ORIGINAL ARTICLE

Frequency of hospital acquired malnutrition at a tertiary care pediatric hospital.

Hina Rajani[1], Misbah Anjum[2]

ABSTRACT… Objective: To determine the frequency of hospital acquired malnutrition in hospitalized pediatric population. **Design:** Cross-sectional study. **Setting:** Department of Pediatrics, National Institute of Child Health, Karachi, Pakistan. **Period:** January 2023 to June 2023. **Methods:** The inclusion criteria were children (irrespective of gender) aged between 1 and 12 years who were admitted for at least 48 hours. Weight of the children was measured daily from the time of admission to discharge. The hospital-acquired malnutrition rate was determined by dividing the patients with decreased weight-for-height (WFH) or body mass index (BMI) z-scores by total samples, then multiplying by 100. **Results:** In a total of 367 children, the mean age was 6.4±2.8 years whereas 203 (55.4%) children were boys. Hospital stays ranged from 2 to 19 days, with a mean of 18±6.9 days. At the time of discharge, the mean weight to be 17.6±6.53 kg, indicating a mean weight drop of 1.3±1.14 kg from admission to discharge. Weight reduction during hospitalization was observed in all age groups, with the highest percentage observed in children aged 2 to 5 years (77.7%) and the lowest in those aged 1 to 2 years (38.9%). Significant changes were observed in both WFH z-scores (mean difference -1.06, ± 1.69, p<0.001) for children under 60 months and BMI z-scores (mean difference -1.07, ± 4.63, p=0.023) for children over 60 months from admission to discharge. **Conclusion:** Hospital acquired malnutrition is common among pediatric patients and deteriorates when a child is hospitalized without attention to adequate nutritional support. Weight loss shows direct correlation with duration of hospitalization.

Key words: Anthropometry, Body Mass Index, Hospitalization, Malnutrition, Z-score.

INTRODUCTION

The European Society of Clinical Nutrition and Metabolic Care (ESPEN) defines malnutrition as an imbalance in energy, protein, and other vital nutrients that has detrimental effects on the body, how it functions, and overall clinical outcomes.[1] Severe acute malnutrition (SAM) predominantly affects infants and young children due to their higher nutritional demands for growth and development.[2] Alarmingly, malnutrition is responsible for approximately 60% of under-five deaths, with two-thirds of these occurring within the first year of life.[3]

Hospital-acquired malnutrition is a higher-catabolic condition brought on by the presence of an illness that is characterized by increased caloric requirements, dietary losses, and decreased food intake during hospital stays.[4]

The rising prevalence of malnutrition has made nutritional screening an essential part of admission and treatment evaluation, minimizing adverse consequences associated with nutritional risk.[5] The prevalence of hospital-acquired malnutrition in pediatric patients worldwide ranges from 2.5% to 51%, depending on factors such as age, gender, initial nutritional status, diagnosis, length of hospitalization, and socioeconomic considerations.[6,7] Unfortunately, approximately 70% of patients with hospital malnutrition do not receive adequate treatment, possibly due to insufficient attention given to pediatric nutritional care and a lack of knowledge regarding nutritional therapy.[8]

In Pakistan, the general pediatric population faces a significant burden of malnutrition, with one out of every three children affected.[9] However, little

1. MBBS, Post-graduate Resident Pediatrics, National Institute of Child Health, Karachi, Pakistan.
2. MBBS, FCPS (Pediatrics), Assistant Professor Pediatrics, National Institute of Child Health, Karachi, Pakistan.

Correspondence Address:
Dr. Hina Rajani
Department of Pediatrics
National Institute of Child Health, Karachi, Pakistan.
hina.rajani55@gmail.com

data is available regarding the deterioration of nutrition during hospital stays. Therefore, this study was planned with the aim of determining the frequency of hospital acquired malnutrition in the hospitalized pediatric population.

METHODS

This prospective cross-sectional study was carried out at the National Institute of Child Health, Karachi, Pakistan, from January 2023 June 2023. Approval from the institutional ethical review board was obtained before the start of the study (letter number: IERB-53/2021, Dated: 02-03-2022). The sample size of 367 was calculated using the openepi.com calculator at a 95% confidence interval with a margin of error of 7.5%. A consecutive non-probability sampling method was used for sample selection. The inclusion criteria were children (irrespective of gender) aged between 1 and 12 years who were admitted for at least 48 hours. The exclusion criteria were patients with edematous malnutrition (having bilateral pitting edema) or those who were admitted to pediatric ICUs or surgical units. Informed and written consent were taken from the parents or accompanying guardians.

Demographic characteristics and anthropometric measurements, including weight, height or length, mid-upper arm circumference (MUAC), and occipital frontal circumference (OFC), were recorded at the time of admission. The weight was measured with the same weighing scale on every alternate day until the day of discharge. In dehydrated children, weight was measured after sufficient rehydration (according to the World Health Organization criteria: alert child with normal skin turgor, moist mucous membrane, flat anterior fontanel, non-sunken eyes, warm extremities, and capillary refill time<2 sec) and was considered the initial weight for the patient. Height or length was measured using an infantometer in children of less than 2 years of age and a wall-mounted stadiometer for >2 years. Weight for height (WFH) z-score was measured for children 12-60 months of age and body mass index (BMI) z-score for children>60 months of age, using the US Centre for Disease Control (CDC) 2000 growth chart. The case description of hospital-acquired malnutrition

was established as a reduction in the WFH z-score for children aged 12 to 60 months and the BMI z-score for those above 60 months old, from the time of admission to discharge. Weight loss was categorized according to WHO criteria as normal (WFH z-score > -1), mild wasting (WFH z-score -2 ≤ to < -1), moderate wasting (WFH z-score -3 ≤ to < -2), and severe wasting (WFH z-score < -3). Similarly, BMI z-score classifications included thinness (z-score < -2), normal (-2 ≤ z-score ≤ +1), overweight (+1 < z-score ≤ +2), and obesity (z-score > +2). Routine nutritional intervention during the hospital stay was also included as to whether the child was kept nil-per-oral, allowed oral supplements, or was given parenteral fluid. The nutritional support was given according to the patient's needs as decided by the pediatrician. All of the relevant data were noted on a specifically predesigned proforma.

Data was subjected to analysis through the "IBM-SPS Statistics", version 26.0. The categorical data like age groups, gender, diagnosis at admission, length of hospital stay across groups, and hospital-acquired malnutrition were presented as frequency and percentage. For the quantitative variables like WFH z-scores and BMI z-scores, the mean and standard deviation (SD) were calculated. Chi-square test was applied to categorical data. taking $p<0.05$ as significant.

RESULTS

Initially, 370 children were enrolled but 3 were excluded based on the exclusion criteria. In a total of 367 children, the mean age was 6.4±2.8 years, with the majority (69.3%) falling between 5 and 12 years. Of the participants, 203 (55.4%) were boys, and 164 (44.6%) were girls. Hospital stays ranged from 2 to 19 days, with a mean of 18±6.9 days. The most common conditions at the time of admission were those affecting the gastrointestinal system (n=120, 32.7%), followed by respiratory (n=113, 30.7%) and central nervous system (n=51, 13.9%), as shown in Table-I.

At the time of admission, the mean weight and height were 18.9±6.54 kg and 108.5±20.7 cm, respectively. At the time of discharge, the mean weight to be 17.6±6.53 kg, indicating a mean

weight drop of 1.3±1.14 kg from admission to discharge. Weight reduction during hospitalization was observed in all age groups, with the highest percentage observed in children aged 2 to 5 years (77.7%) and the lowest in those aged 1 to 2 years (38.9%). Children diagnosed with anemic failure and meningitis/encephalitis showed the greatest weight loss, with 100% experiencing weight reduction. Significant changes were observed in both weight-for-height (WFH) z-scores (mean difference -1.06, ± 1.69, p<0.001) for children under 60 months and body mass index (BMI) z-scores (mean difference -1.07, ± 4.63, p=0.023) for children over 60 months from admission to discharge (Figure-1). Among the 367 participants, 68.3% (251) displayed a decline in their WFH z-scores (for children below 60 months) or BMI z-scores (for children above 60 months), while 24.8% (91) exhibited no alteration, and 6.9% (25) experienced an increase. According to the World Health Organization (WHO) classification of nutritional status based on WFH or BMI, 32.6% of children had normal nutrition status at admission, while 62.4% were mildly malnourished, 3% were moderately malnourished, and 2% were severely malnourished. On discharge, 27.7% of children maintained their nutritional status, 32.7% moved to the mild malnutrition category, 26.7% to the moderate malnutrition category, and 12.9% to the severe malnutrition category.
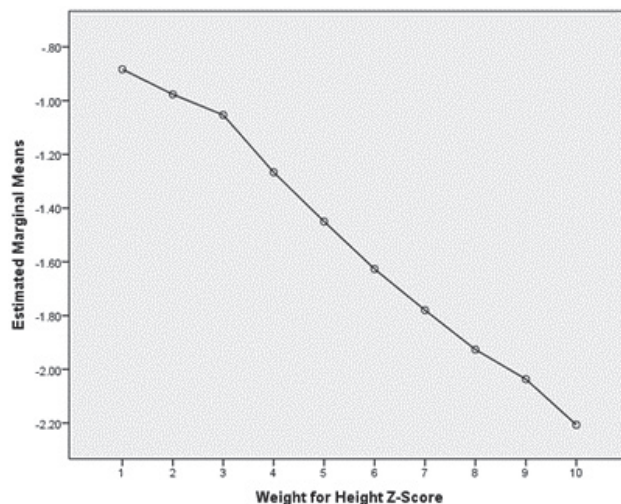

Figure-1. Change in Weight with respect to weight for Height Z-score

The duration of hospital stay showed a significant association with weight loss, with higher percentages of weight loss observed in longer duration of stay: 2 to <3 days (30.5%), >3 to <5 days (50.1%), >5 to <7 days (71.1%), and >7 days (73.6%). Other factors that appeared to be associated with weight loss included an age of 2 to 5 years (77.7%) and neurological conditions with symptoms of altered level of consciousness (100%) (Table-II).

At the time of admission, the mean weight for height (WFH) z-score of children less than 60 months of age was -0.94±1.26, and at discharge, it was -2.00±2.13, showing a significant difference of -1.06±1.69 with a p-value≤0.001. While, at admission and discharge, the mean values of body mass index (BMI) z-score for children of more than 60 months of age were -0.64±4.78 and -1.71±1.94, respectively. A notable change in BMI z-score (-1.07±4.63, p-value=0.023) was observed for this group of children as well. Comparison of nutritional status at admission and at discharge using the WHO criteria is shown in Table-III.

DISCUSSION
Nutrition is a critical requirement for the growth and development of children, especially during periods of stress and illness. However, nutritional status often worsens during hospitalization,

Characteristics		Frequency (%)
Age (months)	12 to 24	18 (4.9%)
	>24 to 60	94 (25.6%)
	>60 to 144	255 (69.5%)
Gender	Male	203 (55.3%)
	Female	164 (44.7%)
Diagnosis at admission	Gastrointestinal conditions	120 (32.7%)
	Respiratory conditions	113 (30.8%)
	Neurological conditions	51 (13.9%)
	Others	83 (22.6%)
Duration of hospital stay (days)	2 to 3	36 (9.8%)
	>3 to 5	62 (16.9%)
	>5 to 7	76 (20.7%)
	>7	193 (52.6%)
Table-I. Characteristics of children (n=367)		

Variables		Weight Loss		P-Value
		No (n=127)	Yes (n=240)	
Age (months)	12 to 24	11 (61.1%)	7 (38.9%)	0.037
	> 24 to 60	21 (22.3%)	73 (77.7%)	
	> 60 to 144	95 (37.3%)	160 (62.7%)	
Symptoms	Abdominal pain	29 (30.9%)	65 (69.1%)	0.016
	Tachypnea	15 (17.9%)	69 (82.1%)	
	Cough	37 (36.3%)	65 (63.7%)	
	Seizures	8 (24.2%)	25 (75.8%)	
	Altered consciousness	-	18 (100%)	
	Diarrhea	15 (27.3%)	40 (72.7%)	
	Fever	91 (29.8%)	214 (70.2%)	
	Vomiting	19 (22.6%)	65 (77.4%)	
Admission diagnosis	Gastroenteritis	7 (38.9%)	11 (60.1%)	0.001
	Asthma	4 (36.4%)	7 (63.6%)	
	Anemic failure	-	11 (100%)	
	Pneumonia	7 (63.6%)	4 (36.4%)	
	Dengue fever	4 (22.2%)	14 (77.8%)	
	Enteric fever	15 (25.9%)	43 (74.1%)	
	Liver abscess	7 (63.6%)	4 (36.4%)	
	Meningitis/encephalitis	-	22 (100%)	
	Pleural effusion	11 (20.4%)	43 (79.6%)	
	Others	69 (45.1%)	84 (54.9%)	
Hospital stay (days)	2 to 3	25 (69.4%)	11 (30.6%)	<0.001
	> 3 to 5	26 (41.9%)	36 (58.1%)	
	> 5 to 7	22 (28.9%)	54 (71.1%)	
	> 7	51 (26.4%)	142 (73.6%)	

Table-II. Associated factors for nutritional deterioration (n=367)

Nutritional Status	Criteria	Admission	Discharge	P-Value
Normal	z-score > -1 SD	120 (32.7%)	102 (27.8%)	<0.001
Mild	-2 < z-score < -1 SD	229 (62.4%)	120 (32.7%)	
Moderate	-3 < z-score < -2 SD	11 (3.0%)	98 (26.7%)	
Severe	z-score < -3 SD	7 (1.9%)	47 (12.8%)	

Table-III. Comparison of nutritional status at admission and discharge using the WHO criteria (n=367)

impacting patients' outcomes and healthcare costs. In our study, we found a high prevalence of hospital-acquired malnutrition, with a rate of 68.3%. During stressful and diseased conditions, the caloric demand increases. Additionally, symptoms like nausea, vomiting, and reluctance to feed can hinder proper nutrition, leading to hospital-acquired malnutrition.[10] Establishing a scheduled routine for meals and minimizing disruptions from clinical processes, such as ward rounds and diagnostic procedures that involve withholding oral intake, is crucial. Some medications may also cause gastrointestinal symptoms, limiting food intake. Other contributing factors to hospital-acquired malnutrition include the inability to recognize malnutrition, the absence of screening tools, a lack of daily intake and weight records, and deficiencies in nutritional training for hospital staff.[10]

Comparing our findings with previous studies[10], we observed an increased occurrence of malnutrition developed during hospitalization, potentially due to the broader age range of patients included in our study. Children with normal nutritional status or mild malnutrition at admission were most affected, progressing to moderate or severe malnutrition by the time of discharge.[11] This suggests a lack of attention to the nutritional needs of patients and a focus

primarily on their medical conditions. Failure to provide sufficient protein and energy during the illness phase can exacerbate preexisting nutritional deficiencies.[12] Therefore, it is crucial to prioritize nutritional evaluation and implement appropriate treatment protocols.[13]

The second part of our study examined the relationship between weight loss and specific medical conditions. We found that children admitted with meningitis/encephalitis and anemic failure experienced the greatest weight loss. This could be attributed to the severity of the diseases, which impairs food intake and reduces focus on enteral and parenteral nutrition. Children with pleural effusion also exhibited significant weight loss, likely due to impending respiratory distress and the resulting imbalance between increased energy demand and decreased intake.[14]

Furthermore, the duration of hospital stays was identified as a significant risk factor for hospital-acquired malnutrition. Prolonged hospitalization, particularly stays exceeding seven days, was associated with the highest percentage of weight loss. These findings align with previous studies conducted by Kazem et al[10] and Quadros et al.[11]

In terms of limitations, our study employed a 7.5% precision error for sample size calculation due to the limited study duration. However, we utilized a 95% confidence interval to estimate the true range of the study. It's important to note that this study did not aim to draw definitive conclusions regarding the risk factors associated with hospital-acquired malnutrition. We highlight the importance of early identification of malnutrition and the implementation of nutritional interventions during the hospitalization period.[15] Our study emphasizes the high prevalence of malnutrition among pediatric patients, which further deteriorates during hospitalization without adequate nutritional support. Hospital-acquired malnutrition is closely linked to longer hospital stays. Further research is warranted to assess the impact of early nutritional intervention on hospital-acquired malnutrition in pediatric patients.

CONCLUSION
Hospital acquired malnutrition is common among pediatric patients and deteriorates when a child is hospitalized without attention to adequate nutritional support. Weight loss shows direct correlation with duration of hospitalization.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

SOURCE OF FUNDING

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Hina Rajani	Data collection, Drafting.	
2	Misbah Anjum	Critical revisions, Proof reading.	