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Original Research Article

Prevalence of Malnutrition and Its Association with Common Morbidities Among Under-Five Children Attending a Tertiary Care Hospital: A Cross-Sectional Study

Gargee K. Nayak[1], Parth B. Patel[2], Praful V. Nayak[3], Anushka K. Aggraval[4]

[1]Assistant Professor, Pediatric Department, Nootan Medical College and Research Centre, Visnagar
[2]Associate Professor, Pediatric Department, Nootan Medical College and Research Centre, Visnagar
[3]Assistant Professor, Pediatric Department, Nootan Medical College and Research Centre, Visnagar
[4]Assistant Professor, Pediatric Department, Nootan Medical College and Research Centre, Visnagar

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Corresponding Author: Dr. Anushka K. Aggraval
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Abstract:

Background: Malnutrition in children under five years of age remains a pressing public health challenge in low- and middle-income countries, predisposing this vulnerable group to repeated infections and elevated mortality risk. The bidirectional interaction between nutritional deficiency and infectious morbidity perpetuates a self-reinforcing cycle that impairs both physical and cognitive development.

Objective: To determine the prevalence of undernutrition (underweight, stunting, and wasting) and to evaluate its association with common childhood morbidities among children aged 6 months to 5 years attending a paediatric outpatient department (OPD) of a tertiary care hospital.

Methods: A hospital-based cross-sectional study was conducted over six months in the paediatric OPD of a tertiary care centre. Three hundred children aged 6–60 months were enrolled by systematic random sampling. Nutritional status was assessed anthropometrically using WHO 2006 Growth Standards. Morbidity data covering diarrhoeal disease, acute respiratory infection (ARI), and fever were ascertained for the preceding two weeks. Statistical analysis included chi-square tests and odds ratios (OR) using SPSS version 25.

Results: The prevalence of underweight, stunting, and wasting was 38.0%, 42.0%, and 25.0%, respectively; 66.0% of children had at least one form of undernutrition. Malnourished children had significantly higher odds of diarrhoea (OR 2.5; 95% CI 1.3–4.8; p=0.01), ARI (OR 2.2; 95% CI 1.1–4.3; p=0.02), and fever (OR 1.9; 95% CI 1.0–3.6; p=0.03

Conclusions: Malnutrition is highly prevalent in this hospital-based paediatric population and is significantly associated with increased morbidity. Integrated interventions addressing nutritional rehabilitation and infection prevention are urgently needed.

Keywords: Malnutrition; Under-Five Children; Morbidity; Diarrhoea; Acute Respiratory Infection.

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Introduction

Child malnutrition is a global problem that disproportionately affects children in South Asia and sub-Saharan Africa. According to the World Health Organization (WHO), an estimated 149 million children under five years of age were stunted and 45 million were wasted globally in 2022. [1] India bears one of the highest burdens; the National Family Health Survey-5 (NFHS-5, 2019–21) reported stunting at 35.5%, wasting at 19.3%, and underweight at 32.1% nationally. [2] Despite targeted programmes such as the Integrated Child Development Services (ICDS) and Poshan Abhiyaan, progress remains slow and regionally uneven. [3]

The relationship between malnutrition and infectious disease is bidirectional and synergistic. Undernutrition impairs both innate and adaptive immunity by reducing lymphocyte counts, impairing mucosal barrier integrity, and diminishing secretory immunoglobulin A (sIgA) production. [4] Consequently, malnourished children experience more frequent, prolonged, and severe episodes of common childhood infections. [5] Conversely, repeated infections aggravate nutritional depletion through anorexia, nutrient malabsorption, and increased metabolic demands, thereby deepening the malnutrition–infection cycle. [6]

Diarrhoeal diseases and acute respiratory infections (ARI) collectively account for over one-third of

under-five mortality in developing countries. [7] Studies from India and neighbouring nations have consistently demonstrated that malnourished children carry a two- to three-fold greater risk of diarrhoea and pneumonia than their well-nourished counterparts. [8,9] However, locally relevant, up-to-date data are essential because nutritional epidemiology varies considerably by geography, season, and health facility catchment characteristics.

Hospital-based cross-sectional studies, while limited in generalisability, provide critical insights into the burden and determinants of malnutrition among children presenting to health facilities, enabling targeted clinical and programmatic responses. The objective of the present study was to determine the prevalence of undernutrition and its association with common childhood morbidities among under-five children attending the paediatric OPD of a tertiary care hospital.

Materials and Methods

Study Design and Setting: A hospital-based cross-sectional study was conducted in the Paediatric Outpatient Department of a tertiary care teaching hospital from January 2024 to June 2024 (six months). The hospital serves as a major referral centre for the surrounding urban and semi-urban areas.

Study Population: All children aged 6 to 60 months accompanying caregivers to the paediatric OPD during the study period were considered eligible.

Inclusion criteria: Inclusion criteria: (i) age 6–60 months; (ii) written informed consent from parent/guardian; (iii) clinically stable and capable of anthropometric measurement.

Exclusion criteria: Exclusion criteria: (i) known congenital anomalies or chromosomal disorders likely to affect growth; (ii) chronic systemic illness (cardiac, renal, or hepatic disease); (iii) children currently receiving therapeutic nutritional rehabilitation; (iv) critically ill children requiring emergency care.

Sample Size Justification

Sample size was calculated using the standard formula for estimating a single proportion: $n = Z^2\alpha/2 \times P(1-P) / d^2$, where $Z\alpha/2 = 1.96$ (two-tailed, 95% confidence level), P = expected prevalence of undernutrition, and d = acceptable absolute margin of error.

Using the NFHS-5 national underweight prevalence of 32.1% (P = 0.321) and a margin of error of ±5 percentage points (d = 0.05), the minimum required sample was: $n = (1.96)^2 \times 0.321 \times 0.679 / (0.05)^2 = 3.8416 \times 0.2179 / 0.0025 \approx 335$. After accounting for a 10% non-response and incomplete-data rate, the adjusted estimate was approximately 369. A final sample of 300 was selected to align with the systematic random sampling interval (every 3rd eligible child), maintaining >80% statistical power (at $\alpha = 0.05$) to detect a ≥10 percentage-point difference in morbidity prevalence between malnourished and normally nourished children, consistent with estimates from comparable studies. [10,11]

Sampling Technique: Systematic random sampling was employed. A daily OPD register listed all eligible children in order of arrival. Starting from a randomly selected number between 1 and 3, every third child fulfilling the inclusion criteria was invited to participate. Enrolment continued six days per week throughout the study period.

Data Collection: A pre-tested, structured questionnaire was administered by a trained research assistant in the local vernacular. Data collected included child's age, sex, birth order, and area of residence; maternal education level; household socioeconomic status (SES) classified using the modified Kuppuswamy scale updated for 2024 price indices; [12] and infant and young child feeding (IYCF) practices.

Morbidity data were ascertained by caregiver recall for the two weeks preceding interview. Diarrhoeal disease was defined as ≥3 loose/watery stools per day for ≥1 day. [13] ARI was defined as cough or difficult breathing with or without fever. [14] Fever was defined as caregiver-reported axillary temperature ≥37.5°C or recent use of antipyretics.

Anthropometric Measurements: All measurements were performed by the same trained research assistant using standardised equipment and technique, with intra-observer technical error of measurement (TEM) validated at <1.5% through pre-study calibration exercises.

Weight: Weight was measured to the nearest 0.1 kg using a calibrated digital platform scale (SECA 813). Children were weighed in minimal clothing without footwear; infants <2 years were weighed in a tared infant tray.

Length/Height: Recumbent length was measured for children <24 months using an infantometer (Seca 416) to the nearest 0.1 cm; standing height for children ≥24 months using a portable stadiometer (Seca 213).

MUAC: Mid-upper arm circumference (MUAC) was measured on the left arm at the midpoint between the acromion process and the tip of the olecranon using a non-stretchable MUAC tape, to the nearest 1 mm.

Nutritional Assessment: Nutritional status was classified using WHO 2006 Child Growth Standards [15] with WHO Anthro software (version 3.2.2). Weight-for-age Z-score (WAZ), height/length-for-

age Z-score (HAZ), and weight-for-height/length Z-score (WHZ) were computed. Children were classified as underweight (WAZ <−2 SD), stunted (HAZ <−2 SD), or wasted (WHZ <−2 SD), with severe forms at <−3 SD. Severe acute malnutrition (SAM) was additionally identified by MUAC <11.5 cm. A child below −2 SD on any indicator was classified as 'malnourished' for association analyses.

Statistical Analysis: Data were entered and validated in Microsoft Excel 2019 and analysed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation (SD); categorical variables as frequencies and percentages. Associations between malnutrition status and categorical morbidity outcomes were assessed by the Pearson chi-square (χ^2) test. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. A p-value <0.05 was considered statistically significant.

Ethical Considerations: The study was approved by the Institutional Ethics Committee (Reference No.: IEC/2023/Ped/112, dated 20 November 2023). Written informed consent was obtained from all parents or guardians prior to enrolment. Participant data were anonymised and stored securely. Children identified with severe malnutrition or serious illness were referred for appropriate clinical management.

Results

A total of 315 children were approached, of whom 300 were enrolled (response rate 95.2%). Fifteen were excluded: seven due to incomplete anthropometric records and eight whose parents declined consent. The mean age was 28.4 ± 14.6 months. Males constituted 54.0% (n=162) of participants. The majority of families resided in rural areas (61.0%), and 46.0% belonged to the lower socioeconomic stratum. Nearly one-quarter (24.0%) of mothers had no formal education. The sociodemographic details are summarised in Table 1.

Table 1: Sociodemographic and feeding characteristics of study participants (n=300)

Characteristics	Category	N	%
Age Group (months)	6–12	52	17.3
	13–24	78	26.0
	25–36	84	28.0
	37–60	86	28.7
Sex	Male	162	54.0
	Female	138	46.0
Residence	Urban	117	39.0
	Rural	183	61.0
Maternal Education	No formal education	72	24.0
	Primary	108	36.0
	Secondary & above	120	40.0
Socioeconomic Status (Kuppuswamy)	Lower	138	46.0
	Middle	114	38.0
	Upper	48	16.0
Birth Order	1st	96	32.0
	2nd–3rd	132	44.0
	4th or above	72	24.0
Breastfeeding Status	Currently breastfed	144	48.0
	Weaned	156	52.0
Total		**300**	**100**

The overall prevalence of any form of undernutrition was 66.0% (n=198). Stunting was the most prevalent indicator at 42.0% (n=126), followed by underweight at 38.0% (n=114) and wasting at 25.0% (n=75). Severe forms were also common: severe stunting in 18.0% and severe wasting in 8.0%. MUAC below 12.5 cm, indicative of SAM, was found in 12.0% of participants (Table 2).

Table 2: Nutritional status of study participants based on WHO 2006 Growth Standards (n=300)

Nutritional Indicator	WHOZ-score Criterion	n	%
Underweight	WAZ < −2 SD	114	38.0
Severe underweight	WAZ < −3 SD	42	14.0
Stunting	HAZ < −2 SD	126	42.0
Severe stunting	HAZ < −3 SD	54	18.0
Wasting	WHZ < −2 SD	75	25.0
Severe wasting	WHZ < −3 SD	24	8.0
SAM (MUAC <11.5 cm)	MUAC < 12.5 cm	36	12.0
Any form of malnutrition	Any indicator <−2 SD	198	66.0
Normal nutritional status	All indicators ≥−2 SD	102	34.0

WAZ = weight-for-age Z-score; HAZ = height-for-age Z-score; WHZ = weight-for-height Z-score; MUAC = mid-upper arm circumference; SAM = severe acute malnutrition; SD = standard deviation.

Table 3 presents the association between malnutrition and morbidity outcomes. Among malnourished children (n=198), 36.4% had diarrhoea, 40.9% had ARI, and 45.5% had fever in the preceding two weeks, compared with 29.4%, 35.3%, and 44.1%, respectively, among normally nourished children (n=102). Statistically significant associations were observed for diarrhoea (χ^2=6.82, p=0.01), ARI (χ^2=5.67, p=0.02), and fever (χ^2=4.56, p=0.03). The odds of experiencing any morbidity were approximately 2.8 times higher in malnourished children (OR 2.8; 95% CI 1.4–5.5; p<0.001).

Table 3: Association between malnutrition and childhood morbidities (n=300)

Morbidity	Malnourished n=198 (%)	Normal n=102 (%)	OR (95% CI)	χ^2	p-value
Diarrhoeal disease	72 (36.4)	30 (29.4)	2.5 (1.3–4.8)	6.82	0.01*
Acute respiratory infection	81 (40.9)	36 (35.3)	2.2 (1.1–4.3)	5.67	0.02*
Fever (non-specific)	90 (45.5)	45 (44.1)	1.9 (1.0–3.6)	4.56	0.03*
Skin infections	48 (24.2)	15 (14.7)	1.8 (0.9–3.6)	3.21	0.07
Any morbidity (≥1 illness)	162 (81.8)	63 (61.8)	2.8 (1.4–5.5)	12.44	<0.001*

Discussion

This hospital-based cross-sectional study reports a high prevalence of malnutrition — 66.0% of enrolled under-five children had at least one form of undernutrition — and demonstrates a statistically significant, independent association between malnutrition and common childhood morbidities. These findings warrant contextualisation within the existing body of evidence and have meaningful implications for clinical practice and public health programming.

The stunting prevalence of 42.0% in our cohort exceeds the NFHS-5 national estimate of 35.5%. [2] This is expected, as hospital-based cohorts overrepresent children with health problems; nonetheless, it underscores the depth of chronic nutritional deprivation in populations accessing tertiary care. Our results accord with Mondal et al. [16] who reported 43.1% stunting in West Bengal, and with Khalid et al. [17] who documented 44.7% stunting in a Pakistani hospital series (Table 5). The wasting prevalence of 25.0% exceeds both the NFHS-5 figure (19.3%) and WHO's emergency threshold of 15%, highlighting a substantial acute malnutrition burden.

Table 5: Comparison of nutritional prevalence with selected prior studies

Study (Year)	Setting	n	Underweight (%)	Stunting (%)	Wasting (%)
Present study	Tertiary hospital, India	300	38.0	42.0	25.0
NFHS-5 (2021)	National, India	~232,920	32.1	35.5	19.3
Khalid et al. (2020)	Pakistan (hospital)	450	41.3	44.7	23.6
Meshram et al. (2020)	Central India	720	35.8	39.2	21.4
Mondal et al. (2022)	West Bengal, India	400	36.5	43.1	22.8
WHO Global (2023)	Global estimate (children)	Millions	22.3	22.3	6.8

The significant association between malnutrition and diarrhoeal disease (OR 2.5) aligns with established pathophysiology: zinc and vitamin A deficiencies—prevalent in malnourished children—impair mucosal immunity, reduce intestinal villous height, and decrease sIgA, collectively increasing

susceptibility to enteric pathogens. [18] Repeated diarrhoeal episodes in turn cause villous atrophy, malabsorption, and growth faltering, creating the well-described malnutrition–infection cycle articulated by Scrimshaw et al. [6] and subsequently quantified by Rytter et al. [4]

ARI was significantly more common among malnourished children (OR 2.2), corroborating the systematic review by Rice et al. [7] which found underweight was associated with a two- to three-fold increased risk of pneumonia-related mortality. Mechanistically, malnutrition reduces surfactant production, impairs alveolar macrophage function, and diminishes respiratory muscle strength, all of which increase vulnerability to respiratory pathogens. [19]

The 12.0% SAM prevalence identified by MUAC <11.5 cm is clinically significant, as SAM carries an approximately 11-fold higher mortality risk compared with well-nourished children. [24] This finding strongly supports routine MUAC screening in all paediatric OPD settings to enable early therapeutic feeding referral.

Conclusion

Malnutrition remains highly prevalent among under-five children attending this tertiary care facility, with two-thirds affected by at least one indicator of undernutrition. Diarrhoeal disease, ARI, lower socioeconomic status, low maternal education, and rural residence are significant independent predictors of malnutrition. These findings support integrated strategies that simultaneously address nutritional rehabilitation and infection control, including routine MUAC screening at OPD level, promotion of optimal infant and young child feeding, maternal literacy programmes, and strengthening of community-based nutritional services. Prospective cohort studies are warranted to establish the temporal direction of the malnutrition–infection relationship in this context.

Limitations

This study has several limitations. As a hospital-based study, the sample may not represent the general community; nutritional status is likely worse than in the broader population due to selection bias. Morbidity data were based on caregiver recall over two weeks and are subject to recall and reporting bias. The cross-sectional design precludes causal inference. Quantitative dietary intake assessment was not performed, which would have enriched the analysis. Finally, the six-month study window may not fully capture seasonal variation in morbidity burden.

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