determinants of under nutrition among under-five children which were considered in the present study. As limitations of study; immunization status assessed based on immunization card, those lost their cards were misclassified. The study also was not taken dietary survey of under-five children.

Conclusions

The present study revealed a widespread prevalence of undernutrition among under-five children in the study area. Illiteracy of the mother and lower socio-economic status were important socio-economic determinants of undernutrition which need long term measures with an inter-sectoral coordinated approach aiming to improve the socio-economic status. Moreover, childhood morbidity and anemia were found to be important determinants of undernutrition among under-five children which highlights a need for an integrated approach towards improving child health and nutrition.

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Authors' contribution

Patra M, Gayen BK, Yasmin S, Sinha N, and Baur B designed the research. Patra M, Yasmin S, and Gayen BK conducted it. Sinha N and Yasmin S analyze the data. Patra M, Gayen BK, Sinha N,Yasmin S, and Baur B wrote the manuscript. Sinha N, Patra M, and Gayen BK had primarily responsible for final content, and all the authors read and approved the final version of the manuscript.

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Conflict of interest

The authors declared no conflict of interests

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