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Outcome of Severe Pneumonia in Pediatric Patients Aged 2 Months to 5 Years

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ABSTRACT

Objective: To determine the frequency of outcome of severe pneumonia in children having age from 2 months to 5 years**. Study Type:** Descriptive Cross sectional study. **Setting:** Department of Pediatrics, Allied Hospital, Faisalabad. **Duration:** 14 March 2025 - 14 June 2025. **Methodology:** Total 190 patients with severe pneumonia of age 2 months to 5 years were included. Children with congenital lung pathologies like cystic fibrosis, immunodeficiency, recurrent chest infections in cerebral palsy patients, penetrating lung injuries with pneumonia, congenital heart disease, reactive airway disease, asthma, and bronchiolitis, as well as malnutrition were excluded. All patients received the WHO's recommended treatment regimen for treating pneumonia. IV antibiotics i.e cefzone and penicillin were injected after proper dose calculation. Patient's oxygen saturation and respiratory rate were monitored hourly by a staff nurse. Report of arterial blood sample sent to the laboratory as well as adverse outcomes including prolonged hospital stay, need for mechanical ventilation and moratlity were recorded. **Results:** The mean age was 3.82+1.17 years. According to the gender distribution, 98 cases (51.58%) were male and 92 cases (48.42%) were female. According to descriptive duration of illness, 124 (65.26%) were ≤3 days and 66 (34.74%) were >3 days. Mean duration of illness was 4.24 ± 2.87 days. According to vaccination status descriptive statistics, there were 86 unvaccinated cases (45.26%) and 104 vaccinated cases (54.74%). The mean hospital stay was 10.04 + 6.26 days. Prolonged hospital stay, need for mechanical ventilation and mortality were noted in 77.53%, 33.18% and 9.47% respectively. **Conclusion:** Pneumonia specially under five years of age is a major cause of morbidity and mortality.

INTRODUCTION

Inflammation of the lung's parenchymal tissue, including the bronchioles and alveoli, with consolidation is known as pneumonia. Children who cough or have trouble breathing and exhibit age-specific fast breathing or chest indrawing are said to have pneumonia, according to the World Health Organization (WHO).[1] One of the main causes of childhood mortality and morbidity in developing countries is pneumonia.[2] 156 million children under the age of five are estimated to be affected by pneumonia annually by the World Health Organization (WHO). Of these, up to 20 million require hospitalization due to their severity, and 1.2 million succumb to the disease. Children under the age of five account for over 90% of pediatric pneumonia-related fatalities.[3]

In our nation, Pakistan, pediatric pneumonia is a significant cause of death for patients younger than five years old, with an estimated ten million cases occurring annually. More than 920000 children under the age of five die from pneumonia, and Pakistan is one of the top 5 countries that account for 99% of pediatric cases. Bacteria, viruses, and fungus are the main things that cause pneumonia, but they are not the only things. Streptococcus pneumoniae is the most prevalent cause of bacterial pneumonia in infants. The second most prevalent cause is Hemophilus influenzae type b (Hib). In adolescents, respiratory syncytial virus is the most common cause of viral pneumonia, while Pneumocystis jirovecii is the most common cause of fungal pneumonia.[4] Numerous studies have shown that hypoxemia, possibly as a result of respiratory failure, is the cause of pneumonia-related deaths. Uncorrected hypoxemia causes a ventilation-perfusion mismatch, which is the primary cause of respiratory failure in the majority of children with hypoxemia. Since they are most at risk for significant consequences, children who are hospitalized with severe pneumonia are receiving management, which may include improved monitoring, early supportive therapy initiation, or referral to a higher level of care.[4] Mortality, need for mechanical ventilation, and length of hospital stay were

recorded in 73.1%, 27.6%, and 7.6% of cases, respectively.[4]

Finding a long-term solution is necessary because the widespread pneumonia in Pakistan has already claimed the lives of many children. Pneumonia is still a major cause of death for children despite continuous efforts to address the problem, so innovative solutions are required. The purpose of this study is to assess the results of severe pneumonia in order to design improved healthcare services, such as early, efficient treatment, nutrition planning, and vaccination against pathogenic organisms.

METHODOLOGY

With approval from the ethical review committee, this descriptive cross-sectional study was carried out from 14 March 2025 to 14 June 2025 at the pediatric department of Allied Hospital in Faisalabad. The sample size, as determined by the WHO sample size calculator, was 190 with the following parameters: 95% confidence level, 3.8% margin of error, and 7.6%[4] mortality. Along with a general danger sign (cyanosis, decreased consciousness, inability to feed, vomiting, seizures), parents whose child had severe pneumonia (coughing or difficulty breathing with tachypnea more than 50 breaths per minute if the child was 2–12 months old, or more than 50 breaths per minute if the child was 12 months to 5 years old) and a chest auscultation finding (a part of the lungs appeared white or opaque on chest x-ray) were included. Children with congenital lung pathologies like cystic fibrosis, immunodeficiency, recurrent chest infections in cerebral palsy patients, penetrating lung injuries with pneumonia, congenital heart disease, reactive airway disease, asthma, and bronchiolitis, as well as malnutrition, were not included.

All patients received the WHO's recommended treatment regimen for treating pneumonia. IV antibiotics, ampicillin and cefzone were administered. Every hour, a staff nurse checked the patient's oxygen saturation and respiratory rate. The pathologist reported that the patient's prolonged hospital stay (more than 7 days), need for mechanical ventilation (age-appropriate tachypnea with grunting or use of extra respiratory muscles), inability to maintain arterial oxygen saturation > 90% with non-invasive respiratory techniques like face mask, nasal prongs, bubble CPAP, and HFNC, and on ABGS type II respiratory failure with fractional inspired oxygen (FIO2) < 0.60, pH < 7.25, and partial pressure of carbon dioxide (PaCO2) > 50 mm Hg, and mortality (death of the patient during hospital stay) were the results of the arterial blood sample sent to the hospital pathology department for testing.

SPSS version 25 was used to enter and evaluate the data. Numerical values such as age and length of sickness before hospitalization were assessed using descriptive statistics, such as mean and standard deviation. All qualitative factors, including gender, immunization status, length of hospital stay, requirement for mechanical ventilation, and mortality, had their frequencies and percentages determined. Stratification was used to adjust for effect modifiers such as age, gender, vaccination status, and length of illness before admission. The chi-squared post-stratification test was used. A p-value of less than 0.05 was deemed significant.

RESULTS

The mean age was 3.82+1.17 years. According to the gender distribution, 98 cases (51.58%) were male and 92 cases (48.42%) were female. According to descriptive duration of illness, 124 (65.26%) were ≤3 days and 66 (34.74%) were >3 days. Mean duration of illness was 4.24 ± 2.87 days. According to vaccination status descriptive statistics, there were 86 unvaccinated cases (45.26%) and 104 vaccinated cases (54.74%). (Table 1).

The mean hospital stay was 10.04 + 6.26 days. Prolonged hospital stay, need for mechanical ventilation and mortality were noted in 77.53%, 33.18% and 9.47% respectively. (Table 2)

Descriptive statistics of prolonged hospital stay by effect modifiers is shown in Table 3 which showed significant effect of age and duration of illness on hospital stay. Descriptive statistics of need for mechanical ventilation and mortality by effect modifiers is shown in Table 4 & 5 respectively which showed only significant effect of duration of illness on these outcome variables.

Table 1

Descriptive Statistics of Variables (n=190)

Variables		No. of patients	%
Age (years)	2 mon-3 yrs	102	53.68
	4-5 years	88	46.32
Gender	Male	98	51.58
	Female	92	48.42
Duration of illness (days)	≤3	124	65.26
	>3	66	34.74
Vaccination status	Unvaccinated	86	45.26
	Vaccinates	104	54.74

Table 2

Outcome of Severe Pneumonia (n=190)

Outcome	Yes	No
Prolonged hospital stay	134 (70.53%)	56 (29.47%)
Need for mechanical ventilation	63 (33.18%)	127 (66.84%)
Mortality	18 (9.47%)	172 (90.53%)

Table 3

Descriptive Statistics of Prolonged Hospital Stay by Effect Modifiers (n=190)

Variables		Prolonged Hospital Stay		P value
		Yes	No	
Age (years)	2 mon-3 years	65	37	0.027
	4-5 years	69	19	
Gender	Male	66	32	
	Female	68	24	0.321
Duration of illness (days)	≤3	98	26	
	>3	36	30	0.0004
Vaccination status	Unvaccinated	57	29	
	Vaccinated	77	27	0.243

Table 4

Descriptive Statistics of Need for Mechanical Ventilation by Effect Modifiers (n=190)

Variables		Need for mechanical ventilation		P value
		Yes	No	
Age (years)	2 mon-3 years	36	66	0.501
	4-5 years	27	61	
Gender	Male	34	64	
	Female	29	63	0.642
Duration of illness (days)	≤3	28	96	
	>3	35	31	0.0001
Vaccination status	Unvaccinated	27	59	
	Vaccinated	36	68	0.639

Table 5
Descriptive Statistics of Mortality by Effect Modifiers (n=190)

Variables		Mortality		P value
		Yes	No	
Age (years)	2 mon-3 years	11	91	0.506
	4-5 years	07	81	
Gender	Male	10	88	0.723
	Female	08	84	
Duration of Illness (days)	≤3	06	118	0.003
	>3	12	54	
Vaccination Status	Unvaccinated	09	77	0.671
	Vaccinated	09	95	

DISCUSSION

Comparable to studies with an incidence ranging from 40.5%[6] to 53.5%, 53.68% of the children in our study who had pneumonia were between the ages of 2 months and 3 years.[7] This implies that young infants are especially susceptible to pneumonia. Therefore, if morbidity and mortality from pneumonia are to be decreased, respiratory symptoms in this age range should be closely watched and effectively addressed. There were 92 instances (48.42%) with females and 98 cases (51.58%) with males. This male predominance may be due to bias in parents' treatment-seeking behavior and is also present in Indian studies.[6,7]

Due to resource limitations, we were unable to determine the viral etiology of pneumonia because only 22.2% of the cases had bacterial culture results. In line with Mathew et al.[6] and Jain et al[8], who found that 91% of patients had fever and 95% had cough, in 100%, 91.67%, 98.15%, 76.39%, and 35.65% of the cases, respectively, we observed that fast breathing, fever, cough, difficulty breathing, and noise breathing were present. Of the children in our study, 62% experienced retractions, with 12.96% having suprasternal retractions. This implies that almost all pediatric pneumonia cases include fever, cough, and rapid breathing. Infants with pneumonia are more likely than older children to exhibit noisy breathing and chest retractions.

S. pneumoniae was recovered in just 4.35% of the cases in our investigation, but S. aureus (mostly MSSA) was the most frequently isolated bacterium. Recent investigations conducted in India have showed similar outcomes.[6,9] S. aureus is the main bacterium in 36.7% of cases in a research by Mathew et al[6]. S. aureus accounted for 44.8% of the organisms in a research by Yudhavir et al[9], with S. pneumonia and Pseudomonas following in 13.8% and 13.8%, respectively. Lack of antigen and molecular-based diagnostic modalities and the fastidious conditions necessary for growth could be the source of no H. influenzae identification, or it could be the result of a decrease in H. influenza pneumonia following the introduction of the pentavalent vaccination into the Universal Immunization Program. Due to resource constraints and the fact that this is a tertiary level referral center, numerous patients had already received antibiotics prior to admittance. However, we did not implement polymerase chain reaction. Therefore, the decreased detection of S. pneumoniae in recent years, which was followed by a relatively higher detection of S. aureus. The IAP immunization schedule includes the pneumococcal vaccine, whereas Uttarakhand's National Immunization Schedule does not. Less S. pneumoniae might have resulted from increased vaccination use in a private setting.

According to our findings, patients with severe pneumonia had a noticeably longer hospital stay. The average length of stay in the hospital was 10.04 + 6.26 days. Mortality, need for mechanical ventilation, and length of hospital stay were recorded in 77.53%, 33.18%, and 9.47% of cases, respectively. These findings are in line with Huang et al[10], who found that children with severe pneumonia exhibiting a progressive clinical course had a longer average hospital stay than children with non-progressive pneumonia, averaging 16.2 days compared to 7.5 days.

Compared to Kumar et al.'s study[11], which found that mechanical ventilation was used in 4.5% of cases, our investigation found that ventilator assistance was provided in 33.18% of cases. Compared to comparable Indian research, ours had a 9.47% lower mortality rate.[6,12] This study was similar to research done in Rabat, Morocco (4%)[13], the Philippines (4.7%)[14], Ethiopia (7.7%)[15], and Ethiopia (5.9%).[16] On the other hand, mortality was higher in this study than in the Chinese study (2.4%).[17] The disparity can be attributed to variations in the quality of the healthcare system in high-income countries and the case management strategies for pediatric pneumonia in underdeveloped nations.[18] It is, however, less than research done in Khartoum, Sudan (16.9%)[19] and New Delhi, India (10.5%).[20] Given that the aforementioned studies were carried out on children under the age of five, this could be the result of variations in the study population.

In earlier research, patient age was taken into account as a risk factor for pneumonia patients' deaths. But according to this study, age had no bearing on mortality risk. Shi et al[21], who found no difference in the fatal outcomes for patients aged 1–14 years and those aged <1 years, support this conclusion. Williams et al., however, observed that while children aged 5 years had a decreased risk of mortality (OR 0.84), those aged <2 months and 10 years had a considerably higher risk of death compared to those aged 2 months (OR 1.22 and 1.87, respectively). The wide range of age groups and cutoffs employed in earlier research may be the cause of these conflicting findings.[21-23]

Compared to immunized children with pneumonia, unimmunized children had a higher risk of dying in this study. Research from Morocco[13], Bangladesh[24], Tikur Anbessa Specialized Hospital in Ethiopia[15], and Jimma University Specialized Hospital in Ethiopia[25], all lend support to this study. This could be because the research area's pneumococcal conjugate vaccination (PCV) coverage was below ideal. Only 39% of children in eastern Ethiopia were fully vaccinated, according to a population-based longitudinal survey, while the region's overall PCV coverage was 66%.[26] Children's pneumonia-related mortality will surely drop significantly with an intervention focusing on anti-pneumococcal and Hib

vaccines.

A clear cause-and-effect link between the variables is not established by the investigation. Additionally, because it is a single-facility study, care should be exercised when extrapolating the findings as they may underestimate the actual pneumonia burden. Furthermore, guardian verbal reports were used to collect vaccination status data, which raises the risk of recall bias. Additionally, subgroup analysis was not possible due to the limited sample size, highlighting the need for bigger sample sizes in future research to allow for more reliable analyses.

CONCLUSION

One of the leading causes of morbidity and mortality in children, particularly those under five, is pneumonia. Two readily changeable risk factors for severe pneumonia are a prolonged illness and insufficient immunization. To assist Pakistan overcome its questionable status as the nation with the highest pneumonia fatality rate, health planning authorities should focus on modifiable risk factors, guarantee the use of the right medications, and provide quality supportive care.

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