

MALNUTRITION AND COMORBIDITY AS DETERMINANTS OF PNEUMONIA SEVERITY IN HOSPITALIZED CHILDREN: A CROSS-SECTIONAL STUDY FROM TERTIARY CARE HOSPITAL IN PESHAWAR, PAKISTAN

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DOI: <https://doi.org/10.5281/zenodo.22891639>

Keywords

pediatric pneumonia; comorbidity;
malnutrition; disease severity;
tertiary care; Pakistan

Article History

Received: 01 June 2026

Accepted: 23 August 2026

Published: 08 September 2026

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Abstract

Background: Comorbid conditions are widely believed to worsen the clinical course of pediatric pneumonia, yet the magnitude of this relationship in South Asian tertiary care settings is not well quantified.

Objective: To determine the prevalence of comorbid conditions among hospitalized children with pneumonia and to quantify their association with pneumonia severity in tertiary care hospitals in Peshawar, Pakistan.

Methods: A cross-sectional, retrospective chart-review study was conducted on 180 pediatric patients (2 months–12 years) with a confirmed diagnosis of pneumonia, selected by non-probability convenience sampling from participating tertiary care hospitals. Comorbidity status and pneumonia severity (mild/moderate/severe) were extracted from structured medical records. Associations were tested using chi-square analysis, one-way ANOVA, and linear regression in SPSS.

Results: A comorbid condition was documented in 41.7% of patients, most commonly malnutrition (20.0%), followed by asthma (10.0%), congenital heart disease (8.9%), and prematurity (2.8%). Pneumonia was moderate in 38.9% of patients, mild in 35.6%, and severe in 25.6%. Mean severity score differed markedly by comorbidity group, from 1.20 in prematurity and 1.76 in children with no comorbidity to 2.06 in asthma and congenital heart disease and 2.25 in malnutrition – the only group whose mean severity exceeded the cohort average (1.90). Comorbidity was significantly associated with severity by ANOVA ($F = 4.318$, $p = 0.002$), chi-square ($\chi^2 = 20.36$,

$df = 8$, $p = 0.009$), and linear regression ($B = -0.111$, $\beta = -0.205$, $p = 0.006$; $R^2 = 0.042$), with malnourished children accounting for the largest share of severe cases (17/46, 37.0% of all severe cases) despite comprising only 20.0% of the cohort.

Conclusion: Comorbidity, and malnutrition in particular, is a significant and clinically meaningful determinant of pneumonia severity among hospitalized children in this tertiary care setting. Systematic nutritional and comorbidity screening at admission may help identify children at elevated risk of severe disease and support earlier, more intensive clinical management.

1. INTRODUCTION

Pneumonia remains among the leading causes of morbidity and hospitalization in children globally, and its clinical trajectory is shaped not only by the causative pathogen but by the child's underlying health status.[1,2] Comorbid conditions – most notably malnutrition, but also asthma, congenital heart disease, and prematurity – are recognized to compromise immune competence and respiratory reserve, predisposing affected children to more severe disease and a greater risk of complications such as septic shock and respiratory failure.[1,2]

In low- and middle-income countries, where malnutrition prevalence remains substantial among hospitalized pediatric populations, the interaction between nutritional status and infectious disease severity carries particular clinical and public-health importance. Prior clinical research in tertiary care settings has linked poor nutritional status and other comorbid illness to worse pneumonia outcomes and prolonged recovery,[2] yet locally generated, quantitative evidence on the strength of this association – expressed in terms clinicians can act on at the bedside – remains limited in Pakistan.

This study was undertaken to determine the prevalence of comorbid conditions among children hospitalized with pneumonia in tertiary care hospitals in Peshawar, Pakistan, and to quantify the association between comorbidity and pneumonia severity, with the aim of informing early risk-stratification and nutritional screening practices at the point of admission.

2. Materials and Methods

2.1 Study Design and Setting

A descriptive, cross-sectional observational study was conducted using retrospective review of hospital medical records at participating tertiary care hospitals in Peshawar, Khyber Pakhtunkhwa, Pakistan. Tertiary care hospitals were selected because their pediatric wards manage the more severe and complex referred cases of childhood pneumonia.

2.2 Study Population and Sampling

Pediatric patients aged 2 months to 12 years with a confirmed clinical diagnosis of pneumonia, admitted to a participating hospital with complete demographic, comorbidity, and severity records, were eligible. Patients with non-pneumonia respiratory diagnoses, incomplete records, outpatient management, or undocumented guardian consent were excluded. Using non-probability convenience sampling, 180 patients met all eligibility criteria and constituted the final analytic sample.

2.3 Variables and Measurement

Comorbidity was recorded in five mutually exclusive categories: none, malnutrition, asthma, congenital heart disease, and prematurity, as documented by the treating clinician in the medical record. Pneumonia severity was categorized as mild, moderate, or severe based on the clinical severity classification recorded at admission. For descriptive analysis, severity was additionally coded numerically (1 = mild, 2 = moderate, 3 = severe) to allow computation of mean severity scores by comorbidity group.

2.4 Statistical Analysis

Data were analyzed in IBM SPSS Statistics. Descriptive statistics characterized the distribution of comorbidity and severity. The association between comorbidity category and severity category was tested using the chi-square test of independence; the effect of comorbidity on the numeric severity score was tested using one-way ANOVA and simple linear regression. A two-tailed p -value < 0.05 was considered statistically significant.

2.5 Ethical Considerations

The study was conducted following ethical clearance from the respective hospital administration and institutional ethical review

committee. No personally identifying information was collected; all data were anonymized prior to analysis.

3. Results

Of the 180 hospitalized pediatric pneumonia patients analyzed, 105 (58.3%) had no documented comorbidity, while 75 (41.7%) had at least one comorbid condition – most commonly malnutrition (36 patients, 20.0%), followed by asthma (18, 10.0%), congenital heart disease (16, 8.9%), and prematurity (5, 2.8%). Pneumonia severity was distributed as moderate in 70 patients (38.9%), mild in 64 (35.6%), and severe in 46 (25.6%) (Table 1).

Table 1. Distribution of comorbidity and pneumonia severity among hospitalized pediatric patients (n = 180).

Variable	Category	n	%
Comorbidity	None	105	58.3
	Malnutrition	36	20.0
	Asthma	18	10.0
	Congenital heart disease	16	8.9
	Prematurity	5	2.8
Pneumonia severity	Mild	64	35.6
	Moderate	70	38.9
	Severe	46	25.6

3.1 Association Between Comorbidity and Pneumonia Severity

A statistically significant difference in mean pneumonia severity score was observed across comorbidity categories (one-way ANOVA: $F(4,175) = 4.318$, $p = 0.002$). Mean severity was lowest among children with prematurity (1.20)

and those with no comorbidity (1.76), intermediate among children with asthma (2.06) and congenital heart disease (2.06), and highest among children with malnutrition (2.25) – the only comorbidity group whose mean severity exceeded the overall cohort mean of 1.90 (Figure 1).

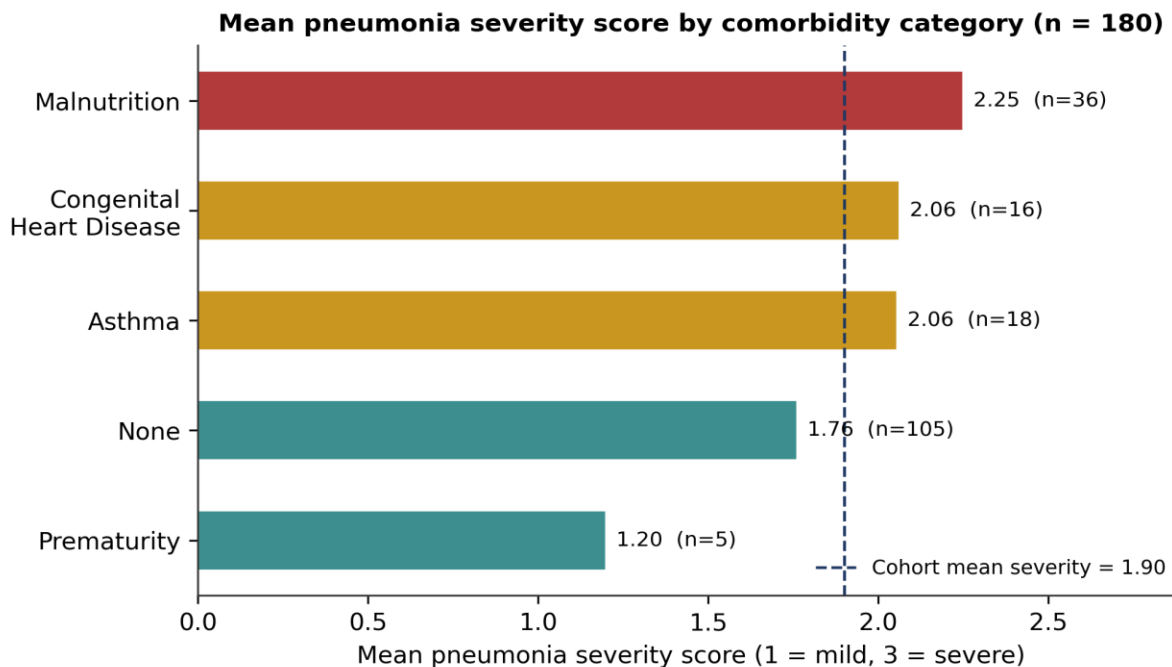


Figure 1. Mean pneumonia severity score by comorbidity category, ordered from lowest to highest (n = 180). Dashed line marks the overall cohort mean severity (1.90).

Linear regression confirmed comorbidity as a statistically significant, though modest, predictor of severity ($B = -0.111$, $SE = 0.040$, $\beta = -0.205$, t

$= -2.790$, $p = 0.006$), explaining approximately 4.2% of the variance in severity score ($R^2 = 0.042$; $F(1,178) = 7.784$, $p = 0.006$) (Table 2).

Table 2. Linear regression of pneumonia severity score on comorbidity.

Model	B	SE	β	t	p
(Constant)	2.335	0.166	—	14.069	<0.001
Comorbidity	-0.111	0.040	-0.205	-2.790	0.006

$R^2 = 0.042$; $F(1,178) = 7.784$, $p = 0.006$.

Cross-tabulation of comorbidity category against severity category confirmed a significant association ($\chi^2 = 20.360$, $df = 8$, $p = 0.009$). Among malnourished children, severe disease accounted for 17 of 36 cases (47.2%) – more than double the

proportion seen among children with no comorbidity (17/105, 16.2%). Malnourished children represented 20.0% of the total cohort but 37.0% (17/46) of all severe pneumonia cases (Table 3, Figure 2).

Table 3. Cross-tabulation of comorbidity and pneumonia severity category.

Comorbidity	Mild, n	Moderate, n	Severe, n	Total, n	% severe
None	42	46	17	105	16.2
Malnutrition	8	11	17	36	47.2

Comorbidity	Mild, n	Moderate, n	Severe, n	Total, n	% severe
Asthma	5	7	6	18	33.3
Congenital heart disease	5	5	6	16	37.5
Prematurity	4	1	0	5	0.0
Total	64	70	46	180	25.6

$\chi^2 = 20.360$, $df = 8$, $p = 0.009$.

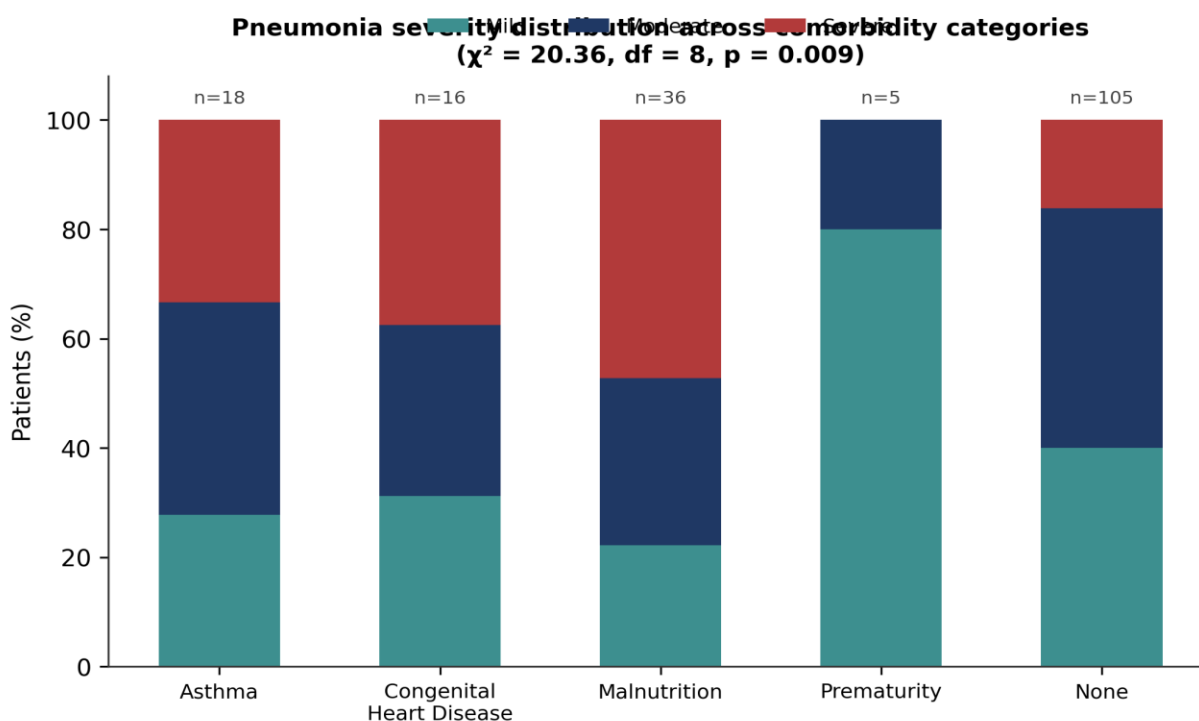


Figure 2. Pneumonia severity distribution (%) across comorbidity categories, showing the disproportionate share of severe disease among malnourished children ($\chi^2 = 20.36$, $df = 8$, $p = 0.009$).

For context, the broader demographic profile of the cohort – 52.8% male, mean age 74.1 ± 40.5 months – and the full distribution of comorbid

conditions and severity categories are summarized graphically in Figure 3.

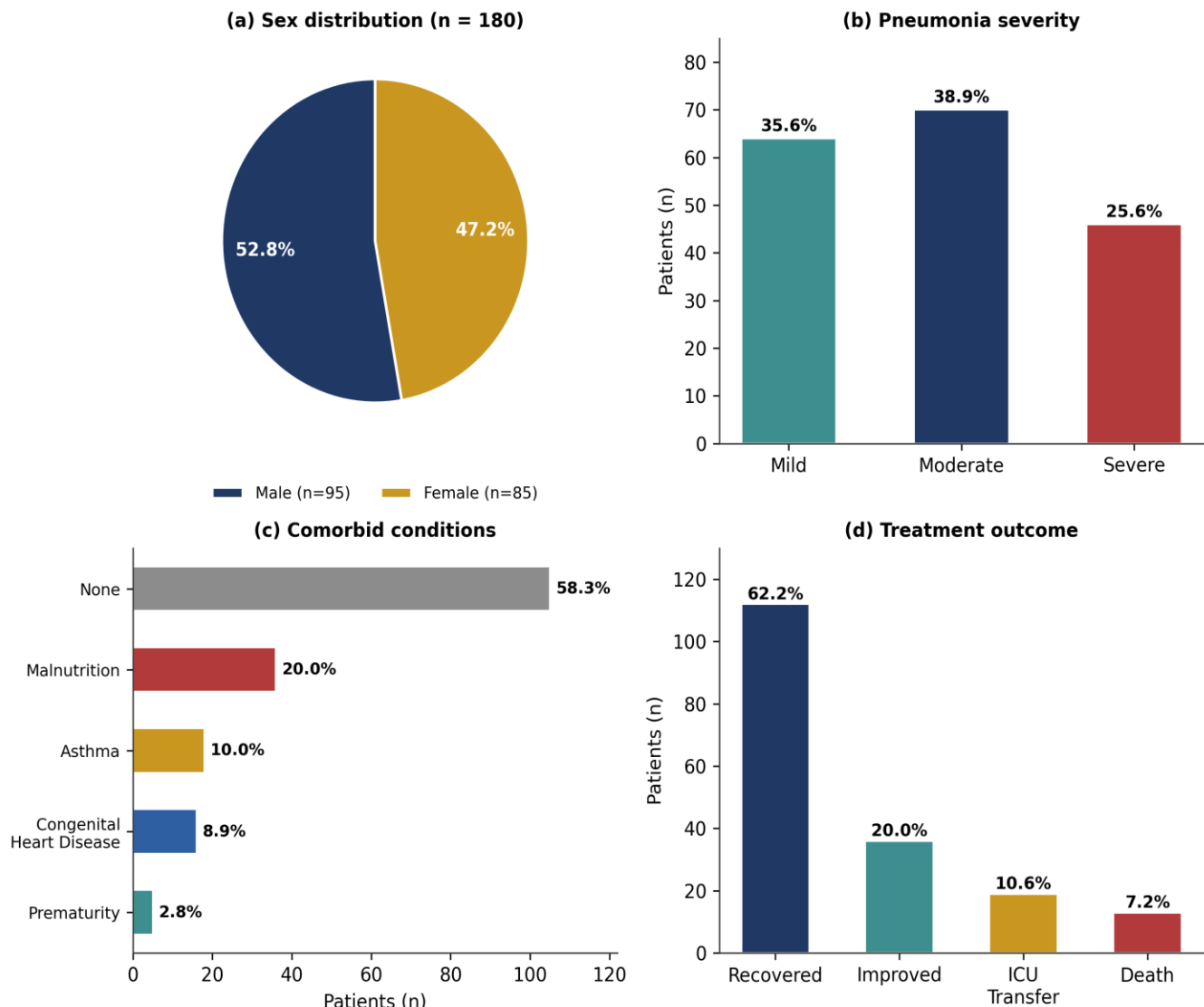


Figure 3. Overview of cohort characteristics: (a) sex distribution, (b) pneumonia severity, (c) comorbid conditions, (d) treatment outcome (n = 180).

4. Discussion

This study found that more than four in ten hospitalized children with pneumonia carried a documented comorbid condition, and that comorbidity — particularly malnutrition — was significantly and independently associated with greater pneumonia severity. Malnourished children had the highest mean severity score of any comorbidity group and accounted for more than a third of all severe pneumonia cases despite representing only a fifth of the cohort, a

disproportion that is both statistically significant and clinically striking.

These findings are consistent with the broader literature linking impaired nutritional status to increased susceptibility to severe respiratory infection and worse clinical trajectories in hospitalized children, including reports of septic complications arising from severe pediatric pneumonia in the presence of impaired host defenses.[1,2] Malnutrition is understood to compromise both innate and adaptive immune

function, reduce respiratory muscle reserve, and impair mucociliary clearance, plausibly explaining the observed gradient in severity.

Interestingly, children with prematurity in this cohort had the lowest mean severity score of any group, though this subgroup was small ($n = 5$) and the estimate should be interpreted cautiously; it may reflect closer neonatal/infant surveillance and earlier presentation to care rather than a true protective effect of prematurity itself. Asthma and congenital heart disease were associated with intermediate severity elevation, broadly consistent with their recognized role as risk-amplifying comorbidities in pediatric respiratory infection.

From a clinical standpoint, these results support incorporating a brief nutritional and comorbidity screen into the initial assessment of children presenting with suspected pneumonia, so that malnourished or otherwise comorbid children can be triaged toward closer monitoring and, where appropriate, earlier or more intensive intervention. Because comorbidity explained a modest share of total variance in severity ($R^2 = 0.042$), it should be regarded as one of several contributing factors — alongside pathogen virulence, age, and time to presentation — rather than a sole determinant.

4.1 Strengths and Limitations

Strengths of this study include a reasonably sized, well-characterized hospital cohort and the use of multiple complementary statistical approaches (ANOVA, regression, and chi-square) to test the comorbidity-severity relationship. Limitations include the single-city, tertiary-care setting, which may limit generalizability; reliance on existing medical records, which precluded independent verification of comorbidity diagnoses or standardized anthropometric malnutrition classification; and the cross-sectional design, which does not support causal inference regarding the direction or mechanism of the comorbidity-severity relationship.

5. Conclusion

Comorbidity, and malnutrition in particular, is a significant determinant of pneumonia severity

among children hospitalized in tertiary care in Peshawar, Pakistan. Systematic screening for malnutrition and other comorbid conditions at the time of admission may help clinicians identify children at elevated risk of severe disease and prioritize them for closer monitoring and more intensive management.

5.1 Recommendations

- Incorporate routine nutritional screening (e.g., anthropometric assessment) into the admission work-up for children presenting with suspected pneumonia.
- Prioritize closer clinical monitoring for children with malnutrition, asthma, or congenital heart disease given their elevated severity risk.
- Pursue multi-center, prospective studies with standardized comorbidity and malnutrition classification to strengthen causal inference and generalizability.

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