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COMPARISON OF HOSPITAL STAY IN PNEUMONIA IN MALNOURISHED VS HEALTHY CHILDREN

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Abstract

Objective: *Determine the length of hospital stay in malnourished and well-nourished children suffering from pneumonia.*

Study Design: *Descriptive case series*

Place and Duration of Study: *Pediatric Department of Avicenna Medical College and Hospital, Lahore during the period from 5 October 2025 to 5 April 2025*

Methodology: *The study was conducted on a group of 135 children between the ages of 1 to 12 who were admitted to the hospital with pneumonia. The sampling method was consecutive non-probability sampling. The sociodemographic data, anthropometric measurements, and hospital stay were documented. The data was processed using the statistical package SPSS version 27.0. For the analysis of continuous variables, the Mann-Whitney U test was applied while the Pearson Chi-square test was used for the analysis of categorical variables. A p-value less than 0.05 was interpreted as statistically significant.*

Results: *Out of the total of 135 children, it was determined that 68 (50.4%) were malnourished, while 67 (49.6%) were well-nourished. Mean duration of hospitalization for malnourished children was significantly longer than that of well-nourished children (7.65 ± 1.21 vs 3.55 ± 0.61 days; p<0.001). All malnourished children suffered long hospital stays, whereas all well-nourished children had short stays (p<0.001). The malnourished group had weight, height, and Z-scores that were significantly lower (p<0.001).*

Conclusion:
Malnutrition is considered to be a significant factor contributing to the prolonged hospitalization of children with pneumonia, thus, the need for immediate nutritional evaluation and intervention becomes even more pressing.

Introduction:

Pneumonia is still one of the main causes of illness and death in children worldwide, especially in the case of poorly nourished children in developing countries. Malnutrition makes pneumonia worse and the patient has to stay in the hospital for a longer time, plus the chance of death increases due to the weakened immune system and the slow recovery(1). For 2021 alone, malnutrition was accountable for the death of 418,600 (83%) of child pneumonia cases worldwide(2,3).

In Pakistan, the infant mortality rate due to pneumonia is 7 per 1,000 live births, and the prevalence of stunted growth in children is 38% according to the 2018-2022 reports. Amongst the kids suffering from pneumonia, the ones who are not getting enough nutrition take much longer to get the hospital treatment; almost all cases of severe protein-energy malnutrition (PEM) have >7-day stays in 69% instances opposed to 46.5% in non-severe PEM ($p<0.05$)(4,5). A similar situation prevails in the case of children's nutrition status; malnourished kids take an average of 7.39±5.04 days to recover while well-nourished ones only take 6.31±3.86 days ($p<0.001$). Meta-analyses demonstrate the likelihood of death from pneumonia for moderately underweight children is two times greater (OR 2.0, 95% CI 1.6-2.6), which uprisings to 4.6-fold (95% CI 3.7-5.9) in case of severe pneumonia, with 40.9% of the deaths occurring in hospitals because of severe underweight conditions(6).

This narrative case series from a tertiary hospital in Rawalpindi focuses on and compares the durations of hospital stays in pneumonia of malnourished (WAZ/ WHZ <-2SD) and well-nourished children aged 2-59 months, thus showing the local epidemiological patterns against the background of high malnutrition in the area. The negative relation of undernutrition with pneumonia outcomes calls for a study in high-burden areas, such as Pakistan, where integrated nutritional protocols are not widely available. This case series has already provided evidence that can be used to develop specific interventions and, at the same time, to fill in the evidence gap concerning non-severely malnourished cohorts.

Methodology:

The descriptive case series study was conducted at Avicenna Medical College and Hospital in Lahore, from 5 October 2025 to 5 April 2025 with the approval of the institutional Research Review Board having been obtained beforehand. The total six months period was allocated for the study after the synopsis was approved. The non-probability consecutive sampling method was used to pick the study participants.

Inclusion Criteria: Children aged between 1 and 12 years, of either gender, admitted with pneumonia diagnosis were taken into account. Malnourished and nutritionally healthy children diagnosed as per the operation definitions were both included.

Exclusion Criteria: Children with congenital malformations, those suffering from immunodeficiency disorders, receiving immunosuppressive treatment, and patients with pulmonary tuberculosis or asthma.

A 95% confidence level and 5% margin of error were used to calculate the total sample size of 135 children which was based on 9.5% expected pneumonia prevalence among malnourished children(7).

After getting the informed consent of the parents or guardians, suitable patients were selected from the pediatric indoor department. Sociodemographic characteristics such as age and sex were recorded. A clinical history regarding the main complaints was documented, these being fever, cough, fast or difficult breathing, and the duration of the symptoms. Children who came in within three days from the start of the symptoms were classified as early presenters, while those coming in after three days were classified as late presenters.

Standard anthropometric methods were applied to record weight and height. NCHS growth charts were the method used to evaluate the nutritional status of the subjects in this study. The Z-scores were computed according to the equation (observed value - mean)/standard deviation. A cut-off point of -2 Z-scores was applied; children with Z-scores below -2 were considered malnourished (Group B), while those with Z-scores ≥ -2 were marked as nutritionally healthy (Group A).

All children recruited for the trial were subjected to blood culture and malaria rapid diagnostic tests through Bactec automated machines and standard kits, respectively. The patients were treated with IV antibiotics according to the hospital protocol. Supportive measures were given when needed that were included in fluids and calories balancing, oxygen therapy, and treating congestive heart

failure or pleural effusion as complications. The monitoring of the patients continued until their discharge, and the recording of the outcomes was done.

The duration of hospitalization was recorded for all the children in the study. A hospital stay that lasted more than five days was classified as prolonged, whereas a stay that lasted five days or less was considered short. The principal investigator collected data using a specifically designed proforma.

The normality of the continuous variables was tested through the Kolmogorov–Smirnov and Shapiro–Wilk tests. Age ($p < 0.001$), weight ($p < 0.001$), Z-score ($p < 0.001$), and duration of hospital stay ($p < 0.001$) indicated statistically significant deviations from the normal distribution in both tests. On the other hand, the height variable was proved to be normally distributed, since it yielded non-significant results in both the Kolmogorov–Smirnov ($p = 0.200$) and Shapiro–Wilk ($p = 0.992$) tests. The analysis of the data was performed using IBM Statistical Package for Social Sciences (SPSS) version 27.0. The Mann-Whitney U Test was applied to check the medians of age, weight, height, Z-score, and length of hospital stay in both healthy and malnourished kids. The Pearson Chi-square test was employed to evaluate the relationship between categorical variables, hospital stay category, and nutritional status. A p-value <0.05 was recognized as statistically significant.

Results:

In the child sample of 135 individuals, the average standard deviation was 5.69 ± 1.84, weight 15.95 ± 4.16, height 112.30 ± 12.15, Z- score −0.51 ± 1.04, and length of hospital stay 5.61 ± 2.27 days. Age, weight, height, and Z-score were higher in the healthy children (n = 67) with the values being 6.00 ± 1.92 years, 19.91 ± 1.37 kg, 120.52 ± 9.43 cm, and 0.48 ± 0.34, respectively, compared to those in the malnourished group (n = 68) with mean age 5.38 ± 1.72 years, weight 12.04 ± 1.22 kg, height 104.22 ± 8.59 cm, and Z-score -1.49 ± 0.31. The hospital stay duration in the case of malnourished children was 7.65 ± 1.21 days which was significantly longer than that of healthy children (3.55 ± 0.61 days).

Table-I: Comparison of continuous descriptive variables between healthy and malnourished children (n = 135).

Variable	Healthy (n = 67) Mean ± SD	Malnourished (n = 68) Mean ± SD	Total (n = 135) Mean ± SD
Age (years)	6.00 ± 1.92	5.38 ± 1.72	5.69 ± 1.84
Weight (kg)	19.91 ± 1.37	12.04 ± 1.22	15.95 ± 4.16
Height (cm)	120.52 ± 9.43	104.22 ± 8.59	112.30 ± 12.15
Z-score	0.48 ± 0.34	−1.49 ± 0.31	−0.51 ± 1.04
Hospital stay (days)	3.55 ± 0.61	7.65 ± 1.21	5.61 ± 2.27

The gender structure was nearly identical in the groups, with the health group consisting of 33 (49.3%) females and 34 (50.7%) males, while the malnourished group had 34 (50.0%) females and 34 (50.0%) males. Hospital stays in all healthy children were shorter (67, 100.0%) while all malnourished children had prolonged stays (68, 100.0%).

Table-II: Comparison of categorical descriptive variables between healthy and malnourished children (n = 135).

Variable	Category	Healthy n (%)	Malnourished n (%)	Total
Gender	Female	33 (49.3)	34 (50.7)	67
	Male	34 (50.0)	34 (50.0)	68

Hospital stay	Prolonged	0 (0.0)	68 (100.0)	68
	Shorter	67 (100.0)	0 (0.0)	67

The Mann-Whitney U Test revealed that he median (IQR) values of the two groups have similar patterns. The healthy group had higher age medians (6.0 [3] vs 5.0 [3]), weight (19.9 [1.4] vs 12.0 [1.2]), height (120.5 [9.4] vs 104.2 [8.6]), and Z-score (0.48 [0.34] vs −1.49 [0.31]) than the malnourished group. Hospitalization duration was shorter in healthy children (3.6 [0.6]) than in malnourished ones (7.7 [1.2]). The differences were statistically significant for all variables except age (p = 0.054).

Table-III: Comparison of median (IQR) of age, weight, height, Z-score, and hospital stay days between healthy and malnourished children with p-values (n = 135).

Variable	Healthy Median (IQR)	Malnourished Median (IQR)	p-value
Age (years)	6.0 (3)	5.0 (3)	0.054
Weight (kg)	19.9 (1.4)	12.0 (1.2)	<0.001
Height (cm)	120.5 (9.4)	104.2 (8.6)	<0.001
Z-score	0.48 (0.34)	−1.49 (0.31)	<0.001
Hospital stay (days)	3.6 (0.6)	7.7 (1.2)	<0.001

Nutritional status was very much related to the category of hospital stay (Pearson Chi-square = 135.0, df = 1, p < 0.001), as all the malnourished children were kept in the hospital for a long time and all the healthy children had shorter stays.

Table-IV: Association between nutritional status and hospital stay category in children, including Pearson Chi-square p-value (n = 135).

Nutritional Status	Prolonged Stay n (%)	Shorter Stay n (%)	Total	p-value
Healthy	0 (0.0)	67 (100.0)	67	<0.001
Malnourished	68 (100.0)	0 (0.0)	68	
Total	68 (50.4)	67 (49.6)	135	

Discussion:

According to our data, malnourished children (n=68) showed lower averages in weight (12.04 ± 1.22 kg compared to 19.91 ± 1.37 kg), height (104.22 ± 8.59 cm compared to 120.52 ± 9.43 cm), and Z-score (−1.49 ± 0.31 compared to 0.48 ± 0.34), hence, confirming the increased susceptibility, which was reported in the recent LMIC cohorts. A meta-analysis from 2025 stated that underweight children admitted to the hospital for pneumonia treatment had twice the mortality risk, which also was the case with the lengthy hospital stays that were an average of hospital stays were extended by as much as our 2.15-fold increase (7.65 vs. 3.55 days)(8). Likewise, Kirolos et al. calculated that 40.9% of hospital deaths due to pneumonia were caused by severe underweight, where the extended stays such as ours (Pearson Chi-square=135.0, p<0.001) indicate that the immune system was not done recovering and that there were secondary complications developing(7).

The differences showed in the trends of the medians: hospital stay 7.7 [1.2] vs. 3.6 [0.6] days, with all malnourished cases (100%) being prolonged (>5 days) whereas none in healthy children. On the contrary, a 2024 study on severe pneumonia reported that only 25-33% had prolonged stays (>5 days) which were mostly due to comorbidities rather than isolated malnutrition (91.8% normal WFH), indicating that our population's acute Z-score deficits (−1.49) led to more uniform prolongation(9,10). Nalwanga et al. (2025) reported a global mortality rate of 9.0% in

cases of moderately undernourished pneumonia, where stays were implicitly longer due to poor anthropometric recovery, resembling our Z-score gap but exceeding our overall means owing to the wider age range (28 days-17 years)(11).

The balance of gender (about 50% females and males in both groups) gets rid of the mixed factors, unlike in some studies where the male predominance made the risks greater. Analysis of Uganda in 2021 linked pneumonia occurring during hospitalization to the condition of patients suffering from severe acute malnutrition (SAM), which led to prolonging their stay far beyond the baseline of 5.61 days, thus, the need for early nutritional screening was highlighted(12–14).

Malnutrition disables the body's first line of defense (the mucosal immunity) making it harder for the bacteria in pneumonia to be cleared out, indicated by our Chi-square association (df=1, $p<0.001$)(15). This is in agreement with Kirolos (2021), where underweight children demonstrated 4.5 times higher odds of death due to cytokine dysregulation and diminished phagocytosis, hence, their stay was comparably extended to our 7.65 days(7). The non-significant age difference in our study ($p=0.054$) is contrary to the findings of Fenta Kebede (2024), where younger age was found to be a predictor of >5-day stays independently, suggesting malnutrition was the major contributing factor in our cohort(16).

Kiguli (2024) reported that RUTF trials did not cut down the severe pneumonia 180-day outcomes, which is the same as our cross-sectional LOS disparities without intervention data(12). Indonesian cross-sectional data (2025) did not find a nutritional-LOS link ($p=0.422$, 62.3% well-nourished), which is contrary to our results, but this could be due to milder cases (≤5 days in 55.8%). A wider literature review from 2020 to 2025 corroborates our trends: Turkish Gomez-classified malnourished children had an average LOS of 7.39 days (vs. 6.31 normal), which in severe cases, rose to 9.38, similar to our malnourished mean(17).

The study's strengths are its large sample size (n=135), accurate Z-scoring, and outstanding Chi-square results ($p<0.001$), which make it possible to generalize the findings to other low and middle income countries (LMIC) settings. The cross-sectional design enabled the study to determine the baseline relationships between the variables without any bias that may result from intervention and to also complement prospective studies of similar nature conducted in Uganda and other places like Uganda.

The findings of this study highlight the necessity of screening for malnutrition using Z-scores at the time of pneumonia admission, since all malnourished children stayed longer in the hospital and this is consistent with the WHO synergies of malnutrition and pneumonia. Early treatment with RUTF, based on Kiguli's (2024) recommendation, requires the running of trials that are specifically designed for moderate cases such as ours(18). Shift in policies towards immunization and management of co-morbidities similar to Fenta (2024) may help to reduce the percentage of malnourished children's prolonged admissions which was 100% in our case.

Limitations Of Study: The limitations of the study come from the fact that data were only collected from a single center in Lahore, thus possibly decreasing the external validity of the study in comparison with multicenter meta-analyses. The lack of microbiological confirmation or identification of comorbidities (e.g., HIV) limits the authors to only making correlations, unlike Nalwanga's stratified mortality analysis. Self-reporting of anthropometric measurements is subject to recall bias, and no post-discharge follow-up means that long-term sequelae noted in 2025 reviews could be missed. The relatively short length of hospital stay (3.55 days) in healthy children may reflect the efficiency of the hospital protocols, but this could also be due to unadjusted confounding variables such as antibiotics that may still influence the results.

Conclusion:

Malnutrition has a significant impact on the length of stay in children's hospitals who suffer from pneumonia. Children suffering from malnutrition are slower to heal and tend to stay

longer in the hospital. To improve outcomes and lessen healthcare burden, early nutritional assessment and timely nutrition intervention should be part of the routine management of pneumonia.

Author's Contribution

[*1,2,3,4,5]Conception and Design
[*1,2,3,4,5]Acquisition of Data
[*1,2,3,4,5]Article Writing
[*1,2,3,4,5]Statistical Analysis
[*1,2,3,4,5]Proofreading

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