Original Article

Epidemiologic correlates of malnutrition among under-three children in the rural community of Northern India

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Abstract

Context: Worldwide malnutrition is identified as a major health and nutrition problem. Undernutrition contributes to an estimated 45% of child deaths globally. The prevalence of underweight among children in India is among the highest in the world. Our children also bear a tremendous double burden of malnutrition. **Aims:** To find out the prevalence and determinants of malnutrition among six months to three-year-old children in the rural community of Northern India. **Settings and Design:** A community-based cross-sectional study conducted among children aged six months to three years in a rural area of Ludhiana district, **Methods and Material:** A total of 662 children in the age group of six months to three years from a population of 30,000 were identified and included in the study. All the relevant information regarding these children was collected from family folders. Socioeconomic status was assessed using the modified Udai Pareek scale (MUP). **Statistical analysis used:** The data collected was entered in MS Excel and was analyzed using SPSS version 26 and WHO Anthro Survey Analyzer. **Results:** Out of 662 children, 16% were underweight. Almost 50% of the children in the two—three years category were underweight. The prevalence of stunting in the study population was 20.7% and that of overweight was 4.8%. The prevalence of underweight was higher in children of low socioeconomic status than in children from upper socioeconomic status ($P = 0.000$). There was a significant association between birth order and increasing cases of underweight ($P = 0.000$). **Conclusions:** The causes of malnutrition in children are complex and involve multiple factors. There is a need for vigorous monitoring for early detection of malnutrition for children aged two—three years. The improvement of maternal education will improve the nutritional status of the child.

Keywords: Anthropometry, children, malnutrition, overweight, stunting, underweight

Introduction

Worldwide malnutrition is identified as a major health and nutrition problem. Undernutrition contributes to an estimated 45% of child deaths globally.[1] It is not only an important cause of childhood morbidity and mortality, but also leads also to permanent impairment of the physical growth of those who survive.[2] The prevalence of underweight among children in India is among the highest in the world. Although

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the burden of underweight in children under five years of age has decreased from 35.8% (National Family Health Survey-4) to 32.8% (NFHS-5), still it is a considerable number.[3] The prevalence of being underweight deserves greater attention as a useful signal of changing public health conditions among under-five children in developing countries.[4] Undernutrition makes the child susceptible to infection and complements its effect in contributing to child mortality. This accounts for 22% of the burden of disease in India and adversely affects the economic growth of the country with an estimated adult productivity loss of 1.4% of Gross Domestic Production (GDP).[5] The effects of malnutrition on human performance, health, and survival have been the subject of extensive research for several decades. The studies show that malnutrition affects cognitive development, reproduction, and work capacity.[6,7] Therefore, it is important for the health system to detect malnutrition at an early stage for planning and implementing timely interventions at the community level. It is known that place of residence, household wealth, birthweight, age of child, awareness regarding diarrheal disease and acute respiratory tract infection control, maternal education, number of under-five-year children, and source of drinking water are strong predictors of child nutritional status in developing countries. Earlier, it was understood that undernutrition and overnutrition were separate problems. However, nowadays it has been seen that these aspects are interconnected. Many low- and middle-income countries are coexisting with issues of undernutrition and obesity.[8] However, statistics in Punjab regarding these anthropometric parameters are better as compared to national figures. The nutritional status of under-five children in Punjab has improved since NFHS-5 by some measures, but not by all measures. Stunting among children decreased from 25.7 to 24.5% in the five years between NFHS-4 and NFHS-5, and the percentage of children who are underweight decreased from 21.9 to 16.9%. However, in the same period, overweight children increased from 2.3 to 4.1%.[9] Despite the improvement in stunting and underweight, child malnutrition is still a major problem in Punjab. Before the appearance of signs of malnutrition, the process starts much earlier in children which can be detected easily.[10] Therefore, it is very important to demarcate the period of most vulnerability of children to malnutrition. Thus, this study was planned in under-three children to quantify for problem of malnutrition and its risk factors in rural area of Ludhiana, Punjab.

Subjects and Methods

The present study is a community-based cross-sectional study conducted among children aged six months to three years in the field practice area of Rural Health Centre under the Department of Community Medicine, Dayanand Medical College and Hospital, Ludhiana. It was approved by the institutional ethics committee. Data collection was done from June 2022 until September 2022. The present study was a part of routine activity being carried out in the area. We have a record of family folders in which there are separate cards for under-five children, these cards are used for line listing. All children (662) in the age group of six months to three years from the adopted population of 30,000 were identified and included in the study. The team consisting of community health workers and interns visited the area daily. The team was supervised by the incharge of the Rural Health Centre. All the relevant information, like family composition, education, occupation, socioeconomic status, and immunization status regarding these children, was collected from family folders. Socioeconomic status was assessed using the modified Udai Pareek scale (MUP). Anthropometric measurements were done by the team after visiting respective households. Mid Upper Arm Circumference (MUAC) was calculated by using Shakir's tape, and weight was calculated by using calibrated weighing machines. Height was measured by infantometer for children aged six months to one year and measuring tape was used for older children/who were able to stand. Underweight was diagnosed by measuring weight for an age index ≤2 SD of the median, stunting was diagnosed by measuring height for an age index ≤2 SD of the median, and overweight and wasting were diagnosed by measuring weight for length/height index ≤2 SD of the median.[11] The confidence level of 95% was selected for the statistical analysis. The data collected was entered in MS Excel and was analyzed using SPSS version 26 and WHO Anthro Survey Analyzer.[12] Chi-square test and proportions were used in the study.

Results

In a population of 30,000, a total of 662 children aged six months to three years making 2.2% of the total population in rural area were included in the study, among these children 51.7% were boys and 48.3% were girls. Most of the children (42.3%) were in the age group of two—three years, while 19.7% of children were in the age group of six months to one year. The mean age of children was 1.8 ± 0.75 years. The immunization status of the majority of children was complete (95.2%). In the selected households, 51.2% of children had one or more siblings. Almost half of children were born in a private healthcare facility (47.7%), followed by Community Health Centers (30.1%). The majority of children, i.e. 91%, had term delivery. According to the modified Udai Pareek scale, 46.2% of children were from the middle class, followed by 42.1% from the lower middle class. Half of the children had first birth order (50.5%), followed by second birth order (35.8%). Out of 662 children, 16% were underweight. Boys predominated underweight category than girls 62 (58.5% vs 41.5%). Almost 50% of the children in the two—three years category were underweight. The majority of underweight children 89 (84%) had a birthweight of 2.5–3.5 kg, and only 13 (12.3%) had a birthweight of <2.5 kg [Table 1].

The prevalence of underweight was higher in children of lower socioeconomic status than in children from upper socioeconomic status (P = 0.000) [Table 2]. There was a significant association between birth order and increasing cases of underweight (P = 0.000). The prevalence of stunting in the study population was 137 (20.7%). It was higher among boys 82 (59.9%) than girls 55 (40.1%) (P = 0.03). Most of the children

in two–three-year-old category 60 (43.8%) were stunted, while those <1 year old only 28 (20.4%) were stunted. Stunting rates increased from 20.4% in children aged <1 year to 43.8% in children aged two—three years. Stunting was present in 10.2% of children whose birthweight was <2.5 kg. It was seen that the higher the birth order more were the cases of stunting ($P = 0.11$). The prevalence of stunting was higher in children from lower socioeconomic status than those from households in upper strata ($P = 0.003$). The prevalence of overweight was 4.8% among study participants and more in girls 18 (56.3%) than boys 14 (43.8%) [Figure 1]. In the present study, 78% of overweight children were exclusively breastfed. Among overweight children, 53% had first birth order. Overweight children were the maximum in educated mothers who were qualified above the 10th standard (53%). It was observed that an increase in birthweight was significantly associated with the prevalence of overweight ($P = 0.023$). The prevalence of wasting was 17.2% in our study and it was almost similar in both genders. There was the direct relationship of wasting with age, it was a maximum, i.e., 43.9%, in the two—three years of age group. The present study showed that the improvement in socioeconomic status led to a decrease in wasting but the result was not significant. The prevalence of wasting was higher in children belonging to lower socioeconomic households than in children from households of upper strata $P = 0.007$. The linear correlation was significant between weight ($R = 0.16$, $P = 0.00$), height ($R = 0.09$, $P = 0.02$), and mid-upper arm circumference ($R = 0.89$, $P = 0.02$) with the socioeconomic status of the family [Figure 2].

Table 1: Characteristics of study population (*n*=662)

Variables	Total	Percentage
Gender		
Boy	342	51.7%
Girl	320	48.3%
Age		
<1 year	131	19.7%
1–2 year	252	38%
2–3 year	279	42.3%
Birthweight		
<2.5	57	8.6%
2.5–3.5	575	86.9%
>3.5	30	4.5%
Breastfeeding		
Exclusive	525	79.3%
Topfeed	137	20.7%
Place of delivery		
District Hospital	145	21.9%
Community Health Centre	199	30.1%
Private	316	47.75
Home	2	0.3%
Type of delivery		
Normal	289	43.7
C-section	372	56.3
Gestational period		
<37	50	7.6%
37–42	602	90.9%
>42	10	1.5%
Socioeconomic status score*		
33–42	77	11.6%
24–32	306	46.2%
13–23	279	42.1%
Immunization		
Complete	630	95.2%
Incomplete	32	4.8%
Mother education		
Illiterate	13	2%
Till 10th	299	45.2%
>10	350	52.8%
Siblings		
0	320	48.34
1	254	38.37
≥2	88	13.29
Birth order		
1	334	50.5%
2	237	35.8%
>3	91	13.7%

*From modified Udai Pareek scale

Discussion

The present study tried to measure the prevalence of malnutrition by using conventional indices like underweight, stunting, and wasting. When compared with NFHS-5 data, the prevalence of stunting in this study was lower than Punjab state (20.7% vs 23.9%) while wasting in this study was higher than the state figures (17.2% vs 10%). Whereas underweight, stunting, and wasting were found lower than national figures (underweight—16% vs 33.8%, stunting—20.7% vs 37.3%). However, the overweight children found in the present study (4.8%) were higher than the national average (3.2%) as reported by NFHS-5 [Figure 3].[9]

In the present study, boys were more prone to stunting and underweight than girls [Figure 3]. According to a study conducted by Khan *et al.*[13] in Pakistan stunting (51% vs 45%), wasting (16.8% vs 15.5%) and underweight (40% vs 38%) were higher in boys than girls. Similarly a study done in India by

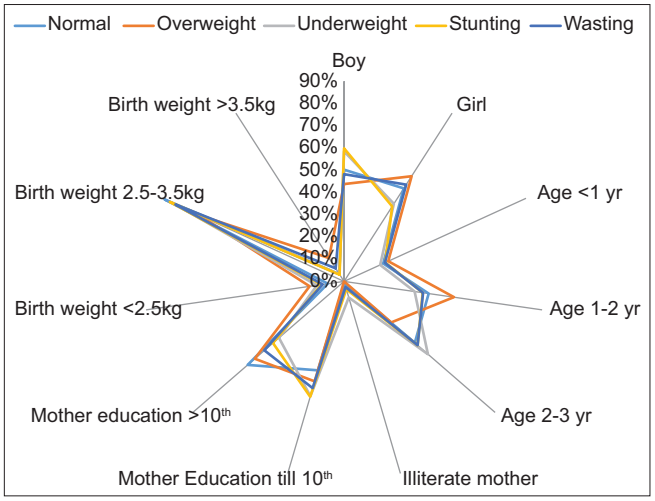

Figure 1: Determinants of malnutrition

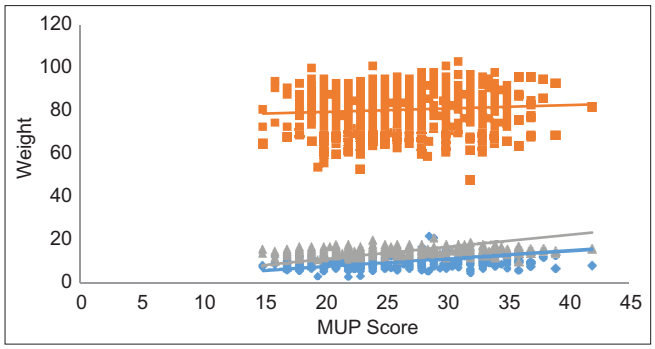

Figure 2: Scatterplot for height, weight, and MUAC with socioeconomic status score

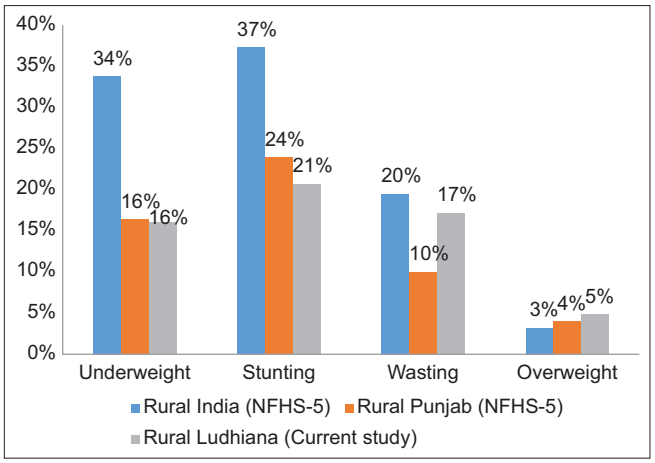

Figure 3: Comparison of malnutrition by prevalence

Shivaprakash *et al.* reported that the prevalence of stunting was higher among boys as compared to girls ($P < 0.05$).[14] According to a study done by Bloss E in Kenya, children in their second year of life were found to be most at risk of underweight and stunting. The increased risk of undernutrition as children reach their second year of life may be due to a combination of interactive effects. First, during this period, growth and nutritional status may be affected as children are being weaned off from the breast milk. Not only do mothers lose their ability to produce enough milk to meet the nutritional demand of the growing infant, children at this age are also losing the passive immunity received from the mother.[15] The present study indicated that an increase in birth order is directly related to childhood stunting and underweight. In the present study, 56% of children with birth order of ≥3 were from the lower middle-class category (MUP Score). India has a large number of malnourished children, so it is important to understand the relationship between birth order, socioeconomic scale, and undernutrition. This study found that higher birth order was associated with poor nutritional status of the child. The prevalence of underweight increased from 13.2% (first order) to 83% (fifth order). The prevalence of stunting increased from 18.6% (first order) to 66.7% (fifth order). According to a study done by Rahman M in Bangladesh, children of third-order, fourth-order, fifth-order, and higher-order birth were 24%, 30%, and 72%, more likely to be stunted than children of first-order birth.[16] A possible explanation for this could be that mothers with more children are likely to have some unwanted births. They are less likely to take care of themselves during pregnancy and use appropriate postnatal care services. They are also less likely to be able to provide adequate food and other resources to their children, resulting in poorer child health.[17] The present study revealed that 98% of mothers were literate and the education of mothers was found to be inversely proportional to the prevalence of stunting. Our findings were supported by other studies done in India.[18-23] This shows that the educational level of mothers was positively related to the better nutritional status of children. The present study also found a positive influence of improved household economic status on child health. However, supporting evidence for this relationship is inconclusive. Many previous studies have claimed that improved economic status facilitates the improvement in child health indicators. However, some studies have pointed out that economic development alone is not enough to improve the nutritional status of children, and have suggested that the equitable allocation of funds to public health, education, and development should be done on a priority basis to keep children healthy.[24] Investment in women's education promotes economic growth. Consequently, improved economic status helps to improve the child nutritional status by allowing good access to food and health-related services.[25]

In the present study, more than half of girls, i.e., 56%, were overweight. Kapral *et al.*[26] conducted a study in Virginia, USA, and showed that high birthweight is most strongly associated with subsequent childhood overweight and obesity. Infants with higher birthweights had increased odds of obesity from kindergarten through second grade as compared to children with normal and lower birthweight. The underlying factors that link higher birthweight and later obesity are unclear but likely include genetic factors, maternal nutrition, and shared lifestyle practices (such as dietary and sedentary behaviors).

The study has its limitations. First, due to the cross-sectional nature of the data, it could not establish a causal relationship between the key socioeconomic, demographic-related characteristics, and child malnutrition. Due to the presence of several intermediate factors, the association might get affected between socioeconomic characteristics and childhood nutritional status. As immunization status was based on immunization card, children who had received some immunizations but lost their immunization card would be misclassified. We have not taken a complete dietary survey of under-three children and whether they were sent to Anganwadi centers. History of Diarrhea and Acute Respiratory Infection in the past six months should be included in the study, as it might affect the nutritional status of children.

Conclusion

The present study indicates that undernutrition is still an important health concern among under-three children. The causes of malnutrition in children are complex and involve multiple factors. Maternal and child-related factors are associated

Table 2: Risk factors of malnutrition among children aged six months to three years (*n*=662)

	Normal		Underweight		*P*
Birth order					
1	290	86.8%	44	13.2%	0.00
2	194	81.9%	43	18.1%	
3	59	84.3%	11	15.7%	
4	12	80.0%	3	20.0%	
5	1	16.7%	5	83.3%	
Socioeconomic status score*					
33–42	73	94.8%	4	5.2%	0.00
24–32	268	87.6%	38	12.4%	
13–23	215	77.1%	64	22.9%	
	Normal		**Stunting**		
Gender					
Boy	260	76.0%	82	24.0%	0.03
Girl	265	82.8%	55	17.2%	
Birth order					
1	272	81.4%	62	18.6%	0.01
2	184	77.6%	53	22.4%	
3	58	82.9%	12	17.1%	
4	9	60.0%	6	40.0%	
5	2	33.3%	4	66.7%	
Socioeconomic status score*					
33–42	68	88.3%	9	11.7%	0.003
24–32	252	82.4%	54	17.6%	
13–23	205	73.5%	74	26.5%	
Mother's education					
Illiterate	8	61.5%	5	38.5%	0.01
Till 10th	225	75.3%	74	24.7%	
>10th	292	83.4%	58	16.6%	
	Normal		**Overweight**		
Birthweight					
<2.5	52	91.2%	5	8.8%	0.02
2.5–3.5	552	96.0%	23	4.0%	
>3.5	26	86.7%	4	13.3%	
	Normal		**Wasting**		
Socioeconomic status score*					
33–42	68	88.3%	9	11.7%	0.01
24–32	264	86.3%	42	13.7%	
13–23	216	77.4%	63	22.6%	

*From modified Udai Pareek scale

with malnutrition in children, and most of them are preventable. However, the study reveals that the time period between two and three years is the most vulnerable for malnutrition. Therefore, the intervention for prevention and detection of malnutrition should start early immediately after six months of age when complementary feeding is started. There is a need for vigorous monitoring for early detection of malnutrition for children aged two—three years. The improvement of maternal education will improve the nutritional status of the child. The double burden of malnutrition is evident even in the rural population. Further research is recommended to investigate potential factors associated with child malnutrition, and interventions to improve nutritional status in children under five years.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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