

# A study on relationship between protein-energy malnutrition and other morbidities among under-five children in a rural area of Hooghly district, West Bengal



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## ABSTRACT

**Background:** Malnutrition affects physical growth, morbidity, and mortality of the under-five children. It is an underlying factor in many diseases for children and is particularly prevalent in developing countries, where it affects one out of every three preschool-age children. **Aims and Objectives:** The aims of this study were to find out the relationship between protein-energy malnutrition and other morbidities among under-five children. **Materials and Methods:** Community-based prospective longitudinal study was conducted in 1 year duration in a rural area of Hooghly District, West Bengal. By adopting sample size calculation formula  $4 pq/L^2$ , total 108 children were participated in the study. With the help of pre-design, pre-tested schedule data were collected by interviewing the care giver, by clinical and anthropometry examination of the children and by record review. **Results:** Among the study population under-weight, stunted, and wasted were 52%, 37%, and 28%, respectively, whereas malnutrition by all types of classification was 61%. Episode of diarrhea, acute respiratory infections (ARI), and worm infestation were 3.50, 4.12, and 1.38/child/year, respectively. Study shows that rate of total morbidities and prevalence of malnutrition was very much interrelated. **Conclusion:** Prevalence of malnutrition along with diarrhea, ARI, and worm infestations is common ailments among rural population. Special emphasis should be given for provision of health-care services and promotion and protection of optimal infant feeding practices for the improvement of nutritional as well as health status of the children.

**Key words:** Protein energy malnutrition; Diarrhea; Respiratory infection; Under-five children

## INTRODUCTION

Globally, childhood mortality is an important public health concern, and thus, the sustainable development goal 3 aims to reduce under-five mortality rate to as low as 25/1000 live births by 2030.<sup>1</sup> According to the united nations inter-agency group for child mortality estimation, the world has made remarkable progress in reducing under-five mortality rate from 93/1000 live births in 1990–38 in 2019.<sup>2</sup>

Malnutrition continues to be a primary cause of ill health and mortality among children in developing countries. It is a major public health problem and accounts for about half of all child deaths worldwide.<sup>3</sup> About 150 million children in developing countries are still malnourished and more than half of underweight children live in South East Asia region. Nearly one in five children under age five in the developing world is underweight (MDG report, 2012).<sup>4</sup> The World health Organization has reported hunger and related malnutrition as the greatest single threat to the world's

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public health. One in every three malnourished children of the world lives in India and under-nutrition is a major cause in more than half of under-five deaths.<sup>5</sup>

The best global indicator of children's well-being is growth. Assessment of growth is the single measurement that best defines the nutritional and health status of children and provides an indirect measurement of the quality of life of the entire population.<sup>5</sup> As per the recent report of NFHS-5 (2019-21), the nutrition indicators for children under 5 years have improved as compared with NFHS-4 (2015-2016). Stunting has reduced from 38.4% to 35.5%, wasting has reduced from 21.0% to 19.3%, and underweight prevalence has reduced from 35.8% to 32.1%. Despite the improvement, under-nutrition is still the major problem in our country especially in underserved areas such as rural area. Acute respiratory infections (ARI) and diarrhea are the common morbidities among under-five children in India.<sup>6</sup>

There are very few data about the relationship between protein-energy malnutrition (PEM) and common morbidities of the children. The present study was an attempt to determine the magnitude and severity of PEM and to find out the episodes of most common acute infections such as acute diarrheal diseases (ADD), ARI, and worm infestations and to find out relation between PEM and these acute infections among under-five children.

### Aims and objectives

The aims of this study were as follows:

1. To determine the magnitude and severity of PEM among under-five children by anthropometric measurements
2. To estimate the occurrence (episode per child per year) of some common acute infections such as ADD, ARI, and worm infestations among under-five children
3. To determine the relationship between acute infections and PEM.

## MATERIALS AND METHODS

This community-based prospective longitudinal study was conducted in 1 year duration under service area of Rural Health Unit and Training Center (RHU and TC), Singur Block, Hooghly district, West Bengal. This study was started after ethical approval from the Institutional Ethics Committee of AIHH and PH Kolkata (Memo No: AIHHPH/PSM/S/6.6/2007). Among the villages under service area of RHU and TC, Singur, two villages (Paltagarh and Diara) were chosen for the study by simple random sampling (SRS) method. Study subject was followed up for 1 year and for this reason, the study population consisted

of children of <4 years of age (e.g., 0 day-47 months, 29 days) at the onset of the study. Above the 48-month-old age group children were not included the study because the final result in that case reflected children of above 5 years age. By adopting sample size calculation formula  $4pq/L^2$  and accepting the episode rate of diarrhea 3.2/child/year, total sample size was 112. Thereafter, a list of children of under 4 years of age was prepared from the family folder which was available in the respective health center by the investigator. One hundred and twelve children were selected from this list by SRS method (Inclusion criteria – age <48 months, willing to participate follow-up of 1 year and exclusion criteria – seriously ill, not a permanent resident of that area). Informed verbal consent was taken from the parents/care giver of those 112 children and four children dropped out (3.57%) during the study due to various reasons such as leaving the area and non-response. Hence, at the end of the study, the sample size was 108.

### Methodology

A schedule was prepared for the purpose of the study. The schedule consisted of three parts. First one was family schedule, second part was individual schedule, and the third one was the follow-up schedule. These schedules were pre-tested before actual study was conducted.

- First part of schedule: Details regarding the family of the individual such as identification, type of family, type of house, lighting, ventilation, floor space of the house, drinking and domestic water source and its distance, latrine, socioeconomic status, and family composition and vital events were recorded in this part
- Second part of schedule: The individual information of children comprised identification, place and agency of delivery, birth weight, weight, height, intake of certain food items, personal hygiene, nutritional status, immunization status, provisions for recording complaints, and findings on clinical examination and information on their health care seeking behavior
- Third part of schedule: Follow-up part of schedule. It comprised information on weight and height, type of illness, place and nature of treatment, and effect of illness. Home visits were made for each child every fortnightly interval for follow-up of occurrence of diarrheal diseases, respiratory infections, and worm infestations; anthropometric measurements of the children were taken every 3 months interval.

Based on the findings of clinical examination and history of children from the mother, a diagnosis was made. Some among the study population were in the process of medical treatment for some ailments from government or private health-care organization. The diagnosis documented in those treatment papers were taken into consideration.

All data were collected by respective children home visits. Anthropometric measurements were done from the 1<sup>st</sup> visit and followed at every 3 months interval. Hence, the total number of visits was 5 times during the study period. In each visit, it was asked to the parents/care giver for history of any morbidities (Diarrhea, respiratory infections, and worm infestations). After 1-year, total number of occurrences of each morbidities counted and then attacks of acute infections were calculated by Episode/Child/Year.

Data were analyzed to find out the magnitude of PEM in sample population and its severity according to Indian Association of Pediatrics classifications. Similarly, attack rate of diarrhea and ARI and prevalence rate of worm infestations were also be included. Finally, the association between magnitude and severity of PEM with frequency of other predefined morbidities was found out. Thus, the antecedent consequent phenomenon of frequency, severity, morbidities, and magnitude of PEM were ascertained. Test for the statistical significance was applied using Chi-square test for analyzing the difference between the two proportions ( $P < 0.05$  was considered significant).

## RESULTS

In this study, total of 108 under 4-year children were followed up for 1 year period. Hence, all results reflected here were children of under 5 years of age. Among the total sample population 26%, 20%, 27%, 13%, and 14% were age of 0–5 months, 6–11 months, 12–23 months, 24–35 months, and 36–47 months, respectively. About 51% were male and 49% were female. In this study, 92% were Hindu and 8% were Muslim, whereas SC, ST, and general were 21%, 02%, and 77%, respectively.

Table 1 showed that among the total sample population in the first visit, under-weight, stunted, and wasted were 52%, 37%, and 28%, respectively, whereas malnutrition by all types of classification was 61%. After that situation changes in subsequent visits and in final visit 48%, 35%, and 23% were under-weight, stunted, and wasted, respectively, whereas 59% were malnourished by all types of classification.

Table 2 showed that, among the total sample population episode of diarrhea, ARI, and worm infestation were 3.50, 4.12, and 1.38/child/year, respectively. All the morbidities may occur in any age group children and these morbidities episodes rate also varied in different age group children, but the table showed that childhood acute infections most commonly occur among 12–23 months of age group.

Table 3 showed that malnutrition was significantly more among children who suffered from >3 episodes of diarrhea than those who suffered from <3 episodes (80% vs. 6%) and this difference was statistically significant. Malnutrition was significantly more among children who suffered from >3 episodes of ARI than those who suffered from <3 episodes (63% vs. 10%) and this difference was also statistically significant. And finally, malnutrition was significantly more among children who suffered from >1 episodes of worm infestation than those who suffered from <1 episodes (70% vs. 35%) and this difference was statistically significant. Hence, this table expressed that among the study population those having malnutrition in any form were more chances of developing any morbidities such as diarrhea, ARI, or worm infestation.

Figure 1, line diagram, showed that rate of total morbidities and prevalence of malnutrition are very much interrelated. All types of morbidities and prevalence of malnutritions both were common among 12–23 months of age group children. The diagram also shows when morbidity increased, malnutrition also increased, and when morbidity decreased, malnutrition decreased.

## DISCUSSION

PEM refers to a form of malnutrition which is defined as a range of pathological conditions arising from coincident lack of protein and or energy in varying proportions. PEM is associated with increased number of common infectious diseases among under-five children.<sup>7</sup>

The present study was carried out on 108 children under 5 years of age in the rural area of Singur block in Hooghly District of West Bengal with a view to determine the magnitude and severity of PEM and to find out the episodes

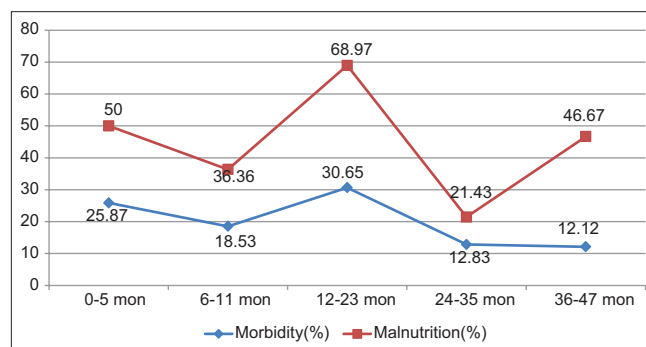
**Table 1: Study population according to magnitude of different type of malnutrition in subsequent visits\* (n=108)**

Type of malnutrition	1 <sup>st</sup> visit No (%)	2 <sup>nd</sup> visit No (%)	3 <sup>rd</sup> visit No (%)	4 <sup>th</sup> visit No (%)	5 <sup>th</sup> visit No (%)
Under-weight (Weight for age)	56 (52)	47 (44)	53 (49)	48 (44)	52 (48)
Stunting (Height for age)	40 (37)	39 (36)	38 (35)	37 (34)	38 (35)
Wasting (Weight for height)	30 (28)	26 (24)	25 (23)	25 (23)	25 (23)
Malnutrition by all types of classification	66 (61)	64 (59)	65 (60)	64 (59)	64 (59)

\*IAP: Indian association of pediatrics classifications

**Table 2: Study subjects according to different age groups and total episodes of different morbidities (episodes/child/year)**

Disease	Age (months)										Total (n=108)	
	(0-5) months (n=28)		(6-11) months (n=22)		(12-23) months (n=29)		(24-35) months (n=14)		(36-47) months (n=15)		Total episode	Episode rate
	Total episode	Episode rate	Total episode	Episode rate	Total episode	Episode rate	Total episode	Episode rate	Total episode	Episode rate		
Diarrhea	92	3.26	65	2.95	129	4.45	47	3.36	45	3.00	378	3.50
Respiratory infections	130	4.64	91	4.14	125	4.31	58	4.14	51	3.40	455	4.12
Worm infestation	32	1.14	26	1.18	47	1.62	21	1.50	23	1.53	149	1.38



**Figure 1:** Line diagram showing that, rate of total morbidities and prevalence of malnutrition with the different age group

of most common acute infections such as ADD, ARI, and worm infestations and to find out relation between PEM and these acute infections during 1 year period. Among the study population 51% were male and 49% were female. In the present study, it was observed that in final visit the proportion of under-weight, stunted, and wasted were 48%, 35%, and 23%, respectively, whereas 59% were malnourished by all types of classification. The most vulnerable age group was 12–23 months age group. Study conducted by Tiwari et al.,<sup>8</sup> shows that prevalence of PEM (stunting and wasting) was 56%, and PEM was more common in 13–24-month age group 66.7%.<sup>8</sup> However, as per the recent report of NFHS-5 (2019–2021), stunting, wasting, and underweight children were 35.5%, 19.3%, and 32.1%, respectively.

The present study reveals that repeated infections are very common among under privileged children, especially those under 5 years of age. The child may have diarrhea, and while recovering from it, h/she might get fever, a cough, and, a little later, boils, followed by diarrhea again. Unless immunized, h/she will also develop measles and whooping cough. These infections have an adverse effect on nutrition, and once the child is malnourished, h/she falls ill more often, making the infections more severe, further worsening malnutrition. In this study, episode of diarrhea, ARI, and worm infestation were 3.50, 4.12, and 1.38/child/year, respectively. Table also shows that childhood acute infections most commonly occur among 12–23 months of age group. Study conducted by Devidas et al.,<sup>9</sup> shows that ARI (25.71%) and diarrhea (20%) are the major health problems, and leading cause of morbidity among the under-five children. Study conducted by Mulatya and Mutuku<sup>10</sup> shows that all-cause morbidity peaks between 6 and 11 months, with diarrhea morbidity characterized by a rapid decrease with age compared with morbidity from ARI or the combined diseases. The burden of diseases is higher in younger age groups, 26.6% of children with diarrhea, 11.4% with ARI, and 4.6% with combined morbidity occur in those between 6 and 11 months of age. They also mentioned that age 6–11 months is therefore a critical

**Table 3: Study population according to different morbidity episodes and presence of malnutrition (n=108)**

Acute morbidities	Total children No (%)	Malnutrition		Test of significance (Chi-square test)
		Present No (%)	Absent No (%)	
Diarrhea				
≤3 episodes	47 (44)	3 (6)	44 (94)	Significant, $\chi^2=55.22$ , $P=0.0000$ , $df=1$
≥3 episodes	61 (56)	49 (80)	12 (20)	
Respiratory infections				
<3 episodes	30 (28)	3 (10)	27 (90)	Significant, $\chi^2=22.14$ , $P=0.0000$ , $df=1$
>3 episodes	78 (72)	49 (63)	29 (37)	
Worm infestations				
<1 episode	68 (63)	24 (35)	44 (65)	Significant, $\chi^2=12.15$ , $P=0.0005$ , $df=1$
>1 episode	40 (37)	28 (70)	12 (30)	

period for targeting interventions that address children's vulnerabilities to both diarrhea and ARI.

The present study also shows that malnutrition was significantly more among children who suffered from >3 episodes of diarrhea than those who suffered from <3 episodes (80% vs. 6%). Malnutrition was significantly more among children who suffered from >3 episodes of ARI than those who suffered from <3 episodes (63% vs. 10%). Malnutrition was significantly more among children who suffered from >1 episodes of worm infestation than those who suffered from <1 episode (70% vs. 35%). All of this difference was statistically significant. Hence, this table expressed that among the study population those having malnutrition in any form were more chances of developing any morbidities such as diarrhea, ARI, or worm infestation. Tiwari et al.<sup>8</sup> revealed that association of h/o respiratory tract infection and diarrhea with PEM can be described as 55% children with more than three episodes of ARI were malnourished, while 45% children with <3 ARI episodes were malnourished. Malnutrition was detected in 64% of children with >3 episodes of diarrhea, while only 36% were found malnourished who had <3 episodes of diarrhea, and in both cases, the difference was statistically significant ( $P<0.001$ ).

The present study also shows that rate of total morbidities and prevalence of malnutrition is very much interrelated. All types of morbidities and prevalence of malnutritions both were common among 12-23 months of age group children. The diagram also shows when morbidity increased, malnutrition also increased, and when morbidity decreased, malnutrition decreased. Study conducted by Sood and Sood<sup>5</sup> also showed that, under-five malnutritions were significantly associated with common under-five morbidities (ARI, Diarrhea etc).

#### Limitations of the study

Present study have some limitations, like:

1. Recall laps of minor ailments of short duration (diarrhea, ARI etc.) in longitudinal studies. These can be avoided by closer follow up and cross checking

of a sub sample by independent observer to find out reliability, sensitivity and specificity of data which may not be possible for this study.

2. There was the problem of confounding or associated variables like environmental factors, socio-economic factors, maintenance of good hygiene etc which could not be studied.

## CONCLUSION

The findings of the present study revealed the widespread prevalence of under nutrition among under-five children. The present study also shows under-five morbidity (diarrhea, ARI, and worm infestations) and malnutrition is closely related. When morbidity increased, malnutrition also increased, and morbidity decreased, malnutrition decreased. The extent of malnutrition can be countered by educating the parents with respect to basic nutritional requirements of their children and also health education for prevention of common childhood morbidities. The study also highlights that common childhood diseases occur mostly ages 6–11 months, at a rate that is greater than other ages, further studies may aim to understand the immunologic and biochemical mechanisms of this relationship in relation to some children being more susceptible to sequential infections due to compromised immune functions.

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**TKS**- Concept, design, data acquisition, manuscript first draft, data analysis, and data interpretation; **EG**- Literature search and data analysis; **KB**- Literature search and manuscript editing.

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