

FACTORS AFFECTING PROLONGED HOSPITALIZATION IN CHILDREN 6 MONTHS TO 5 YEARS WITH SEVERE COMMUNITY ACQUIRED PNEUMONIA

MA. KRISTEL M. NADLANG, MARIA EVA I. JOPSON

ABSTRACT

OBJECTIVE: To determine the factors affecting prolonged hospitalization in children 6 months to 5 years diagnosed with severe pneumonia.

METHODOLOGY: The study was a retrospective chart review of patients aged 6 months to 5 years diagnosed with Severe Community Acquired Pneumonia and admitted at the Philippine Children's Medical Center over a 24-month period from January 2018 to December 2019. Variables such as the age and gender of the child, immunization and socio-economic status as well as presence of hypoxemia, respiratory rate on admission, nutritional status and number of antibiotics were correlated with the duration of stay.

RESULTS: Younger age, low socioeconomic status and greater number of antibiotics used were found to be significantly associated with prolonged duration of hospital stay after controlling for other variables.

CONCLUSION: Findings in this study can help pediatricians to identify children with severe pneumonia who will likely need to be admitted for a prolonged period of time.

KEYWORDS: *community acquired, pneumonia, prolonged hospitalization*

INTRODUCTION

Pneumonia is an infectious disease of the lower respiratory tract that is a leading cause of morbidity and mortality among children under five years of age worldwide. Globally, there are over 1,400 cases of pneumonia per 100,000 children, or one case per 71 children every year, with the greatest incidence occurring in resource-limited regions. Recent data from the United Nations International Children's Emergency Fund (UNICEF) show that it is still the leading infectious cause of death among children under five years old claiming the lives of over 800,000 children every year, or around 2,200 every day in 2018. (1) In the

Philippines, pneumonia is ranked ninth among the ten leading causes of morbidity across all age groups. As for the local incidence, estimates from Department of Health (DOH) in 2010 showed that there were approximately 381,123 (or 412.8 per 100, 000) cases with 197, 852 cases (52%) occurring in the age group of 1 to 4 years old. (2) Thus, pneumonia continues to be a major reason for hospitalizations in this vulnerable age group. In resource-poor countries like the Philippines, the economic burden of this disease cannot be overemphasized. (3)

Because of this economic impact on caregivers, the physician's clinical

assessment of the child diagnosed with pneumonia should be done in a thorough manner through complete history and physical examination to determine the severity of his/her condition. By determining those children with severe pneumonia, appropriate treatment and management can be instituted in a timely manner and they could be discharged well without any sequelae. Among the important outcomes is prolonged hospitalization or length of stay, which takes a toll on the parents' financial capabilities in caring for the sick child. Recent estimates from the US Centers for Disease Control and Prevention (CDC) showed that the average length of hospital stay for treatment of pneumonia in children less than 15 years of age (excluding neonates) is five days. (4) Prolonged hospitalization, therefore, can be considered when a patient exceeds hospital stay of more than 5 days. Studies exploring predictors of prolonged hospitalization among children diagnosed with community acquire pneumonia have been scarce. Literature search only yielded a single study by Kuti and colleagues in 2014 conducted in a rural health center in Gambia. (5) With prolonged hospital stay due to severe pneumonia, the caregivers may have to resort to "out-of-pocket" payment when the insurance coverage has been maxed out. As a result of the extended days receiving treatment in a health facility, the economic burden on the families taking care of children with a severe course of pneumonia will be exacerbated. By mere identification of the children afflicted with severe pneumonia who will most likely need extended hospitalization, the parents or guardians can be advised well

and they can be prepared beforehand of the possible additional costs to be taken into account. With that, they will be able to mobilize their resources in order to provide financially for the recovery of their sick patients.

This research study aims to identify the factors affecting prolonged hospitalization in children six months to five years diagnosed with Community Acquired Pneumonia Severe according to the World Health Organization (WHO) definition and who were admitted at Philippine Children's Medical Center (PCMC). Specifically we aimed to describe the sociodemographic profile of these children as to their age, sex, immunization status and socio-economic status; to identify the clinical features at presentation of the child as to hypoxemia on pulse oximetry reading, respiratory rate on admission, nutritional status and number of antibiotics used; and to determine the association between clinical features at presentation with prolonged hospitalization of children with severe community acquired pneumonia. The information derived from this study can help pediatricians to identify children with severe pneumonia who will likely need to be admitted for a prolonged period of time given that they possess significant sociodemographic factors or clinical features upon initial presentation at the hospital. The findings of the research will also help the clinicians to apprise parents/guardians of the severity of the patient's pneumonia and that prolonged hospitalization may bring about additional financial constraints. This can help them make decisions and find solutions to the problems that may arise in caring for the

sick child. They will be more prepared to mobilize resources in order to cope with the burden of shouldering additional costs that cannot be covered anymore by the health insurance if applicable.

Materials and Methods

This was a cross sectional analytical retrospective study of patients aged six months to five years diagnosed with Severe Community Acquired Pneumonia/Pediatric Community Acquired Pneumonia C and admitted at the Philippine Children's Medical Center over a 24-month period from the month of January 2018 to December 2019. Those admitted to the ICU or were intubated were excluded from the study due to presumed extended stay in the hospital. The target population consisted of all the children aged six months to five years discharged with a final diagnosis of Severe Community Acquired Pneumonia or Pediatric Community Acquired Pneumonia C with International Classification of Diseases (ICD)-10 code of J18.92 during a two-year period.

Sample size calculation for logistic regression to identify prognostic factors was based on the work of Peduzzi et al. (1996):

p is the smallest of the proportions of negative or positive cases in the population

k is the number of covariates (the number of independent variables)
minimum number of cases to include is: $N = 10 k / p$

For this study, eight covariates were included. A proportion of 25.0% (105/420) was used for prevalence of prolonged hospital stay among those with childhood pneumonia based on the study of Kuti et al (2014). The minimum number of cases required was: $N = 10 \times 8 / 0.25 = 320$.

The study was conducted from July 2020 to October 2020. The Pneumonia Registry of the PCMC Medical Records section was accessed for this purpose. From there, cases diagnosed with severe community acquired pneumonia/Pediatric Community Acquired Pneumonia C or those with ICD code of J18.92 were included. Simple random sampling was done using a computer-generated table. Those with missing data on the chart were excluded from the final sample. Data gathered included sociodemographic data such as the age and sex of the child, immunization status and socio-economic status. Classification of the immunization status of the participants was determined following the vaccination schedule recommended for age by the Pediatric Infectious Diseases Society of the Philippines either as complete or incomplete. Socio-economic status was obtained using the information available in the admitting form. Those who were classified as "Service" came from low income families and those who were classified as "Pay" came from high income families. The chart review included clinical features at initial presentation: hypoxemia, respiratory rate on admission, nutritional status, and number of antibiotics. The nutritional statuses of the children were based on the weight and height recorded on the chart. Body mass index (BMI) was also

determined, and the values were then plotted for age using the WHO growth charts and interpreted accordingly.

The analysis of the data was calculated using frequencies and percentages. The data were entered in Microsoft Excel worksheet and analyzed with SPSS Version 17.0. Differences between continuous variables were determined using Student's t-test for normally distributed variables. The level of significance at a 95% confidence interval (CI) was set at $p < 0.05$. Associations between dependent (prolonged hospital stay) and independent variables (risk factors) were assessed using univariate analysis. To find out the independent contribution of each factor towards the outcome, multivariate logistic regression analysis was used. Those that gave significant results were used in the multivariate analysis to determine their independent effects on dependent variables. Results were interpreted with odds ratios (ORs) and 95% CIs. Statistical significance was established when the CI did not embrace unity. The study was submitted to the PCMC Institutional Review Ethics Committee (IREC) and was approved prior to commencement and data collection.

RESULTS

Table 1 shows the socio-demographic characteristics of the children included in this study. A total of 320 children diagnosed with Severe Community Acquired Pneumonia from January 2018 to December 2019, with age six months to five years old were included in the study. More than half of the children were within the 1-5 years old age group (68%) and were mostly males

(61%). Furthermore, as high as 87% of the children included in the study had incomplete vaccination for age based on Childhood Vaccination Schedule set by the PIDSP. Seventy percent of the children belong to low income families.

Table 2 shows the association between the socio-demographic characteristics and the duration of hospital stay. Less than half (41%) had prolonged hospital stay of more than five days and majority were males (61.4%). The younger age group (6-11 months) and low socioeconomic status were also significantly associated with prolonged duration of hospital stay (both at p -value < 0.001). There was a higher proportion patients with low socioeconomic status in those who had prolonged hospital stay (83.3%) compared to those with shorter hospital stay (61.2%). On the other hand, the other variables (Sex and vaccination status) were not significantly associated with duration of hospital stay.

Table 3 shows the association between the clinical features of the patients at presentation and the duration of hospital stay. Incidence of hypoxemia (oxygen saturation of $< \text{or} = 94\%$) was significantly associated with prolonged duration of stay (p -value = 0.004). However, having a respiratory rate > 70 upon assessment on admission of the child was not found to be significantly associated with duration of hospitalization.

Being underweight (z scores below -2 on the WHO weight for age growth chart) was significantly associated with prolonged duration of stay (p -value < 0.001). The

children with shorter hospital stay had less incidence of being moderately and severely undernourished. Stunting (p value < 0.001) and severe wasting (p-value 0.036) were significantly associated with prolonged hospital stay. The incidence of severe wasting was two times higher in those who had prolonged hospitalization. Children who stayed beyond 5 days in the hospital had higher mean number of antibiotic use (2.3±1.4) compared to those with shorter hospitalization (1.3±0.6) (p-value<0.001).

Table 4 shows the association between the variables listed and the duration of hospital stay based on the logistic regression analysis. The following variables were significantly associated with prolonged duration of hospital stay after controlling for other variables: younger age (OR=0.5, 95%CI=0.3 to 0.9, p-value=0.014), low socioeconomic status (OR=2.6, 95%CI=1.4-5.0, p-value=0.003), and number of antibiotics used (OR=3.2, 95%CI=2.2-4.7, p-value<0.001). The other variables (hypoxemia, being underweight, stunted or severely wasted) were not significantly associated with duration of hospital stay based on the multiple logistic regression analysis.

DISCUSSION

The diagnosis of early-onset neonatal sepsis remains to be a challenge to Pneumonia remains as one of the most common infectious diseases affecting the vulnerable pediatric population especially those under five years of age. A child being admitted for severe pneumonia poses a great impact on the resources of his/her family

only to be compounded by a prolonged length of stay in the hospital if seen with adverse predictive factors. In our study, younger age was found to be a significant variable contributing to prolonged hospital stay. Children 6 to 11 months of age may have been more susceptible to infections owing to their immature immune system and underdeveloped mechanisms to combat disease as compared to the relatively older age group. This is congruent with the results of the study of Kaiser, S.V. and colleagues in 2015 exploring the risk factors for prolonged length of stay and complications of children less than 18 years old diagnosed with pediatric respiratory diseases in Pneumonia remains as one of the most common infectious diseases affecting the vulnerable pediatric population especially those under five years of age. A child being admitted for severe pneumonia poses a great impact on the resources of his/her family only to be compounded by a prolonged length of stay in the hospital if seen with adverse predictive factors. In our study, younger age was found to be a significant variable contributing to prolonged hospital stay. Children 6 to 11 months of age may have been more susceptible to infections owing to their immature immune system and underdeveloped mechanisms to combat disease as compared to the relatively older age group. This is congruent with the results of the study of Kaiser, S.V. and colleagues in 2015 exploring the risk factors for prolonged length of stay and complications of children less than 18 years old diagnosed with pediatric respiratory diseases in general. The risks of both prolonged LOS and complications during LRI

hospitalizations were increased in younger children. In their study, odds of prolonged LOS decreased 2% and complications decreased 5% for every year of age, making the odds of these events up to 85% higher in infants. Possible reasons for this included more severe disease courses in the younger children or greater variation in the care of young children, such as in the use of pulse oximetry in monitoring their course. (6) Furthermore, Pati et al (2012) also found that risks of prolonged LOS were highest in the youngest children admitted for pneumonia. (7) Meanwhile, the results in this study also had contradicting results with the recent study of Mohakud, N.K. et al in 2018 wherein the hospital stay was significantly higher in children diagnosed with lower respiratory tract infections within the age range of 11-14 years in comparison to 1 month to 1-year aged children. However, in their study, other lower respiratory tract infections such as bronchiolitis, wheeze-associated lower respiratory tract infection were included aside from pneumonia. (9)

Other variables such as sex and vaccination status did not yield any significant correlation with prolonged hospitalization. This is like Kuti wherein no statistically significant relationship was found between the duration of hospital stay and variables such as sex and immunization status of the children. In this study, among those children with a prolonged hospital stay, majority were males although no statistical significance was found in this study. This is similar to the findings in the retrospective study of Mohakud et.al in 2018 wherein the duration of hospitalization was

found to be higher in males indicating that sex has a role in susceptibility and severity of the disease. The study cited findings in a paper by Muenchhoff M et al stating that there was a stronger humoral and cellular immune response to infection in females than males. (10) Vaccination status also did not have a statistical significance with regard to the duration of hospital stay. In this paper, as high as 86.6% of the children included in the study had incomplete vaccination for age although when all other factors were adjusted, this did not yield any impact on the results.

Having a low socioeconomic status was also found to be significant in relation to the prolonged hospitalization. In this study, there was a higher proportion of low socioeconomic status patients in those who had prolonged hospital stay compared to those with shorter hospital stay. In the study by Kaiser, S.V. et al in 2015, socioeconomic status was also part of the variables studied contributing to prolonged length of stay. In the aforementioned study, most hospitalizations were of children coming from the lower median household income quartiles and those with public insurance as the payment source. Low socioeconomic status had significant correlation with a longer hospital stay. Findings such as these may likely be attributed to multiple factors that may include worse disease severity on presentation which contributed negatively to the course of the patient upon admission. The resource-poor families might have no money to shoulder transportation costs to bring the patient to the hospital hence late presentation and consult. The investigators of the aforementioned study, however,

recommended further research to investigate whether the results were due to differences in processes of care, quality of care, or other outcomes related to inpatient management for children with different insurance coverage.

In this study, only a few patients recorded values more than 70 cycles per minute among the participants in the study. Respiratory rate more than 70 cycles per minute was not significantly related to prolonged hospital stay similar to results in the study of Kuti et. al in 2014. This is also congruent with the findings of Jakhar et al in 2017 wherein respiratory rate more than 70 cycles per minute was not significantly related to longer hospital days among patients with pneumonia between 2 months to 5 years of age.

This study also found out that children who used a greater number of antibiotics had prolonged hospital stay compared to those with fewer antibiotic uses. Those with prolonged hospital stay significantly had higher mean number of antibiotic use compared to those with short duration. Children diagnosed with community acquired pneumonia requiring multiple antibiotic use may signify a more complicated course of the disease. As a result, the duration of antibiotic use may contribute to the prolonged hospital stay of patients especially among the younger age group wherein intravenous antibiotics were preferred more than the oral route of administration especially for those children unable to feed per oreum. This may further explain the additional number of days that the patient needed for mere completion of

antibiotics alone. Findings were congruent with the study of Tiewsoh et. al in 2009 which explored the factors determining the outcome of children hospitalized with severe pneumonia in India. This prospective study involved 200 children aged 2 months to 5 years of age and the researchers found out that 56.5% of the children enrolled needed a change in the antibiotics and 51% stayed for more than 5 days in the hospital. The need of change of antibiotics was found to be significantly associated with increased hospital stay among the under-five children hospitalized for severe pneumonia. (11)

A prospective cohort study is recommended, among the under-five age group presenting with severe pneumonia to determine other risk factors for prolonged hospitalization to include laboratory parameters and other ancillary diagnostics such as chest x-ray. Similar future studies may also be done focusing on the adolescent age group as well.

Based on the findings presented, variables such as younger age, low socioeconomic status and greater number of antibiotics used were found to be significantly associated with prolonged duration of hospital stay after controlling for other variables. On the other hand, hypoxemia, respiratory rate more than 70 cycles per minute and presence of malnutrition such as being overweight, stunted or wasted did not yield any significant correlation with the longer length of hospital stay among the patients included in the study.

REFERENCES

1. UNICEF analysis based on WHO and Maternal and Child Epidemiology Estimation Group interim estimates produced in September 2019, applying cause of deaths for the year 2017 to United Nations Inter-agency Group for Child Mortality Estimation estimates for the year 2018. Available at <https://data.unicef.org/topic/child-health/pneumonia/>. (Accessed 7 May 2020)
2. Republic of the Philippines Department of Health Ten (10) Leading Causes of Child Mortality By Age-Group. Available at <https://www.doh.gov.ph/Statistics/Leading-Causes-of-Child-Mortality>. (Accessed 7 May 2020)
3. Tumanan-Mendoza BA, Mendoza VL, Frias MVG. Economic burden of community acquired pneumonia among pediatric patients (aged 3 months to. *Value Health Reg Issues* 2017; 12: 115–22.
4. Hall MJ, De Frances CJ. National hospital discharge survey. Available at <http://www.cdc.gov/nchs/data/ad/> (Accessed 8 May 2020).
5. Kuti, B P, Adegoke, S A, Oyelami, O A et.al. Predictors of prolonged hospitalisation in childhood pneumonia in a rural health centre. *South African Journal of Child Health* 2014 8(1), 11-15.
6. Kaiser, S. V., Bakel, L. A., Okumura, M. J. et al. Risk Factors for Prolonged Length of Stay or Complications During Pediatric Respiratory Hospitalizations. *Hospital pediatrics* 2015 5(9), 461–473.
7. Pati S, Lorch SA, Lee GE et al. Health insurance and length of stay for children hospitalized with community-acquired pneumonia. *J Hosp Med.* 2012; 7(4):304–310
8. Jakhar, S. K., Pandey, M., Shah, D et al. Etiology and Risk Factors Determining Poor Outcome of Severe Pneumonia in Under-Five Children. *Indian journal of pediatrics* 2018 85 (1), 20–24.
9. Mohakud, N. K., Mishra, M., Tripathy, R et al. Incidence and Risk Factors for Prolonged Stay in Children Hospitalised with Pneumonia. *Journal of Clinical & Diagnostic Research* 2018 12(8).
10. Muenchhoff M, Goulder PJ. Sex differences in pediatric infectious diseases. *The Journal of infectious diseases.* 2014; 209 (suppl_3):S120-26.
11. Tiewsoh K, Lodha R, Pandey RM, et al. Factors determining the outcome of children hospitalized with severe pneumonia. *BMC Pediatrics* 2009;9:15
12. Zhang S, Sammon PM, King I et al. Cost of management of severe pneumonia in young children: systematic analysis. *Journal of Global Health.* 2016; 6 (1): 010408.

TABLE 1 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE CHILDREN

Parameter	N=320	Percentage (%)
Age range		
6 -11 months	103	32.2%
1-5 years	217	67.8%
Sex		
Male	194	60.6%
Female	126	39.4%
Incomplete vaccination for age	277	86.6%
Low socio-economic status	225	70.3%

TABLE 2 ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC CHARACTERISTICS AND DURATION OF HOSPITAL STAY

Parameters	Duration of hospital stay > or = 5 days N=132 (41.2%)	Duration of hospital stay <5 days n =188 (58.8%)	Total	X ²	p-value
Age range					
6 -11 months	56 (42.4)	47 (25.0)	103	10.8	0.001
1-5 years	76 (57.6%)	141 (75.0)	217		
Sex					
Male	81 (61.4%)	113 (60.1)	194	0.05	0.821 (NS)
Female	51 (38.6%)	75 (39.9)	126		
Incomplete vaccination for age	120 (90.9%)	157 (83.5)	277	3.6	0.056 (NS)
Low socioeconomic status	110 (83.3%)	115 (61.2)	225	10.8	<0.001

P value significant at <0.05

TABLE 3 ASSOCIATION BETWEEN CLINICAL FEATURES AT PRESENTATION AND DURATION OF HOSPITAL STAY

Parameters	Duration of hospital stay > or = 5 days N=132 (41.2%)	Duration of hospital stay <5 days n =188 (58.8%)	Total	X ²	p-value
Hypoxemia	48 (36.4)	41 (21.8)	89 (27.8)	8.2	0.004
RR >70	8 (6.1)	5 (2.7)	13 (4.1)	2.3	0.129 (NS)
Underweight					
Moderate	22 (16.7)	27 (14.4)	49 (15.3)	15.4	<0.001
Severe	32 (24.2)	17 (9.0)	49 (15.3)		
Stunting	65 (49.2)	46 (24.5)	111 (34.7)	21.0	<0.001
Severe Wasting	28 (21.2)	19 (10.1)	47 (14.7)	8.5	0.036
Number of antibiotics used	2.3±1.4	1.3±0.6	1.8±1.1	t-stat-8.7	<0.001

P value significant at <0.05

TABLE 4 ASSOCIATION BETWEEN VARIABLES AND DURATION OF HOSPITAL STAY BASED ON MULTIPLE LOGISTIC REGRESSION ANALYSIS

Parameters	Unadjusted Odds Ratio (95%CI)	P-value (simple logistic regression)	Adjusted Odds Ratio (95%CI)	P-value (multiple logistic regression)
Age				
6 -11 months	0.4 (0.3-0.7)	0.001	0.5 (0.3-0.9)	0.014
1-5 years				
Low socioeconomic status	3.2 (1.8-5.5)	<0.001	2.6 (1.4-5.0)	0.003
Hypoxemia	2.0 (1.2-3.4)	0.005	1.8 (1.0-3.2)	0.059 (NS)
Underweight				
Moderate	1.5 (0.8-2.8)	0.202	0.9 (0.4-2.2)	0.816 (NS)
Severe	3.5 (1.8-6.6)	<0.001	2.1 (0.6-6.8)	0.223 (NS)
Stunting	3.0 (1.8-4.8)	<0.001	1.8 (0.9-3.6)	0.109 (NS)
Severe Wasting	2.3 (1.2-4.4)	0.008	1.0 (0.4-2.8)	0.960 (NS)
Number of antibiotics used	3.2 (2.3-4.4)	<0.001	3.2 (2.2-4.7)	<0.001