Frontiers of Nursing • 11(3) • 2024
DOI: 10.2478/FON-2024-0038

sciendo

Frontiers of **Nursing**

Time to recovery from severe pneumonia and its predictors among pediatric patients admitted in Mizan-Tepi University Teaching Hospital, South West Ethiopia, 2022

Original article

Belete Fenta Kebede[a,*], Aynalem Yetwale Hiwot[b], Tsegaw Biyazin Tesfa[c], Yalemtsehay Dagnaw Genie[d], Nigatu Dessalegn Mulu[e]

[a]*Department of Midwifery, College of Medicine and Health Sciences, Debre Markos University, Debre Markos 269, Ethiopia*
[b]*Department of Midwifery, Woldiya University, Woldiya, Ethiopia*
[c]*School of Midwifery, Institute of Health, Jimma University, Jimma 378, Ethiopia*
[d]*Department of Pediatrics and Child Health Nursing, Debre Markos University, Debre Markos 269, Ethiopia*
[e]*Department of Pediatrics and Child Health Nursing, Injibara University, Injibara, Ethiopia*

Received: 3 April 2023; Accepted: 27 September 2023; Published: 20 September 2024

Abstract: **Objective:** Despite trials and programs for the prevention of childhood mortality due to pneumonia, Ethiopia is among the top five countries with the highest number of deaths due to pneumonia. Although the prevalence of pneumonia has increased in the above-mentioned trials, little is known about the recovery time from severe pneumonia and its predictors in the study area. Therefore, this study aimed to assess the time to recovery from severe pneumonia and its predictors among pediatric patients admitted to Mizan-Tepi University Teaching Hospital, Ethiopia, in 2022.

Methods: A total of 591 children admitted for severe pneumonia were selected using simple random sampling. Data were entered into Epi-data version 4.4.2.1 and exported to STATA version 14 for analysis, and the assumptions of Cox proportional hazard models and goodness of fit were assessed through Shoenfeld residual and Cox-Snell residual, respectively. Bivariate and multivariable Cox regression models were used to identify the predictors of mortality.

Results: This study revealed that 91.54% (95% confidence interval [CI]: 89.00–93.53) of participants recovered with an incidence rate of 24.10 (95% CI: 22.15–26.21) per 100 person-day–observations. The hmedian recovery time of children was 4 days (95% CI: 2–6). Children who were not exclusively breastfed (AHR = 1.3; 95% CI: 1.03–1.66), who had a history of inability to suck/feed (AHR = 0.81; 95% CI: 0.65–0.99) were independent predictors of the time to recovery.

Conclusions: Children with severe pneumonia who had not exclusively breastfed and who had a history of inability to suck/feed were independent predictors of time to recovery. Therefore, all stakeholders and concerned health care providers should focus more on early diagnosis and management and hasten early recovery based on the identified factors.

Keywords: *Mizan-Tepi University Teaching Hospital • pediatric patients • predictors • severe pneumonia • Southwest Ethiopia • time to recovery*

Abbreviations: AHR, adjusted hazard ratio; CHR, crude hazard ratio; HFA, height for age; MTUTH, Mizan-Tepi University Teaching Hospital; RDS, respiratory distress syndrome; WFA, weight for age; WFH, weight for height.

How to cite this article: Fenta Kebede B, Yetwale Hiwot A, Biyazin Tesfa T, Dagnaw Genie Y, Dessalegn Mulu N. Time to recovery from severe pneumonia and its predictors among pediatric patients admitted in Mizan-Tepi University Teaching Hospital, South West Ethiopia, 2022. *Front Nurs*. 2024;3:343–354.

**Corresponding author.*
E-mail: belete121wy@gmail.com (B. Fenta Kebede).

1. Introduction

According to the World Health Organization (WHO), severe pneumonia is diagnosed in children with a history of cough or reported breathing difficulty and with at least one of the following: Oxygen saturation <90%, severe respiratory distress, general danger signs, and increased respiratory rate (RR >50 b/min in children aged 2–12 months, RR >40 b/min in children aged 12–59 months, and RR >30/min in children aged ≥60 months).[1]

The global annual incidence of pneumonia is 150–156 million, accounting for approximately 10–20 million hospitalizations.[2] Each year, almost 700,000 children die from pneumonia, and every minute 2 children die from pneumonia. Of these, 80% of deaths occur in low and middle-income countries.[3] Globally, there are over 1,400 cases of pneumonia per 100,000 children, or 1 case per 71 children every year, with the highest incidence occurring in South Asia and West and Central Africa.[4]

Caring for a child with pneumonia for a prolonged period may be financially burdensome in resource-poor areas.[5,6] The medical costs (direct and indirect) of care show a significant difference based on how long a child is hospitalized for different conditions.[7–9] Prolonged recovery time for severe pneumonia creates pressure on patients for the development of adverse drug reactions and the chance of infection and takes time away from work for parents.[1,2] In addition to the effects on patients, prolonged recovery from severe pneumonia also creates a burden on time expenditure by clinical staff and parents.[10,11] In addition to case fatality, the length of hospitalization is a commonly accepted indicator of pneumonia severity.[12,13]

Previous findings revealed that patients who stay longer in the hospital have poorer treatment outcomes.[14] A prolonged recovery time is associated with unfavorable outcomes, indirectly resulting in decreased recovery rates.[2] Several factors have been reported to be associated with the recovery time among pediatric patients with severe pneumonia,[15–17] and the outcome status and overall hospitalization until recovery time of pediatric patients with pneumonia vary depending on the number of causative factors,[2,15–18] comorbidities, complications, severity, and type of drug prescribed.[19] Severe pneumonia combined with other comorbidities increases the need for oxygen therapy.[18] The recovery time of patients with severe pneumonia is also affected by the type of microorganism infected.[20]

In Ethiopia, trials are currently underway to prevent the onset of pneumonia in children and to reduce deaths due to pneumonia. The Federal Ministry of Health has been working to improve newborn and childhood health by providing vaccines such as PCV and Hib vaccines, as well as developing strategies such as integrated treatment of newborn and childhood illnesses to treat cases. Ethiopian Health Sector Transformation plans, in 2015, to reduce the mortality rate of children to 31 and 14 per 1000 live births in 2025 and 2035, respectively.[21] Despite these trials and initiatives, Ethiopia has a high incidence of pneumonia and a higher risk of mortality, ranking among the top five countries with the highest number of pneumonia deaths,[22] as well as a higher proportion of hospitalizations and a lower proportion of recovery rates.[23]

Although the prevalence of pneumonia and its hospitalization has increased in the above-mentioned trials, little is known regarding the time recovery from severe pneumonia and its predictors in Ethiopia as well as in the article's study area. Thus, this study aimed to assess the time to recovery from severe pneumonia and its predictors among pediatric patients admitted to the Mizan-Tepi University Teaching Hospital (MTUTH) in Southwest Ethiopia. Therefore, this study contributes significantly to the existing and missing evidence in the study area.

2. Methods

2.1. Study area and period

The study was conducted at the MTUTH. MTUTH is located 584 km from Addis Ababa. It serves the Bench Sheko Zone, neighboring woredas of Kaffa, Sheka zones, and partial Gambella regions (Majang zone) as a referral center, resulting in a catchment population of more than two million people. MTUTH provides various services in medical, surgical, ophthalmological, psychiatric, pediatric, and neonatal intensive care, under 5 out pertinent department (OPD), adult OPDs, and other related services. The study was conducted from 15 January 2022 to 30 January 2022.

2.2. Study design

An institutional-based retrospective cohort study was employed.

2.3. Participants

All children with severe pneumonia admitted to the pediatric ward of MTUTH were the source participants, and all children admitted to the pediatric ward with severe pneumonia during the study period were the study population.

2.4. Eligibility criteria

All children aged from 1 month to 15 years with severe pneumonia admitted to the hospital during the study period were eligible for inclusion. Medical charts with incomplete or missing key information were also excluded.

2.5. Sample size determination

The required sample size for this study was determined by using the STATA statistical package (Cox-model), version 14, based on the following assumptions: HR of 0.68 which is the selected covariate (formula feeding) taken from a study done in Gondar Hospital, a variability standard deviation (SD) of 0.5, 5% margin of error, 95% confidence interval (CI) and 80% power, and probability of recovery (event) 0.3636.[16] The minimum sample size required was 581. After adding a 5% non-response rate, the final sample size for this study was 610.

2.6. Sampling techniques and procedures

The 3-year data of all children with pneumonia admitted to the pediatric ward between 01 January 2019 and 30 December 2021 were enrolled using the admission registration book by recording their medical record numbers sequentially. A total of 2124 medical registrations were obtained from the hospital over the past 3 years. The required number of medical registration cards was selected using a simple random sampling technique with a computer random number generation system in Excel. The selected medical cards were obtained from the medical records office.

2.7. Variables

The dependent variable was the time to recovery from severe pneumonia in children dichotomized as recovered or censored. The independent variables of the study included the following: socio-demographic variables (sex, age, and residency), clinical presentation and therapeutic-related variables (fever, antibiotic administration, danger signs during admission sign [inability to feed/drink, vomiting everything, head nodding, grunting]), drug regimen, oxygen saturation at admission, preterm birth history, low birth weight history, comorbidity, and nutritional and feeding characteristics (nutritional status [stunting, wasting, underweight], mode of infancy feeding [cow milk feeding, formula feeding, breastfeeding], and exclusive breastfeeding history).

2.8. Operational definitions

2.8.1. Recovery time

Defined as the time from the date of admission to event/recovery from severe pneumonia.

2.8.2. Recovered

Pediatric patients improved from severe pneumonia as declared by the physician.

2.8.3. Median recovery time

This is the time when 50% of the children had recovered.

2.8.4. Censored

Children with severe pneumonia, who died and were lost to follow-up (left against medical advice or transferred to other health institutions, discharged for any reason without recovery during the study period) were taken as censored.

2.8.5. Co-morbidity

Any disease condition (acute or chronic) present at admission in addition to severe pneumonia, which includes hyperactive airway disease (childhood asthma), retroviral infection, tuberculosis, acute gastroenteritis, pertussis, anemia, meningitis, measles, bronchitis, heart failure, and urinary tract infection.[17]

2.8.6. Time scale

The survival time was measured in days.

2.8.7. Starting time origin

The first day of admission of children at the pediatric ward.

2.8.8. End of follow-up time

Last day of an event or censored occurrence in the hospital.

2.9. Data collection tools and procedures

The checklist was adapted from a similar study conducted at the Debre Markos Referral Hospital[17] and modified after reviewing the related literature.[15–17]

The tool provides information on socio-demographic characteristics, clinical presentation and therapeutic characteristics, nutrition, and feeding characteristics. Data were collected through chart review, following the outcome of children starting from the day of admission in the pediatric ward up to the occurrence of an outcome (event or censored) in the hospital.

2.10. Data Processing, Analysis, Interpretation, and Presentation

After checking for data completeness and consistency, the collected data were coded and entered into Epi-data version 4.4.2.1 statistical software packages, and the data were then transported to STATA version 14 for cleaning and analysis. The data were then described using relative frequencies and percentages. Kaplan–Meier survival estimates were used to estimate the median survival time and cumulative probability of survival at a given point in time. A life table was used to estimate the probability of survival at different time intervals during the follow-up period. The Log-rank test was used to compare the time to recovery differences between the different groups. The assumptions of the Cox proportional hazards (CPH) regression model were tested using the Schoenfeld residual test (global test). Additionally, the multicollinearity of each independent variable was checked using the variance inflation factor (VIF). Finally, the goodness of fit of model was checked using the Cox Snell residual graph. The CPH model was used to identify the independent predictors of mortality. Based on bivariate analysis, variables with a *P*-value <0.25 in the bivariate analysis were transferred to the multivariable analysis. Finally in multivariable analysis, those variables a *P*-value <0.05 at 95% CI level were considered as an independent predictor for time to recovery of children who had pneumonia. The final measure of the association between independent and dependent variables was expressed as an adjusted hazard ratio (AHR). Finally, the findings are presented in tables, graphs, and text.

2.11. Data quality assurance

To assure the quality, the study pretest was conducted on 5% (31) of the sample size, 2 weeks before the actual data collection period, which was not included in the actual study. Training was provided to data collectors and supervisors on how and what information should be collected from medical records for 1 day. The supervisor checked the data to ensure completeness and clarity. Completeness was checked before the data was entered.

3. Result

From the beginning of 2019 to the end of 2021, a total of 2124 children under 15 years of age were admitted with severe pneumonia. Of these, 610 medical charts were reviewed based on the required samples. Of these, 19 cases (3.11%) of medical charts were excluded because 11 charts were not available at the time of data collection and 8 were incomplete medical charts. The remaining 591 children were included in the analysis making a response rate of 96.89%.

3.1. Socio-demographic characteristics

Out of the 591 participants, males accounted for 359 (60.74%). Three hundred eight (52.12%) of them were in the age group of <1 year. Concerning to residency 380 (64.30%) of children came from rural areas (Table 1).

Characteristics	Total, N (%)	Outcome variable, N (%)	
		Censored, N = 50	Recovered, N = 541
Sex			
Male	359 (60.74)	18 (5.0)	341 (95.0)
Female	232 (39.26)	32 (13.8)	200 (86.2)
Age (years)			
<1	308 (52.12)	33 (10.7)	275 (89.3)
1–5	170 (28.76)	9 (5.3)	161 (94.7)
5–14	113 (19.12)	8 (7.1)	105 (92.9)
Residency			
Urban	211 (35.70)	11 (5.2)	200 (94.8)
Rural	380 (64.30)	39 (10.3)	341 (89.7)

Note: MTUTH, Mizan-Tepi University Teaching Hospital.

Table 1. Socio-demographic characteristics of children admitted from 01 January 2019 to 30 December 2021 at the pediatric ward of MTUTH, Ethiopia, 2022 (N = 591).

3.2. Clinical and therapeutics regimen characteristics

Two hundred forty-eight (41.96%) of the participants had hypoxia (oxygen saturation <90) during admission. Three hundred eighty-two (64.64%) children had fever during admission. Approximately 404 (68.36%) of participants have respiratory distress at the time of admission. The most common antibiotic first given to respondents 338 (57.19%) was ceftriaxone. For 324 (54.82%) children, antibiotics were changed after admission. Concerning the birth weight of children, 530 (89.68%) respondents had birth weights of 2500–4000g. Only 84 (14.21%) of participants were preterm (gestational age <37 weeks) (Table 2).

3.3. Nutritional status and feeding characteristics

Of the total study participants, 397 (67.17%) were on exclusive breastfeeding. Related to baseline nutritional status, 82 (13.87%), 94 (15.91%), and 94 (15.91%) of the participants were characterized as underweight, wasting, and stunting, respectively. Of all study participants, 379 (64.13%) of them were on breast milk feeding (Table 3).

3.4. Incidence rate and median recovery time from severe pneumonia among children

A total of 591 Children were followed for 1–11 days. Of 591 children, 541 (91.54%; 95% CI: 89.00–93.53) recovered from severe pneumonia during the follow-up period/hospitalization period and 50 (8.46%; 95% CI: 6.46–10.99) were censored. Children were followed for 2245 person-day observations, with an incidence rate of 24.10 (95% CI: 22.15–26.21) deaths per 1000 person-day observations (hospitalization period). The overall median recovery time of children in this study was 4 days (95% CI: 2–6). The Kaplan–Meier survival graph also confirmed the median recovery time of children (Figure 1).

In this study, the incidence rates for different age groups of children were 22.47 (95% CI: 19.96–25.28), 26.10 (95% CI: 22.32–30.40), and 26. 05 (95% CI: 21.52–31.54) in the <1 year, 1–5 years, and in >5 years, respectively (Table 4).

3.5. Comparison of recovery among children with severe pneumonia

The Kaplan–Meier graphs show the overall cumulative survival and failure probability among children (Figure 2).

3.6. Comparison of survivorship functions for different categorical variables

Comparisons of the survival time differences between different groups of categorical covariates were done through the Kaplan–Meier survival graph and statistical log-rank test at a 5% level of significance.

In this study, there was a recovery time difference between the categories of mode of infant feeding (P = 0.0148), breastfeeding status (P = 0.0331), respiratory distress (P = 0.0072), vomiting everything (P = 0.0121), altered level of consciousness (P = 0.0031), and inability to suck/feed (P = 0.0002) compared to their counterparts.

3.7. CPH Assumption and multicollinearity Test

The assumptions of the CPH model were assessed using the Schoenfeld residual/global test, which became non-significant (0.4575) indicating that the proportional hazard assumption of CPH regression was met. The multicollinearity of each independent variable was checked using the VIF and the mean-VIF for these variables was 1.26.

3.8. Predictors of recovery time from severe community-acquired pneumonia

In bivariate Cox regression analysis, predictors such as age, respiratory distress, vomiting, exclusive breastfeeding, antibiotic change, mode of infant feeding, altered level of consciousness, and inability to suck/feed were associated with time to recovery. In the final CPH model, exclusively breastfeeding and inability to suck/feed were found to be independent predictors of recovery from severe pneumonia in children at 95% CI level. The time to recovery of children with severe pneumonia who did not have exclusively breastfeeding was observed to increase 1.3 times (AHR = 1.3; 95% CI: 1.03–1.66) than their counterparts. This indicates that children who were exclusively breastfed had a shorter time to recovery than those who were not exclusively breastfed. In addition to this, children who had a history of inability to suck/feed were observed to have 19% lower hazard of recovery from severe pneumonia (AHR = 0.81; 95% CI: 0.65–0.99) than their counterparts (Table 5).

4. Discussion

This study was conducted to determine the time to recovery from severe pneumonia and its predictors among pediatric patients admitted to MTUTH, Southwest Ethiopia, in 2022.

Characteristics	Total, N (%)	Outcome variable, N (%)	
		Censored, N = 50	Recovered, N = 541
Danger sign during admission			
No	115 (19.46)	2 (1.7)	113 (98.3)
Yes	476 (80.54)	48 (10.1)	428 (89.9)
Hypoxia during admission			
No	343 (58.04)	5 (1.5)	338 (98.5)
Yes	248 (41.96)	45 (18.1)	203 (81.9)
Fever during admission			
No	209 (35.36)	19 (9.1)	190 (90.9)
Yes	382 (64.64)	31 (8.1)	351 (91.9)
Respiratory distress			
No	187 (31.64)	4 (2.1)	183 (97.9)
Yes	404 (68.36)	46 (11.4)	358 (88.6)
Vomiting everything			
No	483 (81.73)	36 (7.5)	447 (92.5)
Yes	108 (18.27)	14 (13.0)	94 (87.0)
Altered consciousness			
No	539 (91.20)	31 (5.8)	508 (94.2)
Yes	52 (8.80)	19 (36.5)	33 (63.5)
Inability to breastfeeding or drink			
No	363 (61.42)	9 (2.5)	354 (97.5)
Yes	228 (38.58)	41 (18.0)	187 (82.0)
Abnormal body movement/convulsion			
No	589 (99.66)	48 (8.1)	541 (91.9)
Yes	2 (0.34)	2 (100.0)	-
Antibiotic first given			
Ceftriaxone	338 (57.19)	29 (8.6)	309 (91.4)
Crystalline penicillin	45 (7.61)	2 (4.4)	43 (95.6)
Ampicillin and gentamicin	208 (35.19)	19 (9.1)	189 (90.9)
Antibiotic change after admission			
No	267 (45.18)	12 (4.5)	255 (95.5)
Yes	324 (54.82)	38 (11.7)	286 (88.3)
Co-morbidity			
No	395 (66.84)	32 (8.1)	363 (91.9)
Yes	196 (33.16)	18 (9.2)	178 (90.8)
Birth weight during birth (g)			
<2500	61 (10.32)	4 (6.6)	57 (93.4)
>2500	530 (89.68)	46 (8.7)	484 (91.3)
Gestational age (weeks)			
<37	84 (14.21)	8 (9.5)	76 (90.5)
37–42	507 (85.79)	42 (8.3)	465 (91.7)
Presentation to seek care (days)			
5	203 (34.35)	32 (15.8)	171 (84.2)
<5	388 (65.65)	18 (4.6)	370 (95.4)

Note: MTUTH, Mizan-Tepi University Teaching Hospital.

Table 2. Clinical and therapeutic regimen characteristics of children admitted from 01 January 2019 to 30 December 2021 at the pediatric ward of MTUTH, Ethiopia, 2022 (N = 591).

Characteristics	Total, N (%)	Outcome variable, N (%)	
		Censored, N = 50	Recovered, N = 541
WFA			
Normal	509 (86.13)	41 (8.1)	468 (91.9)
Underweight	82 (13.87)	9 (11.0)	73 (89.0)
WFH			
Normal	497 (84.09)	41 (8.2)	456 (91.8)
Wasted	94 (15.91)	9 (9.6)	85 (90.4)
HFA			
Normal	492 (83.25)	36 (7.3)	456 (92.7)
Stunted	99 (16.75)	14 (14.1)	85 (85.9)
Mode of infant feeding			
Breast milk	379 (64.13)	33 (8.7)	346 (91.3)
Formula	30 (5.08)	2 (6.7)	28 (93.3)
Cow milk	182 (30.80)	15 (8.2)	167 (91.8)
Exclusive breastfeeding			
Yes	397 (67.17)	37 (9.3)	360 (90.7)
No	194 (32.83)	13 (6.7)	181 (93.3)

Note: HFA, height for age; MTUTH, Mizan-Tepi University Teaching Hospital; WFA, weight for age; WFH, weight for height.

Table 3. Nutritional status and feeding characteristics of children admitted from 01 January 2019 to 30 December 2021 at the pediatric ward of MTUTH, Ethiopia, 2022 (N = 591).

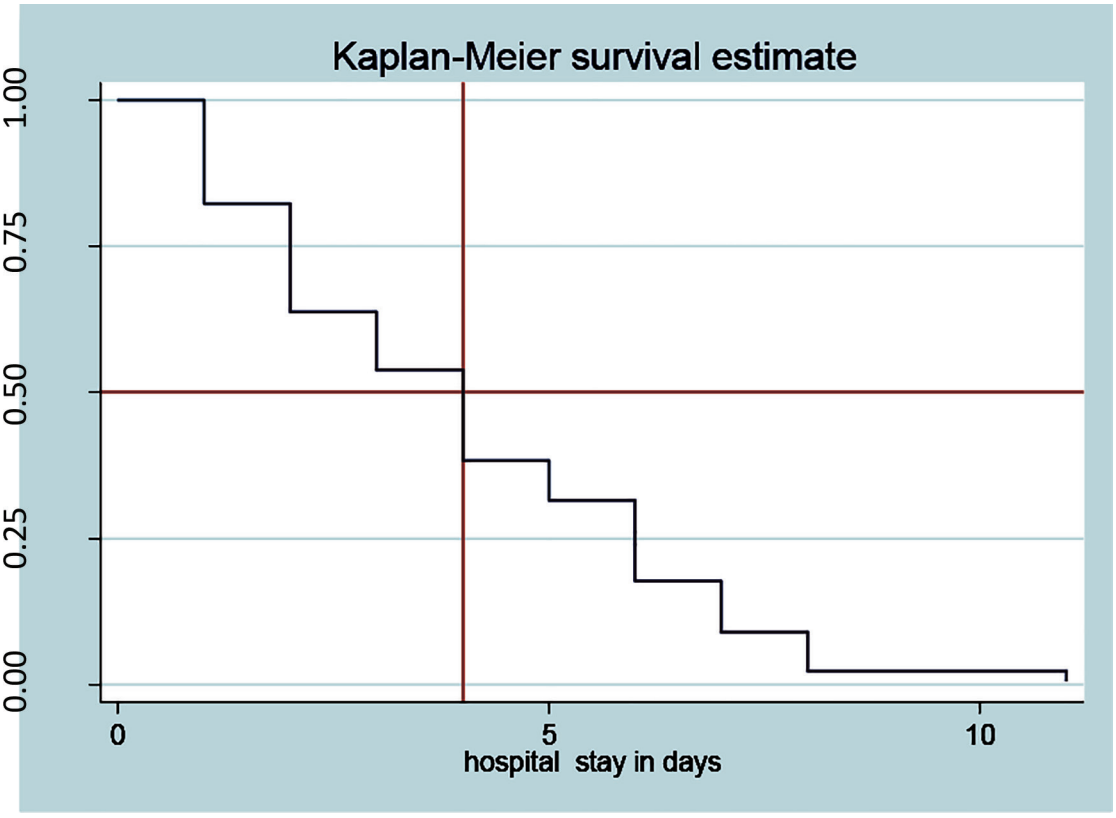

Figure 1. Kaplan–Meier survival estimate graph overall median recovery time among children admitted from 01 January 2019 to 30 December 2021 at pediatric ward of MTUTH, Ethiopia, 2022. MTUTH, Mizan-Tepi University Teaching Hospital.

Birthweight category	Events	Total time at risk	Incidence rate/100 (95% CI)	Median recovery time
<1 year (n = 308)	275	1224	22.47 (95% CI: 19.96–25.28)	4
1–5 years (n = 170)	161	618	26.10 (95% CI: 22.32–30.40)	4
>5 years (n = 113)	105	403	26. 05 (95% CI: 21.52–31.54)	3

Note: CI, confidence interval; MTUTH, Mizan-Tepi University Teaching Hospital.

Table 4. Incidence rate and median recovery time of children with severe pneumonia in each age group category admitted from 01 January 2019 to 30 December 2021 at NICU of MTUTH Hospital, Ethiopia, 2022.

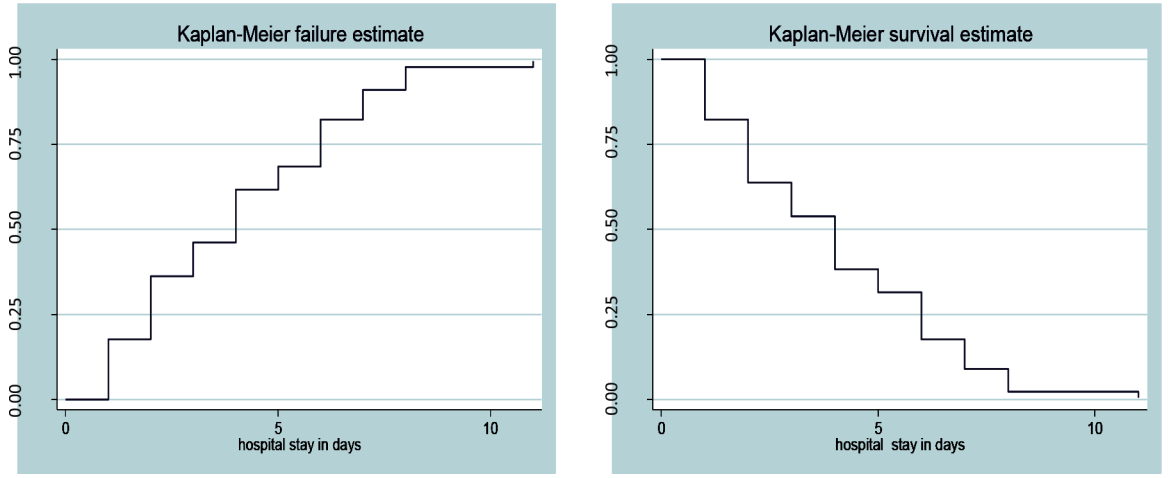

Figure 2. Overall Kaplan–Meier survival and failure estimate of children admitted from 01 January 2019 to 30 December 2021 at pediatric ward of MTUTH, Ethiopia, 2022. MTUTH, Mizan-Tepi University Teaching Hospital.

In this study, the overall incidence rate of recovery was 24.10 (95% CI: 22.15–26.21) per 100 person-days–observations which is found to be lower than the finding in the University of Gondar Comprehensive Specialized Hospital, Ethiopia[16] where the incidence rate was 29.7 per 100 children per day observations. This difference might be due to differences in service provision. An additional possible reason for this discrepancy might be related to the study participant age limit difference since the study at Gondar, focused on under-five children where respondents were under 15 years old. However, the findings of this study were similar to those of a study conducted at Nigist Eleni Mohammed Memorial Comprehensive Specialized Hospital, Hossana, Ethiopia[15] with an incidence rate of recovery of 24.16 per 100 person-days. However, this finding was higher than that in the Debre Markos Referral Hospital, Northwest, Ethiopia,[17] where the incidence rate was 16.25 per 100 person-day observations. This may be due to sociodemographic differences and the health care settings.

The median time to recovery from severe pneumonia in the current study was 4 days (95% CI: 2–6). A similar finding was reported in a study by Debre Markos Referral Hospital, Ethiopia[17] and Hossana, Ethiopia.[15] However the median time to recovery was slightly higher than that reported in a study conducted at the University of Gondar Comprehensive Specialized Hospital where the median time to recovery was 3 days. This might be due to the study participant age limit difference and another explanation for the discrepancy may be due to the difference in the number of participants.

This study revealed that the overall proportion of recovery was 91.54% (95% CI: 89.00–93.53). This finding was higher than the finding in Debre Markos Referral Hospital, Ethiopia[17] which was 88.9%. The possible reason for the difference might be due to time variation when the study was conducted since this study was conducted more recently and may had advanced care than previous studies which can lead to more recovery proportion. However, this finding was lower than the finding from Hawassa, Ethiopia[2] and Hossana, Ethiopia[15] which showed that 96.7% and 92.86% of the children were discharged with improvement, respectively. The difference from the study in Hawwassa might be due to study design and model analysis differences.

The current study also showed that children who do not have exclusively breastfeeding were observed to have 1.3 times increased time to recovery (AHR = 1.3; 95% CI: 1.03–1.66) than their counterparts. Another study conducted in New Delhi[12] supported these findings. The possible reason might be the fact that exclusively

Predictor	CHR (95% CI)	AHR (95% CI)	*P*-value
Age (years)			
<1	0.83 (0.66–1.04)	0.92 (0.72–1.17)	0.496
1–5	0.98 (0.77–1.25)	0.96 (0.74–1.24)	0.754
>5	1	1.00	
Respiratory distress			
No	1	1.00	
Yes	0.81 (0.68–0.97)	0.95 (0.78–1.17)	0.642
Vomiting everything			
No	1	1.00	
Yes	0.79 (0.63–0.99)	0.84 (0.67–1.06)	0.142
Antibiotic changed			
No	1	1.00	
Yes	0.89 (0.76–1.06)	0.88 (0.74–1.05)	0.148
Infant feeding			
Breast milk	1	1.00	
Formula	1.65 (1.12–2.44)	1.29 (0.81–2.03)	0.279
Cow milk	1.03 (0.85–1.24)	0.81 (0.64–1.04)	0.102
Exclusive Breastfeeding			
Yes	1	1.00	
No	1.18 (0.98–1.41)	1.3 (1.03–1.66)	0.025*
Altered level of consciousness			
No	1	1.00	
Yes	0.64 (0.45–0.92)	0.71 (0.49–1.04)	0.077
Unable to suck			
No	1	1.00	
Yes	0.75 (0.63–0.89)	0.81 (0.65–0.99)	0.048*

Note: *Significant at *P*-value <0.05 in multivariable analysis, 1.00 = considered as reference categories; AHR, adjusted hazard ratio; CHR, crude hazard ratio; CI, confidence interval; MTUTH, Mizan-Tepi University Teaching Hospital.

Table 5. Results of the bivariate and multivariable analysis of children admitted from 01 January 2019 to 30 December 2021 at the pediatric ward of the MTUTH, Ethiopia, 2022.

breastfeeding is important to improve immunity and fast recovery from diseases such as pneumonia.

Further children who had a history of being unable to suck/feed were observed to have 19% lower hazard of recovery from severe pneumonia (AHR = 0.81; 95% CI: 0.65–0.99). This finding was supported by studies conducted in Nepal,[5] University of Gondar Comprehensive Specialized Hospital, Ethiopia,[16] and Debre Markos Referral Hospital, Ethiopia.[17] The possible reason might be that longer hospital stays may be required for those children with the complication of being unable to suck/feed, since extra time may be needed to improve feeding and medication to recover from severe pneumonia.

5. Conclusions

This study revealed that a higher number of participants recovered. The median recovery time of children was 4 days in this study. It was also found that factors "no exclusively breastfeeding" and "inability to suck/feed" were independent predictors of recovery. Therefore, all stakeholders and health care professionals must focus on early diagnosis, and management to facilitate early recovery of children who develop severe pneumonia.

Acknowledgment

Mizan-Tepi University College of Health Science is acknowledged for providing this opportunity to conduct this study. Our thanks also go to the MTUTH hospital staff of the pediatric care team and the card extractors. It is also our pleasure to thank the data collectors as well as the supervisor.

Availability of data and materials

The raw data file could be provided for research purposes only, upon request via e-mail of the corresponding author.

Authors' contributions

Author's contributions: All authors contributed to the study's conception and design. BF, AY, and TB drafted the manuscript. NG and YD have critically reviewed the draft for the intellect and rewritten the entire manuscript which is currently presented. All authors had approved the final version.

Ethical approval

This study was approved by the research ethics committee of Mizan-Tepi University College of Health Science, Department of Nursing with IRB approval number: NURS/576/10/2014. Then, data were collected after consent of cooperation was obtained from the hospital administrator to use the secondary data for this study. Consent of cooperation was obtained from record room workers. Because of the anonymous and retrospective nature of the study, the need for informed consent was waived and therefore no written consent from the child or parent was required. To keep confidentiality, the names and medical record numbers of the participants were not registered in the data collection tool. Generally, the study was performed per the Declaration of Helsinki.

Conflicts of interest

All contributing authors declare no conflicts of interest.

References

1. Scher MS, Dokianakis SG, Steppe DA, Banks DL, Sclabassi RJ. Computer classification of state in healthy preterm neonates. *Sleep*. 1997;20: 132–141.
2. Hassen M, Toma A, Tesfay M, et al. Radiologic diagnosis and hospitalization among children with severe community acquired pneumonia: a prospective cohort study. *Biomed Res Int*. 2019;2019:6202405.
3. Fact Sheet: World Pneumonia Day. The Forum of International Respiratory Societies. 2019. https://goldcopd.org/world-pneumonia-day/. Accessed February 24, 2022.
4. UNICEF DATA. Pneumonia in Children Statistics. https://data.unicef.org/topic/child-health/pneumonia/. Accessed January 15, 2022.
5. Basnet S, Sharma A, Mathisen M, et al. Predictors of duration and treatment failure of severe pneumonia in hospitalized young Nepalese children. *PLoS One*. 2015;10:e0122052.
6. Hyderabad PH. Outcome predictors of severe and very severe pneumonia in children between 2 and 59 months of age admitted in a tertiary care hospital. *Indian J Child Health*. 2017;4:39–43.
7. Sulley S, Ndanga M. Pediatric pneumonia: an analysis of cost & outcome influencers in the United States. *Int J Pediatr Adolesc Med*. 2019;6: 79–86.
8. Nunes SEA, Minamisava R, Vieira MADS, et al. Hospitalization costs of severe bacterial pneumonia in children: comparative analysis considering different costing methods. *Einstein (Sao Paulo)*. 2017;15:212–219.
9. Zhang S, Sammon PM, King I, et al. Cost of management of severe pneumonia in young children: systematic analysis. *J Glob Health*. 2016;6:010408.
10. Bozzani FM, Arnold M, Colbourn T, et al. Measurement and valuation of health providers' time for the management of childhood pneumonia in rural Malawi: an empirical study. *BMC Health Serv Res*. 2016;16:314.
11. Ayieko P, Akumu AO, Griffiths UK, English M. The economic burden of inpatient paediatric care in Kenya: household and provider costs for treatment of pneumonia, malaria and meningitis. *Cost Eff Resour Alloc*. 2009;7:3.
12. Tiewsoh K, Lodha R, Pandey RM, Broor S, Kalaivani M, Kabra SK. Factors determining the outcome of children hospitalized with severe pneumonia. *BMC Pediatr*. 2009;9:15.
13. Kuti BP, Adegoke SA, Oyelami OA, Ota MO. Predictors of prolonged hospitalisation in childhood pneumonia in a rural health centre. *S Afr J Child Health*. 2014;8:11–15.
14. Tsegaw H, Yimam M, Nureye D, Woldeselassie W, Hambisa S. Predictors of treatment outcomes among pediatric patients hospitalized with pneumonia in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. *Adv Pharmacol Pharm Sci*. 2021;2021:6690622.
15. Tirore LL, Abame DE, Sedoro T, et al. Time to recovery from severe pneumonia and its predictors among children 2-59 months of age admitted to pediatric ward of Nigist Eleni Mohammed memorial comprehensive specialized hospital, Hossana, Ethiopia: retrospective cohort study. *Pediatr Health Med Ther*. 2021;12:347–357.
16. Assfaw T, Yenew C, Alemu K, Sisay W, Geletaw T. Time-to-recovery from severe pneumonia and its

determinants among children under-five admitted to university of Gondar comprehensive specialized hospital in Ethiopia: a retrospective follow-up study; 2015-2020. *Pediatr Health Med Ther*. 2021;12:189–196.
17. Mengist B, Tesfa M, Kassie B. Time to recovery and predictors of severe community-acquired pneumonia among pediatric patients in Debre Markos referral hospital, North West Ethiopia: a retrospective follow-up study. *PLoS One*. 2020;15:e0239655.
18. Caggiano S, Ullmann N, De Vitis E, et al. Factors that negatively affect the prognosis of pediatric community-acquired pneumonia in district hospital in Tanzania. *Int J Mol Sci*. 2017;18:623.
19. Esubalew H, Messelu MA, Tarekegn BT, Admasu AT, Abrha NN, Terefe B. Time to full enteral feeding and its predictors among very low birth weight (VLBW) neonates admitted to the neonatal intensive care units (NICU) in comprehensive specialized hospitals in Northwest Ethiopia. *BMC Pediatr*. 2024;24:366.
20. Zheng L, Liao W, Liang F, Li K, Li L, Liang H. Clinical characteristics and outcomes of severe pneumonia in children under 5 years old with and without adenovirus infection in Guangzhou. *Front Pediatr*. 2021;9:599500.
21. Ministry of Health, Federal Democratic Republic of Ethiopia (2015). Ethiopia: Health Sector Transformation Plan 2015/16 – 2019/20 (2008-2012 EFY). https://www.medbox.org/document/ethiopia-health-sector-transformation-plan-201516-201920-2008-2012-efy. Accessed January 15, 2022.
22. McAllister DA, Liu L, Shi T, et al. Global, regional, and national estimates of pneumonia morbidity and mortality in children younger than 5 years between 2000 and 2015: a systematic analysis. *Lancet Glob Health*. 2019;7:e47–e57.
23. Shebl EM, Said AM, El-Korashi LA, Ibraheem HA. The outcome of hospital-acquired pneumonia in patients admitted for long-term care according to the antibiotic duration. *Egypt J Chest Dis Tuberc*. 2019;68:378–382.