Risk factors and clinical outcomes for pneumonia among under-five children in Afghanistan

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Abstract

Background: Pneumonia is a leading cause of death among under-5 children in Afghanistan, yet data to guide interventions are scarce.

Aim: To assess the risk factors and outcomes of pneumonia among under-5 children in Kabul, Afghanistan.

Methods: Between January 2022 and December 2023 we collected data from hospital paper-based medical records on 252 paediatric patients aged <5 years, in Kabul, Afghanistan, primarily diagnosed with a respiratory condition. We analysed the data using R version 4.3.2. We used the Shapiro-Wilk test to assess the normality of continuous data, and Levene test to evaluate homogeneity of variances. Group comparisons were performed using the Student's t-test or one-way ANOVA for normally distributed data, and Mann–Whitney U test for abnormally distributed variables. $P < 0.05$ was regarded as statistical significance.

Results: Of the children, 89% (95% CI: 84.5–92.5%) had severe or very severe pneumonia. The key risk factors for severity were previous respiratory illness (OR 2.33, 95% CI: 1.12–4.85, $P = 0.02$) and self-medication (OR 4.88, 95% CI: 0.98–24.4, $P = 0.05$), while adequate nutrition was protective (OR 0.32, 95% CI: 0.11–0.89, $P = 0.03$). Self-medication with antibiotic significantly increased complication risk (OR 9.27, 95% CI: 3.18–32.15, $P = 0.0003$). Cox regression showed faster recovery was associated with higher weight (HR 1.10, 95% CI: 1.03–1.18, $P = 0.004$), better economic status (HR 1.21, 95% CI: 1.03–1.43, $P = 0.021$) and full immunisation (HR 1.74, 95% CI: 1.23–2.46, $P = 0.002$). A history of syndromes delayed recovery (HR 0.51, 95% CI: 0.31–0.83, $P = 0.007$).

Conclusion: The incidence of paediatric pneumonia in Kabul is overwhelmingly high, due mainly to malnutrition, unsafe medication, delayed care, and socioeconomic disadvantage. To improve paediatric health outcomes, there is an urgent need for pneumonia prevention and management strategies, including nutrition support, community education on responsible medication use and vaccination adherence, timely health care access, and socioeconomic support.

Keywords: pneumonia, under-5 children, paediatric patient, respiratory disease, malnutrition, immunisation, self-medication, Afghanistan

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Introduction

Pneumonia is an acute infection of the lower respiratory tract that affects the alveoli, leading to inflammation, fluid accumulation and impaired gas exchange. It remains the leading infectious cause of death among under-5 children worldwide, accounting for nearly 700 000 deaths annually—around 2000 each day—including 190 000 newborns (*1–4*) . Despite advances in vaccination and treatment, the global incidence of paediatric pneumonia exceeds 1400 cases per 100 000 children annually, with the highest burden observed in South Asia and sub-Saharan Africa (*5,6*).

In low-income countries such as Afghanistan, paediatric pneumonia poses an even greater challenge. It contributes to approximately 20% of under-5 mortality (*7*). In 2018 alone, more than 11 000 under-5 Afghan children died from the disease, equivalent to one child every hour (*8*). The under-5 mortality rate in Afghanistan (90 per 1000 livebirths) is nearly double the global average (*7*). Limited access to antibiotics, insufficient oxygen therapy and shortage of trained health care professionals further exacerbate the burden.

Recent reports show alarming increases in pneumonia cases, with a 55% increase in admissions at Indira Gandhi Children's Hospital in 2022 compared to 2025 (*9,10*). More than 25 000 cases of acute respiratory infections were reported in December 2022, twice the seasonal average for previous years (*9*).

The consequences extend beyond mortality. Misuse of antibiotics has accelerated antimicrobial resistance, complicating treatment options, and poverty,

malnutrition and inadequate vaccination coverage create a vicious cycle of vulnerability. Malnourished children with weakened immunity are particularly prone to severe pneumonia, long-term complications and repeated infections (*11*).

Although several studies have examined childhood pneumonia in high-burden regions, there remains a notable lack of data from Afghanistan, particularly on the risk factors, disease severity and clinical outcomes among under-5 children. This knowledge gap limits the ability of health authorities to design targeted prevention and management strategies. Addressing paediatric pneumonia in Kabul requires context-specific, evidence-based data to guide effective interventions and inform national public health policy.

This study examined the prevalence of pneumonia, identified the key risk factors associated with severe disease and prolonged recovery among under- children in Kabul. It examined the association between sociodemographic and clinical characteristics and pneumonia severity, as well as the relationship of treatment-related and care-seeking factors with recovery time. The study provides critical insights to guide public health strategies and policy decisions in Afghanistan.

Methods

Study design

This retrospective cohort study was conducted from January 2022 to December 2023 at tertiary care hospitals across Kabul, Afghanistan, where a significant proportion of paediatric patients with respiratory complications are treated. The study used a comprehensive, medical archival investigation, which allowed the exploration of various clinical and demographic variables without intervening in patient treatment protocols. It examined a wide range of demographic and clinical variables, including history of health conditions, self-medication, clinical symptoms, and vital signs at admission. The outcomes of interest were severity of pneumonia, complications, time to recovery, and treatment effectiveness.

The study population consisted of under-5 paediatric patients who were primarily diagnosed with lower respiratory tract infections, such as bronchiolitis, atelectasis and pleural effusion, and were admitted to the paediatric ward of a tertiary care hospital in Kabul, Afghanistan. The final diagnosis was determined by comprehensive clinical evaluation and diagnostic tests, which included complete blood count, chest X-ray and electrolyte test.

Patients were included in the study if their age was less than 5 years, and their final diagnosis was categorised as one of the pneumonia classifications suggested by the WHO (*12*). Patients who had complete clinical, radiologic and laboratory medical records were included, while patients with incomplete medical records or missing key data, and patients with comorbidities that would interfere with the study's focus on pneumonia-related factors, were excluded.

The sample size for the study was based on the retrospective review of patient records from the paediatric ward of each of the hospitals. A total of 252 paediatric patients who were primarily diagnosed with a respiratory condition, which was classified as one of the categories of pneumonia, were finally included in the study sample. Given the study's retrospective nature, all available cases that met the inclusion criteria were selected to ensure representativeness of the paediatric population with pneumonia admitted to the hospital during the study period.

Data collection

Data were extracted from hospital paper-based medical records using a standardized data extraction form. Two researchers, who worked independently, systematically collected sociodemographic, clinic, diagnostic, treatment-related, and outcome data, and any discrepancies were resolved by consensus. To ensure reliability, 10% of the records were re-examined by a third researcher. The sociodemographic data collected included age in months, gender, weight, growth and developmental status, nutritional status, family size, and household economic background.

Clinical history was assessed through documentation of previous health conditions, self-medication practices, family history of respiratory disease, adherence to the national immunisation programme, and time to seeking healthcare. Clinical presentation was based on vital signs at admission, including respiratory rate, pulse rate, oxygen saturation, and body temperature, in addition to findings from the general, cardiovascular, respiratory, gastrointestinal, neurologic, and peripheral capillary examinations. Diagnostic data were collected from chest X-rays and complete blood counts, while other investigations, such as urine and stool analysis, CT scans, or ECG results were included when available. Treatment-related data included the route of administration (oral, intravenous or intramuscular), type of antibiotic (e.g. cephalosporin, fluoroquinolone, macrolide), other medication such as salbutamol or nebulized adrenaline, and oxygen therapy. The outcome data included pneumonia severity, complications during hospitalisation, changes in vital signs throughout treatment, and time to recovery. Pneumonia severity was classified at admission according to the 2016 WHO criteria, based on clinical signs such as cough, tachypnoea, chest indrawing, and danger signs (e.g. central cyanosis, inability to drink) (*12*). Time to recovery was defined as the number of days from hospital admission until the patient met standard discharge criteria, which included normalisation of vital signs (e.g. oxygen saturation >94%, afebrile for >24 hours), significant clinical improvement and the ability to maintain oral hydration.

The nutritional status of the children was evaluated according to the WHO child growth standards. Children were classified as well-nourished, suspected malnutrition

or malnourished based on their weight-for-age Z-scores: −2 to +2 (well-nourished), −3 to −2 (suspected malnutrition) and below −3 (malnourished).

In this study, complications were defined as any adverse clinical condition occurring during hospitalisation that extended the recovery period, required additional medical intervention or worsened the patient's clinical status, such as respiratory failure, hypoxemia, sepsis, pleural effusion, pneumothorax, and secondary infections. Each complication was recorded if confirmed by clinical sign, diagnostic test or specialist consultation, ensuring standardised and consistent reporting across all cases.

Data analysis

All statistical analyses were performed using R version 4.3.2. Continuous variables were expressed as mean ± standard deviation (SD) with ranges, while categorical variables were summarised as frequencies and percentages. The Shapiro-Wilk test was applied to assess the normality of continuous data, and the Levene test was used to evaluate homogeneity of variances. Group comparisons were performed using the Student's t-test or one-way ANOVA for normally distributed data that met parametric assumptions, and the Mann-Whitney U test was applied for abnormally distributed variables. Associations between categorical variables were examined using the chi-square test for independence, while correlations between continuous variables were analysed using correlation coefficients.

To identify the predictors of pneumonia severity, an ordered categorical outcome with 4 levels (no pneumonia, pneumonia, severe pneumonia, very severe pneumonia), an ordinal logistic regression model, was used. Time-to-event outcomes, specifically recovery time, were assessed using Kaplan-Meier survival curves, and group differences were tested with the Log-Rank test. Cox proportional hazards regression models were used to estimate the effect of demographic, clinical and disease severity on time to recovery. Statistical significance was defined as $P < 0.05$.

Ethics consideration

This retrospective study was approved by the Kateb Medical Research Center, Kateb University, approval code KMRC-83752024. Since the study involved anonymised patient records with no identifiable information, the requirement for informed consent was waived by the ethics committee. All procedures were conducted in accordance with the ethics guidelines in the Declaration of Helsinki.

Results

Demographic characteristics

A total of 252 children were included in the study [147 males (58.3%) and 105 females (41.7%)], aged 0.12–60 months (mean ± SD: 14.7 ± 17.9 months). Among these, 101 (40.1%) were less than 6 months old. Participants had a weight range of 1.2–22.5 kg, with a mean of 8.4 ± 4.1 kg. Most families self-reported sufficient economic status (67.9%), whereas 32.1% were classified as having poor economic conditions. Of the children, 51.6% were well-nourished, 32.9% were suspected of malnutrition and 15.5% were malnourished. Household size was generally small, with 53.2% having 1–3 members, 39.7% with 4–6 members, and 7.1% with ≥7 members (Table 1).

Clinical presentation and admission findings

The duration of illness prior to admission was one week in 65.1% of participants, 1–3 weeks in 29.0% and ≥4 weeks in 6.0%. Self-medication was frequently reported, with 43.3% using antibiotics, 40.9% nonsteroidal anti-inflammatory drugs (NSAIDs), 15.1% steroids, and 3.6% other or unclear medication. General symptoms included loss of appetite (60.7%), headache (50.8%) and chills (46.8%). Consciousness levels at admission were normal in 46.8% of the children, mildly decreased in 30.2%, confused in 18.3%, and comatose in 4.8% (Table 2).

Table 1 Demographic and baseline characteristics of study participants

Characteristic	Category	Value/Frequency (%)
Sex	Male	147 (58.3)
	Female	105 (41.7)
Age (months)	Mean ± SD	14.7 ± 17.9
	Range	0.12 – 60
	<6	101 (40.1)
Weight	Mean ± SD (kg)	8.4 ± 4.1
	Range (kg)	1.2 – 22.5
Economic status	Sufficient	171 (67.9)
	Poor	81 (32.1)
Nutritional status	Well-nourished	130 (51.6)
	Suspected malnutrition	83 (32.9)
	Malnourished	39 (15.5)
Household size (number)	1–3	134 (53.2)
	4–6	100 (39.7)
	≥7	18 (7.1)

Table 2 Clinical presentation and findings at time of admission

Category	Finding	Value/frequency (%)
History of illness (duration in weeks)	≤1	164 (65.1)
	1–3	73 (29.0)
	≥4	15 (6.0)
Self-medication prior to admission	Antibiotics	109 (43.3)
	NSAIDs	103 (40.9)
	Steroids	38 (15.1)
	Other/unclear	9 (3.6)
General symptoms	Loss of appetite	153 (60.7)
	Headache	128 (50.8)
	Chills	118 (46.8)
Level of consciousness	Normal	118 (46.8)
	Mildly decreased	76 (30.2)
	Confused	46 (18.3)
	Comatose	12 (4.8)
Respiratory signs	Tachycardia	242 (96.0)
	Fast breathing (tachypnea)	229 (90.9)
	Nasal flaring	183 (72.6)
	Cyanosis	182 (72.2)
	Chest indrawing	144 (57.1)
Gastrointestinal symptoms	Vomiting	156 (61.9)
	Abdominal pain	17 (6.8)
	Diarrhoea	11 (4.4)
Other clinical signs	Abnormal oxygen saturation	220 (87.3)
	Hyperthermia (≥37.5°C)	152 (60.3)
	Meningeal irritation	40 (15.9)

Respiratory signs were prominent, with fast breathing observed in 90.9%, chest indrawing in 57.1%, nasal flaring in 72.6%, and cyanosis in 72.2% of participants. Tachycardia was noted in 96.0% of the children. Gastrointestinal symptoms were less frequent: vomiting (61.9%), abdominal pain (6.8%) and diarrhoea (4.4%). Signs of meningeal irritation were present in 15.9% of cases. Initial oxygen saturation was abnormal in 87.3% of participants, and 60.3% exhibited hyperthermia (≥37.5°C).

Diagnosis and severity classification

Initial diagnoses included bronchiolitis (71.4%), atelectasis (21.4%), pleural effusion (11.9%), and cardiac disease (12.7%). After comprehensive evaluation, children were classified according to WHO pneumonia severity: no pneumonia (2.7%), pneumonia (11.0%), severe pneumonia (57.1%), and very severe pneumonia (31.8%). At the time of discharge, oxygen saturation normalised in 97.2% of the children and body temperature was normal in 75.8%. Complications occurred in 10.7% (Table 3).

Associations between clinical and demographic factors

Several significant associations were identified. Household size was linked to oxygen saturation at admission (P = 0.009) and nutritional status was correlated with body temperature (P = 0.036). Growth and developmental abnormalities (P = 0.024), abdominal pain (P = 0.001) and cyanosis (P = 0.022) were significantly associated with respiratory rate. Cyanosis and decreased consciousness were related to pulse rate ($P \leq 0.043$), while cyanosis alone was linked to heart rate (P = 0.039), and decreased consciousness was associated with oxygen saturation (P = 0.004). Fast breathing and chest indrawing were associated with body temperature and heart rate ($P \leq 0.04$), and fast breathing was associated with oxygen saturation (P = 0.003). Post-treatment, significant improvements were observed in respiratory rate, pulse rate, heart rate, oxygen saturation, and body temperature ($P < 0.00001$ to P = 0.004).

Predictors of pneumonia severity

An ordinal logistic regression model identified key factors influencing pneumonia severity. History of respiratory conditions (OR = 2.43, 95% CI= 1.25–4.80, P = 0.009) and self-medication with unspecified drugs (OR = 4.88,

Table 3 Diagnosis, severity classification and outcomes of paediatric pneumonia

Category	Classification/diagnosis	Frequency (%)
***Initial diagnosis at admission**	Bronchiolitis	180 (71.4)
	Atelectasis	54 (21.4)
	Cardiac disease	32 (12.7)
	Pleural effusion	30 (11.9)
WHO pneumonia severity classification	Severe pneumonia	144 (57.1)
	Very severe pneumonia	80 (31.8)
	Pneumonia	28 (11.0)
	No Pneumonia	7 (2.7)
Status at discharge	Normal oxygen saturation	245 (97.2)
	Normal body temperature	191 (75.8)
	Experienced complications	(10.7)

**Initial diagnoses are not mutually exclusive; a single patient could have multiple conditions.*

95% CI= 0.89–21.37, P = 0.05) significantly increased the odds of severe pneumonia. Conversely, well-nourished children were less likely to develop severe pneumonia (OR = 0.67, 95% CI = 0.37–0.94, P = 0.03), indicating a protective effect of proper nutrition. Other variables, such as time to visit health centre, chronic disease, lower economic status, and family history showed trends toward increased severity but did not reach statistical significance.

Complications

Self-medication with antibiotic was significantly associated with complications (OR = 9.27, 95% CI = 3.18–32.15, P = 0.0003), while self-medication with steroid and NSAID showed no significant effect. Abnormal growth

Table 4 Cox proportional hazards regression analysis of factors associated with time to recovery

Variable	HR	95% CI	P
Age	0.983	0.969–0.998	0.0247
Sex (male)	0.932	0.694–1.252	0.6395
Weight	1.103	1.032–1.179	0.0037
Economic situation	1.212	1.029–1.428	0.0214
Nutrition	1.200	0.965–1.491	0.1009
Growth status	1.325	0.948–1.853	0.0991
Family number	0.929	0.725–1.190	0.5606
Present illness history	1.284	1.018–1.618	0.0345
Past respiratory disease	0.828	0.598–1.148	0.2582
Past chest surgery	0.917	0.586–1.433	0.7024
Past chronic disease	1.439	0.892–2.321	0.1357
Past syndrome	0.511	0.314–0.833	0.0070
Antibiotic use	1.204	0.878–1.651	0.2485
Steroid use	0.830	0.544–1.267	0.3875
NSAIDs use	1.445	1.077–1.938	0.0141
Not clear drug use	1.076	0.481–2.408	0.8593
Allergy history	1.265	0.864–1.852	0.2266
Immunisation status	1.742	1.233–2.461	0.0016
Family history	0.748	0.563–0.993	0.0445
Respiratory rate	1.300	1.078–1.569	0.0061
Pulse rate	0.947	0.794–1.129	0.5441
Heart rate	0.868	0.736–1.023	0.0913
Oxygen saturation (SpO2)	1.306	0.840–2.031	0.2358
Temperature	0.937	0.767–1.144	0.5210
Severity: Severe	0.826	0.517–1.318	0.4218
Severity: Very severe	0.515	0.308–0.860	0.0112

HR: Hazard ratio; CI: Confidence interval.

and developmental status increased the likelihood of complications (OR = 4.45, 95% CI = 1.78–11.12, *P* = 0.03), whereas good nutrition was protective (OR = 0.41, 95% CI = 0.18–0.93, p = 0.026). A history of respiratory disease elevated the odds of complications (OR = 2.33, 95% 1.64–3.46, *P* = 0.016).

Recovery time and survival analysis

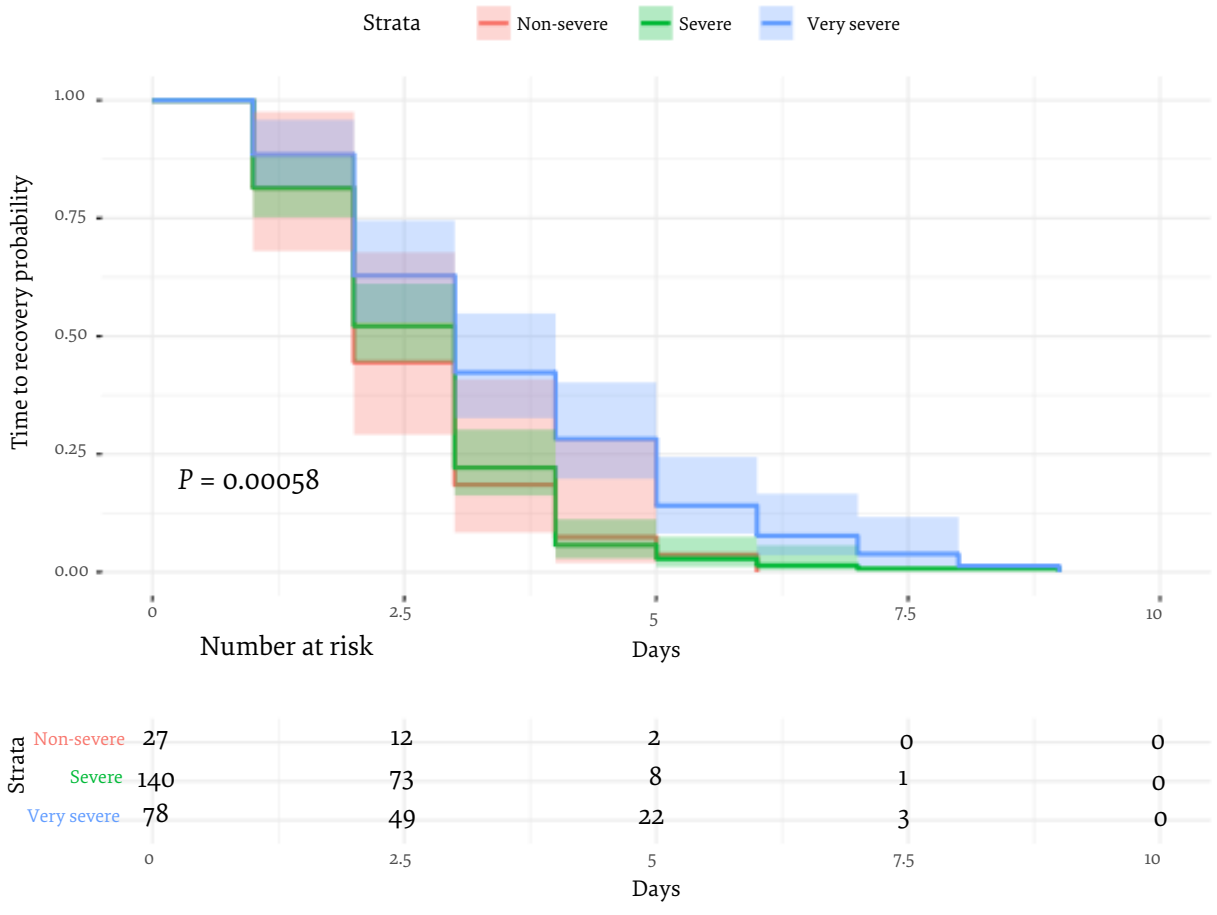
Cox proportional hazards regression was used to identify factors significantly associated with time to recovery (Table 4). Several demographic, clinical and treatment-seeking factors were significant predictors of recovery time. Factors associated with slower recovery (HR < 1) were history of a syndrome (HR = 0.51, 95% CI: 0.31–0.83, *P* = 0.007), positive family history of respiratory disease (HR = 0.75, 95% CI: 0.56–0.99, *P* = 0.044) and diagnosis of very severe pneumonia at admission (HR = 0.52, 95% CI: 0.31–0.86, *P* = 0.011). Conversely, factors associated with faster recovery (HR > 1) were higher patient weight (HR = 1.10, 95% CI: 1.03–1.18, *P* = 0.004), better economic situation (HR = 1.21, 95% CI: 1.03–1.43, *P* = 0.021), current illness (HR = 1.28, 95% CI: 1.02–1.62, *P* = 0.035), self-medication with NSAIDs prior to admission (HR = 1.45, 95% CI: 1.08–1.94, *P* = 0.014), complete immunisation status (HR = 1.74, 95% CI: 1.23–2.46, *P* = 0.002), and higher respiratory rate at admission (HR = 1.30, 95% CI: 1.08–1.57, *P* = 0.006). Kaplan-Meier analysis corroborated these findings, indicating that children with uncomplicated pneumonia had the fastest recovery probability, whereas severe and very severe cases experienced significantly longer recovery time (*P* < 0.05) (Figure 1).

Discussion

This study identified demographic, clinical and socioeconomic factors influencing the severity and treatment outcomes of paediatric pneumonia in Kabul, Afghanistan. To our knowledge, this is the first study to comprehensively assess high-risk paediatric groups for pneumonia in this context, providing population-specific evidence on factors affecting disease progression and recovery. Among the under-6 months children, 86.1% developed severe or very severe pneumonia, indicating the vulnerability of young infants. Overall, 86.1% of participants presented with severe or very severe pneumonia, indicating the high disease burden in this low-resource setting.

Household and socioeconomic characteristics played an important role in disease progression. Children from larger households had lower oxygen saturation at admission, suggesting that crowding may contribute to the exposure and severity of infection, possibly through increased risk of transmission or household air pollution (*13–16*). Poorer economic status was associated with

Figure 1 Kaplan-Meier curve: time to recovery by severity



longer recovery time and more severe presentations, consistent with the well-documented impact of poverty on nutrition, health care access and treatment adherence (*15–17*).

Nutritional status emerged as a strong determinant of outcomes. Children with normal growth and development had significantly lower odds of severe pneumonia and complications than those who were malnourished. This finding supports previous evidence that adequate nutrition enhances immunity and protects against severe respiratory infections (*18–21*) . Although breastfeeding was expected to be protective (*22,23*), our findings suggest that additional factors, such as the timing of complementary feeding, may also determine susceptibility to pneumonia in this population.

Clinical signs at admission, including cyanosis, fast breathing, chest indrawing, and altered consciousness and were strongly correlated with disease severity and vital parameters such as respiratory rate, pulse and oxygen saturation. These results reinforce the prognostic value of clinical assessment in paediatric pneumonia, particularly in resource-limited hospitals where laboratory and radiological facilities are scarce. These signs constitute a core component of severity assessment tools and the WHO criteria for paediatric pneumonia, especially in low-resource settings where laboratory and imaging are limited. For example, tachypnoea (fast breathing) and chest indrawing are key clinical markers used by WHO to identify pneumonia severity (*24,25*). Importantly, improvements in these parameters following treatment indicate the effectiveness of current management strategies in stabilising patients and reducing complications.

Medical history and parental treatment practices were found to influence patient outcomes. Children with a history of respiratory illness were more likely to develop severe pneumonia (*26*), and those given unspecified drugs before hospital admission had nearly 5 times the odds of severe disease. Self-medication with antibiotics was strongly associated with complications, indicating the risks of inappropriate or delayed therapy and raising concerns about antimicrobial resistance (*16,26*). These findings indicate the need for parental education and stricter regulation of over-the-counter drug use among children, particularly in underdeveloped countries.

Recovery time was closely associated with both disease severity and contextual factors. Children with severe pneumonia required significantly longer hospitalisation (*27*). Delayed health-seeking, poor economic status, higher respiratory rate at admission, and cyanosis were additional contributors to prolonged recovery. Conversely, older age, completion of the national immunisation schedule and certain syndromic conditions were associated with shorter hospital stays. Notably, the use of NSAIDs was associated with slower recovery, suggesting that inappropriate self-treatment may delay access to effective care.

Taken together, these findings highlight the multifactorial nature of pneumonia outcomes among children, shaped not only by biological vulnerability but also by nutritional, socioeconomic and behavioural determinants. They suggest that interventions should go beyond hospital-based management to include nutritional support, expansion of immunisation coverage and community education aimed at discouraging self-medication and promoting early care-seeking.

Study limitations

This study has several limitations. The retrospective design may have introduced selection bias and incomplete or missing medical records may have affected data quality. Reliance on self-reported information may have introduced recall bias. The study used a convenience sample of all available cases that met the inclusion criteria, without sample size or power calculation, which may limit the generalisability of the findings. Microbiological confirmation of pneumonia subtypes was not performed, limiting pathogen-specific conclusions. Variations in treatment protocols across hospitals may have influenced recovery outcomes.

Future studies should incorporate microbiological testing, prospective designs and standardised treatment protocols to strengthen causal inference. Exploring the impact of comorbidities such as diabetes or cardiovascular disease could provide a more comprehensive understanding of the pneumonia risk factors.

Conclusion

This study highlights the interplay between demographic, clinical, nutritional, and socioeconomic factors in paediatric pneumonia severity and recovery in Kabul, Afghanistan. The key risk factors include previous respiratory illness, self-medication, malnutrition, and household overcrowding. Effective prevention and management strategies should focus on early intervention, nutrition support, responsible medication use, and vaccination adherence, and seek to reduce socioeconomic disparities to improve paediatric health outcomes in this and other low-resource settings.

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