Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Time To Recovery And Its Predictors Among Severe Community Acquired Pneumonia Patients Admitted To Pediatric Ward, Debre-markos Referral Hospital, North West Ethiopia, Retrospective Follow-up Study, 2019

Belayneh Mengist Mitiku (belaynehmengist2008@gmail.com)

Research article

Keywords: pediatrics, predictors, severe community acquired pneumonia and time to recovery

Posted Date: August 30th, 2019

DOI: https://doi.org/10.21203/rs.2.12085/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

TIME TO RECOVERY AND ITS PREDICTORS AMONG SEVERE COMMUNITY ACQUIRED PNEUMONIA PATIENTS ADMITTED TO PEDIATRIC WARD, DEBRE-MARKOS REFERRAL HOSPITAL, NORTH WEST ETHIOPIA, RETROSPECTIVE FOLLOW-UP STUDY, 2019.

- BELAYNEH MENGIST*, belaynehmengist2008@gmail.com,
- MULUGETA TESFA*
- BEKALU KASSIE**

ABSTRACT

Background- Globally, pneumonia is a major cause of morbidity and mortality among children which affects 151.8 million each year. It leads over 156 million episodes and 14.9 million hospitalizations per year. Besides this fact, the recovery time and predictors of children's hospitalization related to severe community acquired pneumonia is not well known.

Objective-The aim of this study was to estimate the median time to recovery and its predictors among severe community acquired pneumonia patients admitted to pediatric ward, Debre Markos Referral Hospital, North West Ethiopia.

Methods- An institution based retrospective follow up study was employed among 352 records of children who were admitted starting from January 2016 to December, 2018. Patients chart were retrieved using a structured data extraction tool. Data was entered using Epi-Data version 3.02 and analyzed using STATA version 14 statistical software. The Kaplan Meier survival curve and log rank tests were used. Cox proportional hazard model assumption and model fitness were checked. Stratified Cox regression was fitted as a final model. Hazard ratio with its 95% confidence interval was used and P-value < 0.05 was considered as statistically significant association.

Result- The overall median recovery time was 4 days IQR (3-7). Recovery rate from severe community acquired pneumonia was 16.25 (95 % CI: 14.54–18.15) per 100 person day observation. Age (AHR; 0.94 95% CI (0.90-0.98)), being stunted (AHR; 0.62 95% CI (0.43-0.91)), presence of danger sign at admission (AHR; 0.61 95% CI ((0.40-0.94)), late presentation to seek care (AHR; 0.64 95% CI (0.47-0.88)) and co-morbidity (AHR; 0.45 95% CI ((0.45(0.35-0.58)) were significant predictors of recovery time.

Conclusion: The median recovery time from severe community acquired pneumonia was long. Measures to reduce recovery time should be strengthened.

Key words:-pediatrics, predictors, severe community acquired pneumonia and time to recovery.

Background

Pneumonia is defined as an inflammation of parenchymal tissues of the lung, such as the alveoli and the bronchioles(1). It is a form of acute respiratory tract infection (ARTI) that affects the lungs. During normal breathing, small sacs in the lungs called alveoli fill with air. When children contract pneumonia the alveoli fill with pus and fluid, restricting breathing and making it painful (2). It is a common infection of the lungs affecting millions of people worldwide. WHO has defined pneumonia solely on the basis of clinical findings obtained by visual inspection and on timing of the respiratory rate(3).

Pneumonias can be classified based on the type of agent causing the infection, distribution of the infection and setting in which it occurs(1, 4). The etiologic agents of pneumonia could be infectious or non infectious agents. There are over 30 micro-organisms that cause pneumonia, including several types of bacteria, viruses and fungi. Streptococcus pneumoniae is the most common cause of bacterial pneumonia in children, followed by Haemophilus influenzae type b (Hib). Respiratory syncytial virus is the most common viral cause of pneumonia (2, 5).

Commonly pneumonias classified as community-acquired and hospital-acquired (nosocomial) pneumonia. Community-acquired pneumonia (CAP) is an infection that begins outside the hospital or is diagnosed within 48 hours after admission to the hospital in a person who has not resided in a long-term care facility for 14 days or more before admission(6). Hospital-acquired pneumonia is pneumonia that occurs more than 48 hours after admission and without any antecedent signs of infection at the time of hospital admission(7).

CAP is an acute lower respiratory tract infection (LRTI) acquired from the community, with fever, cough, dyspnea, tachypnea, and pleural chest pain as typical symptoms(8). It is the most common type of pneumonia and generally presents as an acute infection, with symptoms appearing over the course of hours or days and diagnosed clinically(9).

Although pneumonia is highly treatable in most patients, it can be a serious medical condition requiring hospitalization and become life-threatening(5). CAP is a leading infectious disease requiring hospital admission and constitutes a major burden on health care resources(9).

Clinical factors of an illness at admission affect the prognosis of pediatric pneumonia. A study conducted on risk factors for a poor outcome among children admitted with clinically severe pneumonia to a university hospital in Rabat, Morocco showed that impaired consciousness, cyanosis and pallor were independent risk factors for an adverse outcome (10).

Another study noted that as median time of clinical stability increases, the severity of pneumonia also increases significantly (11). A prospective observational study on Severity of Pneumonia in under-five children also showed that length of hospitalization days varied for children with hypoxemia and without hypoxemia (12). The type of drug prescribed for SCAP patients had significant effect on the recovery time of the disease (13).

Pneumonia is a major cause of morbidity and mortality of children globally in general and among low income countries in particular. Studies were conducted on the prevalence, associated factors and determinants of pneumonia among under-five children (6). However, those studies were conducted mainly among under-five children and did not determine the predictors of recovery time. Recovery time and its predictors of children's hospitalization related to severe community acquired pneumonia is not well known. Determining up-to-date predictors of recovery time and period of hospitalization by including children whose age is under-15 is crucial. Therefore, this study was conducted to fill such information gap particularly in Debre Markos where no similar study was conducted yet.

Objective

General objective

- To estimate median recovery time and its predictors from severe community acquired pneumonia among patients admitted to pediatric ward, Debre Markos Referral Hospital, North West Ethiopia 2019.

Specific objectives

- To estimate the median recovery time from severe community acquired pneumonia.
- To identify predictors of recovery time from severe community acquired pneumonia.

Methods

Study design

Institution based retrospective follow up study was employed.

Study area and period

This study was conducted at Debre Markos referral hospital which is the only referral hospital in East Gojjam zone and found in Debre Markos, the town of the administrative Zone. According to information obtained from administrative office of the hospital, it serves for more than 3.5 million populations in its catchment area. The hospital provides service for children less than 15 years in separate ward of pediatrics. In this hospital, children with severe community acquired pneumonia are admitted in pediatric ward and further diagnose and treatment provided by pediatricians, general practitioners and nurses.

The study was conducted from 1st of January 2016 to December 31, 2018 among children who were admitted with SCAP and children's registration chart was retrieved from March 15 to 30, 2019.

Population

Source population

All children admitted at the hospital by severe community acquired pneumonia during the study period.

Study population

All children admitted at the hospital by severe community acquired pneumonia whose charts were available during data collection time.

Eligibility criteria

Inclusion criteria

The inclusion criteria was children who were from 1month to 15 years and admitted at pediatric ward by severe community acquired pneumonia during the study period.

Exclusion criteria

The exclusion criterion was children who were admitted at the hospital with incomplete medical records which were required as predictor.

Sample size determination and procedure

Sample size determination

- To determine sample size various predictors significantly associated with the outcome variable were considered. Accordingly sample size was determined using double population proportion formula by considering major predictors based on the study conducted in Kersa district, South West Ethiopia(6) using the Kelsey formula in Epi info version 7 Statistical software.

$$N_{Kelsey} = \frac{\left(z_{\alpha/2} + z_{\beta}\right)^2 p(1-p)(r+1)}{r(p_0 - p_1)^2}, \qquad p = \frac{p_0 + r p_1}{r+1}$$

- ✓ P1: proportion of exposed with outcome
- ✓ P2: proportion of non exposed with outcome
- ✓ Z α/2: by taking 95% confidence level
- ✓ Zβ:80% power
- ✓ **r** is the ratio of exposed to non- exposed which is 1:1

Variables	**P1 (%)**	**P2 (%)**	**Sample size**
Non exclusive breast feeding	65	33	78
Wasting	62.6	43.9	224
Underweight	66.25	45.6	182
URTI in the last 2weeks	74.2	37	58
Child not received PCV	62.3	47.4	352

- ❖ By taking the largest, the final sample size for this study was 352.

Sampling procedure

The study participants were selected from the registration book. The medical records of children who were admitted by sever community acquired pneumonia between January1st, 2016 to December 31, 2018 were selected. A total of 793 children were recorded from registration book of which 721 complete cards were available. Then 352 cards were sampled using simple random sampling technique by computer-generating method. Finally, the selected medical charts were extracted.

Variable of the study

Dependent variable

- ✓ Time to recovery from severe community acquired pneumonia

Independent variables

- ✓ Age of children
- ✓ Sex of children
- ✓ Residence
- ✓ Presence of concomitant disease (co-morbidity)
- ✓ Nutritional status of children (stunting, wasting, underweight)
- ✓ Time elapsed to seek care (duration)
- ✓ History of previous ARTI
- ✓ Vaccination status of children
- ✓ Health insurance
- ✓ Clinical presentation during admission/danger sign (impaired consciousness, abnormal body movement, vomiting everything)
- ✓ Breast feeding
- ✓ Drug regimen

Operational definitions

- **Recovery**-children discharged/ declared by the clinician as improved from an illness.
- **Event-** recovery from an illness during the study period.
- **Survival time-** defined as the time starting from the date of admission to recovery as a result of improvement due to SCAP determined for each participant.
- **Censored–**children referred, died or discharged for any reason without recovery during the study period.
- **Pediatrics-**children whose age is above 1month and below 15 years.

Data collection procedure

The patient records were first observed and appropriate data extraction format was prepared in English. Data collectors used the data collection tool to collect the information from children's charts. Charts were retrieved using the children's registration number which was found in data base in the electronic system and the data clerks of the hospital were also support them by identifying the charts.

Data collection tool

A structured data extraction tool was developed by considering study variables such as socio-demographic, nutritional, and clinical predictors from patients chart.

Data quality assurance

Data were collected from patients' charts by two experienced BSC nurses who were working in the pediatric ward. Pretest was done in the hospital on 5% of charts and modification of checklist was made. One supervisor was closely supervising the entire data collection process. One day training was given for both data collectors and supervisor concerning the data collection tool and data collection process. Data quality was also assured by designing proper data abstraction tool and through continuous supervision. All collected data were checked for completeness and clarity by data collector and supervisor every day.

Data processing and analysis

Data were entered using Epi-Data version 3.02 and analysis was done using STATA Version14 statistical software. Data were cleaned and edited before analysis. The collected data were described in terms of central tendency (median) and dispersion (IQR), in frequency distribution and graphically for categorical data.

Days were used as time scale to calculate time to recovery. The outcome of each participant was dichotomized into censored or event (recovered). Life table was used to estimate cumulative survival probabilities after admission. Kaplan Meier survival curve and log rank test were used to describe the survival function. Bivariable Cox-proportional hazards regression model was fitted for each predictors. Those variables having p-value ≤ 0.25 in the bivariable analysis were selected. Moreover, further variable selection was undertaken using stepwise backward variable selection approach. Cox proportional hazard model assumption was checked for each covariate. Proportionality hazard assumption was tested using schoenfeld residuals tests, graphically using log-log plot of survival and time dependant test using (tvc) command. Stratified Cox regression model with no-interaction was employed as the final model for the study. Hazard ratio with its 95% confidence interval and p-values was used to measure strength of association and to identify statistical significant result. P-value < 0.05 was considered as statistically significant association.

Ethical consideration

Ethical issues within the study were taken into consideration when carrying out the study. Ethical clearance was obtained from ethical review committee of Debre Markos University, College of Health sciences. A formal letter was submitted to Debre Markos referral Hospital and permission was assured. To keep the confidentiality, all collected data was coded and locked in a separate room before entered in to the computer. After entered to the computer the data was locked by password, names and medical registration numbers were not included in data collection format and the data was not disclosed to any person other than principal investigator. All information collected from patient cards was kept strictly confidential and names of patients were not included in the checklist.

Result

Socio-Demographic Characteristics

A total of 793 severe community acquired pneumonia patients were admitted at pediatric ward of Debre Markos Referral Hospital during the study period. Of which 352 children were included in the study. Of this study participants 185(52.56%) were males and 171 (48.58%) were younger than 1 year at enrolment. The median age of the participants was 1.17 years IQR (0.67, 2.17). Half of the study participants were came from rural residence and 254(72.16%) children were not member of social health insurance.

Table 1: Socio-demographic characteristics of severe community acquired pneumonia patients in Debre Markos Referral Hospital, North West Ethiopia, 2016 to 2018.

Variable	**Frequency** (n=352)	**Percent**
Age (years)		
<1	171	48.58
1-5	150	46.61
5-14	31	8.81
Sex		
Male	185	52.56
Female	167	47.44
Residence		
Rural	176	50
Urban	176	50
Insurance		
Insured	98	27.84
Not insured	254	72.16

Base line nutritional status

Majority of children 308(87.5%) fed breast for the first six months exclusively. From the overall study participants, 21(5.97%), 15(4.26) and 14(3.98%) of them were categorized under severe underweight, severe stunting and severe wasting respectively. Of the study participants 65.6%, 27% and 7.4% were fully vaccinated, partially vaccinated and non-vaccinated respectively. .

Clinical characteristics

Of the study participants 73% of children sought care within five days of an illness and (65.1%) of children had past history of acute respiratory tract infection. Two third (68.5%) of children were febrile at admission of which 24.43% had high grade fever. Of all study participants, 9.09% of them developed danger signs such as loss of consciousness, abnormal body of movement and vomiting everything at admission.

Among children admitted due to SCAP, half (50.57%) of them had co-morbidity. The most frequent co-morbidities were hyper active air way disease (39.9%), acute gastro enteritis (20.22%) and tuberculosis (11.23%) of which 15 (8.4%) of children had more than one co-morbidities at admission.

Treatment regimen and outcome

Of all children who were treated as an inpatient, more than half (59.66%) received Crystalline penicillin followed by ceftriaxon (33.24%) and only (7.1%) of children treated by ampicilin with gentamicin. Majority of children (89%) recovered from their illness and 2.27% were died **(figure2).**

Table 2: Base line clinical characteristics of severe community acquired pneumonia patients in Debre Markos Referral Hospital, North West Ethiopia, 2016 to 2018.

Variable	**Frequency**(n=352)	**Percent**
Days elapsed prior to seeking care (days)		
≤5(early presenters)	259	73.58
>5(late presenters)	93	26.42
Past history of ARTI		
No	229	65.06
Yes	123	34.94
Danger sign		
No	320	90.91
Yes	32	9.09
Co-morbidity		
No	174	49.43
Yes	178	50.57
Types of co-morbidity(n=178)*		
Highly Active Air way Disease	71	39.88
Acute Gastro-enteritis	36	20.22
TB	20	11.23
Pertusis	13	7.3
Retro Viral Infection	12	6.74
Meningitis	12	6.74
Congestive Heart Failure	12	6.74
Anemia	10	5.61
Others	7	3.94
Drug regimen		
Crystalline penicillin	210	59.66
Ceftriaxon	117	33.24
Ampicillin&gentamicin	25	7.10

*Multiple response possible

Survival status and incidence rate

Of 352 study participants 313 children develop event and the rest 39 children were censored observations. The lowest and the highest length of follow-up were 1 and 34 days respectively and the total person time risk was 1923. The overall recovery rate from SCAP was16.25 per 100 person day (95 % CI: 14.54–18.15) observation. The recovery rate among male and female children was 14.64 per 100 person day (95 % CI: 12.52–17.12) and 18.26 per 100 person day (95 % CI: 15.61–21.37) respectively.

Comparison of Survival time

Log-Rank test was used to compare survival time between categories of different predictors. Based on this test, survival time among different groups of predictors such as age, sex, insurance status, residence, nutritional status and other baseline clinical and therapeutic characteristics were significantly different in survival time at 5% level of significant.

Median time to recovery

An estimated median time to recovery from SCAP for all observations was 4 days IQR (3-7). Median recovery time of children from SCAP varied among various categories of socio-demographic predictors. For instance, the median recovery time of under one and one to five years children was 4 days where as above five years children was 7 days. The median recovery times of male and female children were 5 and 4 days respectively.

Table 3: Median time to recovery and comparison of survival time among SCAP patients by Socio-demographic characteristics, DMRH, North West Ethiopia, 2016 to 2018.

Variable	Frequency (n=352)	Median recovery time Point estimate(95%CI)	Log rank x^2 value(df)	p-value
Age (years				
<1	171	4(4-5)	16.93(2)	0.0002
1-5	150	4(3-4)		
5-14	31	7(6-8)		
Sex				
Male	185	5(4-5)	7.37(1)	0.0066
Female	167	4(3-4)		
Residence				
Rural	176	5(4-5)	24.73(1)	<0.0001
Urban	176	4(3-4)		
Insurance				
Insured	98	6(4-7)	20.28 (1)	<0.0001
Not insured	254	4		

- Df- degree of freedom

Median recovery time of children from SCAP was different regarding different categories of nutritional and clinical characteristics. Under weight children had recovery time of 5 days which is somewhat higher than normal weighted one which is 4. Median recovery time of children admitted with dander sign was 8 days where as 4 days for those SCAP patient admitted without danger sign.

Table 4: Median time to recovery and comparison of survival time among SCAP patients by nutritional and clinical characteristics, DMRH, North West Ethiopia, 2016 to 2018.

Variable	Frequency (n=352)	Median recovery time Point estimate(95%CI)	Log rank x^2 value(df)	p-value
WFA				
Normal	277	4	27.65(1)	<0.0001
Under wt.	75	5(4-8)		
HFA				
Normal	297	4	28.75(1)	<0.0001
Stunting	55	6(5-10)		
WFH				
Normal	294	4	17.46(1)	<0.0001
Wasting	58	6(5-7)		
Duration (days)				
≤5(early presenters)	259	4(3-4)	53.99(1)	<0.0001
>5(late presenters)	93	6(5-8)		
Past history of ARTI				
No	229	4	12.97(1)	0.0003
Yes	123	5(4-6)		
Danger sign				
No	320	4	15.05(1)	0.0001
Yes	32	8(5-12)		
Co-morbidity				
No	174	3(3-4)	74.28(1)	<0.0001
Yes	178	6(5-7)		
Drug regimen				
Crystalline penicillin	210	4(3-4)	41.11(2)	<0.0001
Ceftriaxon	117	4(4-5)		
Ampicillin&gentamicin	25	11(7-18)		

- WFH -Weight forage, HFA-Height for age, WFH-Weight for height
- Df- degree of freedom

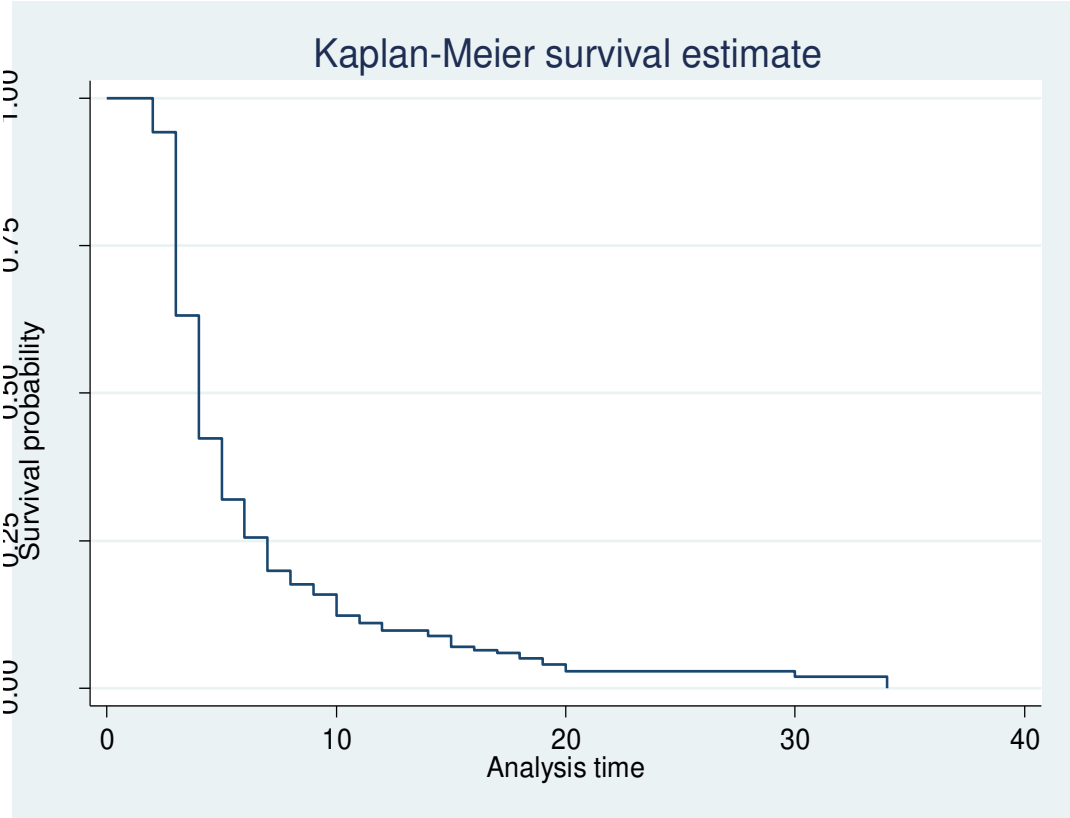


Figure 1 : Kaplan-Meier survival estimate of recovery time among children with SCAP admitted to Debre Markos referral hospital, 2016 to 2018.

As we see from figure, survival curve tend to decrease rapidly within the first ten days indicating that most children recovered from the disease within this time.

Predictors of recovery time from SCAP

Predictors which had association at p-value of 0.25 in bivariable Cox regression were included in multivariable Cox regression. Age, sex, stunting, vaccination status, duration prior to seeking care, danger sign associated with SCAP, co-morbidity and drug regimen were selected through stepwise backward elimination approach at 25% level of significance. In the final stratified Cox regression model seven predictors were analyzed and five predictors (age, stunting, duration of seeking care, and danger sign at admission and co-morbidity) became statistically significant predictors of recovery time from SCAP at 0.05 level of significance.

Predictor drug regimen violates proportional hazard assumption and the Cox-Snell residual suggests that Cox proportional hazard model does not fit the data adequately. Therefore extension of Cox proportional hazard model is required for this data. Since predictors were tested as not time dependent, stratified Cox regression model is adequate to be used.

Checking no-interaction assumption

- Log likelihood for non interaction model = -1303.997
- Log likelihood for interaction model = -1299.84

Likelihood ratio (*LR*) test which compares log-likelihood statistics for the interaction model and the no-interaction model.

LR=-2Log likelihood for non interaction model (reduced model) - 2Log likelihood for interaction model (full model).

This *LR* test statistic has approximately a chi-square distribution under the null hypothesis that the no-interaction model is correct. The degree of freedom here is 7 because there are seven product terms being tested in the interaction model. The log-likelihood statistic for the reduced model (no-interaction model) = −2 x-1303.997= 2607.995 and the log-likelihood statistic for the full model (interaction model) = −2 x -1299.84= 2599.68. The *LR* statistic is therefore 2607.995- 2599.68, which equals 8.315.When this value is compared with tabulated chi square value (14.067), it is not statistically significant at 0.05 level with 7 degrees of freedom. Thus, no-interaction model is acceptable for these data. Therefore, stratified Cox regression with no interaction model based on drug regimen as the stratified variable and seven predictors which hold proportional hazard assumption was carried out.

Table 5: Stratified Cox regression model stratified by drug regimen.

Covariate	AHR(95%CI)	P- value
Age (years)	0.94(0.90-0.98	0.016*
Sex		
Male	1	
Female	1.23(0.98-1.55)	0.071
Stunting		
No	1	
Yes	0.62(0.43-0.91)	0.016*
Vaccination status		
None vaccinated	1	
Partially vaccinated	1.22(0.73-2.03)	0.43
Fully vaccinated	1.52(0.93-2.5)	0.09
Duration (days)		
≤5(early presenters)	1	
>5(late presenters	0.64(0.47-0.88)	0.007*
Danger sign		
No	1	
Yes	0.61(0.40-0.94)	0.025*
Co-morbidity		
No	1	
Yes	0.45(0.35-0.58)	< 0.001*

* Statistically significant at 0.05

From the stratified Cox regression model five predictors became statistically significant at 0.05 level of significant.

- Age was an independent socio-demographic predictor. For a unit increase in age, the rate of recovery early from SCAP decreased by 6% (AHR; 0.94, 95% CI (0.90-0.98)).
- Nutritional status of children was seen in the analysis. The recovery rate of stunted children from SCAP decreased by 38% as compared to none stunted(AHR; 0.62, 95% CI (0.43-0.91)).
- the rate of recovery among children who sought care after five days of an illness decreased by 36% as compared to their counter parts (AHR; 0.64, 95% CI (0.47-0.88)).
- The recovery rate of children who were admitted with danger sign reduced by 39% than those admitted without danger sign (AHR; 0.61, 95% CI ((0.40-0.94)).
- Co-morbidity was an independent predictor of recovery time from SCAP among pediatrics. The rate of recovery among children admitted with co-morbidity decreased by 55% as compared to those children who had not co-morbidity at admission (AHR; 0.45, 95% CI ((0.45(0.35-0.58)).

Discussion

The overall median recovery time from SCAP was 4 days. In a study conducted in South West part of Ethiopia at Jimma, the duration of hospital stay was less than 3 for 76% of children which is almost consistent with what was observed in this study(14). The finding of this study is almost similar with the study conducted in rural health center of Gambia which reported that the mean time of recovery was 4.5 days(15). The finding of this study is higher than the study done in Vanderbilt (2.3days) and Nepal (2days) (11, 16). This variation might be due to socio-economic difference in the study areas. This finding is lower than the study finding in Poland on trends in hospitalization of children with bacterial pneumonia that reported 10.1 to 8.2 days (17). This discrepancy might be due to the time difference in which the studies were conducted. As it was conducted from 2007 to 2011, different things such as treatment protocol which could reduce hospitalization period have been done after it. Another possible reason for this inconsistency might be related to differences in treatment and caring practices, health care settings and other socioeconomic factors between areas where the studies were conducted.

In this study, age of children is an important socio-demographic predictor that has a significant effect on the recovery time of SCAP patients. This study indicated that younger children recover sooner than older ones. This finding is in line with the study conducted on time to clinical stability among hospitalized children which reported higher hospital stay among children above five years than below(11). The current finding is also supported by study conducted in Italy on Prediction of delayed recovery from pediatric community-acquired pneumonia (18). This finding is not consistent with other study findings (16, 17). Study on the trend of hospitalization of children revealed that the longest and the shortest hospital stay was recorded among younger and older children respectively (17). Similar study conducted in Nepal also showed that as age increase recovery time from an illness also increased (16). This discrepancy might be due to difference in age group of children as the studies included under-six and under-three year's children. Other possible reason of such contradiction could be as a result of variation in base line clinical conditions and treatment protocols in the study areas.

Nutritional status of children who were admitted to the hospital due to SCAP has been investigated in the study. Stunting is significantly associated with the recovery time from the disease. Stunted children recover from the disease slower in compression to normal children. This is due to the fact that

nutrition is an important component for the overall metabolic process of the body and recovery from an illness as well. Malnutrition magnifies the effect of disease and cause more severe disease episodes, complications and spends more time ill(19). Under-nutrition is often associated with depressed immune system of children and consequently worsen prognosis of disease and prone to difficultly to recover(20).

The other predictor that has a significant effect in the median time to recovery from SCAP is danger sign at admission like of loss of consciousness. The rate of recovery from SCAP was lower among patients who had danger sign at admission. This finding is in line with other studies (15, 16). This is because of the effect of severity of the disease. Danger signs are severity indicators of a disease. As disease becomes severe, the required time to recover from the disease becomes too long due to the pathophysiologic state of the disease (1).

Duration prior to seeking care is an independent significant predictor for recovery time of pneumonia. Children who presented to the hospital early (before five days of an illness) recovered sooner than those children presented lately. This finding is consistence with a prospective study conducted in Gambia(15). This is due to the fact that as progression of disease increased, the required time to recover from it also increase.

The other important predictor which was significantly associated with recovery time from SCAP is the presence of concomitant disease. In this study Hyper active airway disease (HAAD), acute gastroenteritis (AGE), pertussis, tuberculosis, HIV/AIDS, meningitis and other diseases were considered as a co-morbid disease with SCAP. Children who were admitted in the hospital with co-morbidity recover slowly as compared to children who were admitted without co-morbidity. This finding is in line with other study (15). This is due to the fact that when children acquired different illnesses at a time, they take prolonged time of recovery. This may associated with decrease in immune system of children. Co-morbidity might lead to poor adherence of prescribed drugs due to pill burden which could cause prolonged hospitalization of children.

As the study was conducted retrospectively by reviewing patients chart, the study failed to include all variables particularly parental socio-demographic, socio-economic and environmental characteristics which could be potential predictors of the outcome variable.

Conclusion

This study assessed median time to recovery from SCAP and potential predictors. The median time to recovery from SCAP was long according to British Thoracic Society (BTS) guidelines for the management of SCAP. Age of children, stunting, danger sign at admission, duration prior to seek care and co-morbidity were statistically significant predictors of recovery time from the disease in the final stratified Cox regression model. However, sex, residence, vaccination status and previous history of ARTI were not associated statistically with the recovery time.

Measures to reduce recovery time from the disease should be strengthened. Parents or care takers shall take their children to health facility immediately when they become ill. Health care providers should give due attention for children with the identified predictors while treating them. Further study using prospective design by including other parental variables which did not included in this study is advised to fill its limitation.

Abbreviations

AHR: Adjusted Hazard Ratio, AOR: Adjusted Odds Ratio, ARTI: Acute Respiratory Tract Infection, CI: Confidence Interval, DMRH: Debre Markos Referral Hospital, EDHS: Ethiopia Demographic and Health Survey, HIV: Human Immune Virus, IMNCI: Integrated Management of Neonatal and Childhood Illness, ICCM: Integrated Community Case Management, IQR: Inter Quartile Range, PCV: Pneumococcal Conjugated Vaccine, SCAP: Severe Community Acquired Pneumonia, SDG: Sustainable Development Goals.

Acknowledgements

We would like to thank Debre Markos University and Debre Markos referral hospital administrators and staff for their cooperation.

Funding

No fund was obtained for this study.

Availability of data and materials

The datasets used for this study are available from the corresponding author on reasonable request.

Authors' contributions

BM participated in the design of the study, acquisition of data, carried out the statistical analysis and drafted the manuscript. MT and BK reviewed all the drafts, participated in critical review and editing of all the manuscript drafts. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical approval and clearance was obtained from Ethical Review Committee from Debre Markos University. Permission to conduct the study was obtained from Debre Markos referral hospital prior to data collection.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Author details

*Department of Public Health, College of Health Sciences, Debre Markos University, Debre Markos, Ethiopia.

**Department of Midwifery, College of Health Sciences, Debre Markos University, Debre Markos, Ethiopia.

References

1. C.M P. Essentials of Pathophysiology: Concepts of altered health states. (second edn). Wolters Kluwer Health Lippincott Williams & Wilkins. 2009:pp.360-3.

2. UNICEF One is too many Ending child deaths from pneumonia and diarrhoea report,New York. November 2016.

3. Nicholas J. B. JD. Pediatric pneumonia. Steele RW, editor: Medscape; 2018.

4. Tessema T. Modelling Under-Five Mortality among Hospitalized Pneumonia Patients in Hawassa City, Ethiopia: A Cross-ClassifiedMultilevel Analysis. Ann Data Sci. 2018;5(2):111-32.

5. Chow S. Pneumonia Classification from Wikipedia, the free encyclopedia. I. 2018.

6. Ewnetu H. DG, Fasil T. Determinants of Community Acquired Pneumonia among Children in Kersa District, Southwest Ethiopia: Facility Based Case Control Study. Journal of Pediatrics & Neonatal Care. 2016;5(2).

7. Kieninger AN, Lipsett PA. Hospital-acquired pneumonia: pathophysiology, diagnosis, and treatment. The Surgical clinics of North America. 2009;89(2):439-61, ix.

8. Karhu J. Sever community acquired pneumonia studies on imaging ,etiology,treatment and outcome among intensive care patients. University of Oulu. 2014.

9. Cajetan C. Onyedum JCC. Admission profile and management of community acquired pneumonia in Nigeria-5 year experience in a tertiary hospital. respiratory medicine. 2011;105:298-302.

10. Jroundi I, Mahraoui C, Benmessaoud R, Moraleda C, Tligui H, Seffar M, et al. Risk factors for a poor outcome among children admitted with clinically severe pneumonia to a university hospital in Rabat, Morocco. International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases. 2014;28:164-70.

11. Rachel B. W. KE, Carlos G. G., Wesley H. S., Yuwei Z., James C., Anna B., Seema J. and Derek J. W. Time to clinical stability among children hospitalized with pneumonia. Journal of hospital medicine. 2015;10(6):380-3.

12. Benet T, Picot VS, Awasthi S, Pandey N, Bavdekar A, Kawade A, et al. Severity of Pneumonia in Under 5-Year-Old Children from Developing Countries: A Multicenter, Prospective, Observational Study. The American journal of tropical medicine and hygiene. 2017;97(1):68-76.

13. Don M, Valent F, Canciani M, Korppi M. Prediction of delayed recovery from pediatric community-acquired pneumonia. Italian journal of pediatrics. 2010;36:51.
14. Firaol B. MS, Javed A. Q., Abhay K., A Shariff, Tabarak M. Factors associated with outcomes of severe pneumonia in children aged 2 months to 59 months at jimma university specialized hospital, southwest Ethiopia. Curr Pediatr Res 2017;21 (3)(0971-9032):447-54.

15. Kuti BP BP, Adegoke S A SA, Oyelami O A OA, Ota M O MO. Predictors of prolonged hospitalisation in childhood pneumonia in a rural health centre. South African Journal of Child Health. 2014;8(1):11.
16. Basnet S., Sharma A., Mathisen M., Shrestha P. S., Ghimire R. K., Shrestha DM, et al. Predictors of duration and treatment failure of severe pneumonia in hospitalized young Nepalese children. PloS one. 2015;10(3):e0122052.
17. M. G, K. L, Scheres J., Albrecht P., P. G. Trends in Hospitalization of Children with Bacterial Pneumonia in Poland. Central European journal of public health. 2016;24(3):188-92.
18. Don M. VF, Canciani M., Korppi M. Prediction of delayed recovery from pediatric community-acquired pneumonia. Italian journal of pediatrics. 2010;36:51.
19. Fenn B. Malnutrition in Humanitarian Emergencies. London school of hygien and tropical medicine. 2009.

20. Blössner M, de Onis, Mercedes. Malnutrition: quantifying the health impact at national and local levels. Geneva, World Health Organization, 2005. (WHO, Environmental Burden of Disease Series, No 12).

Figures

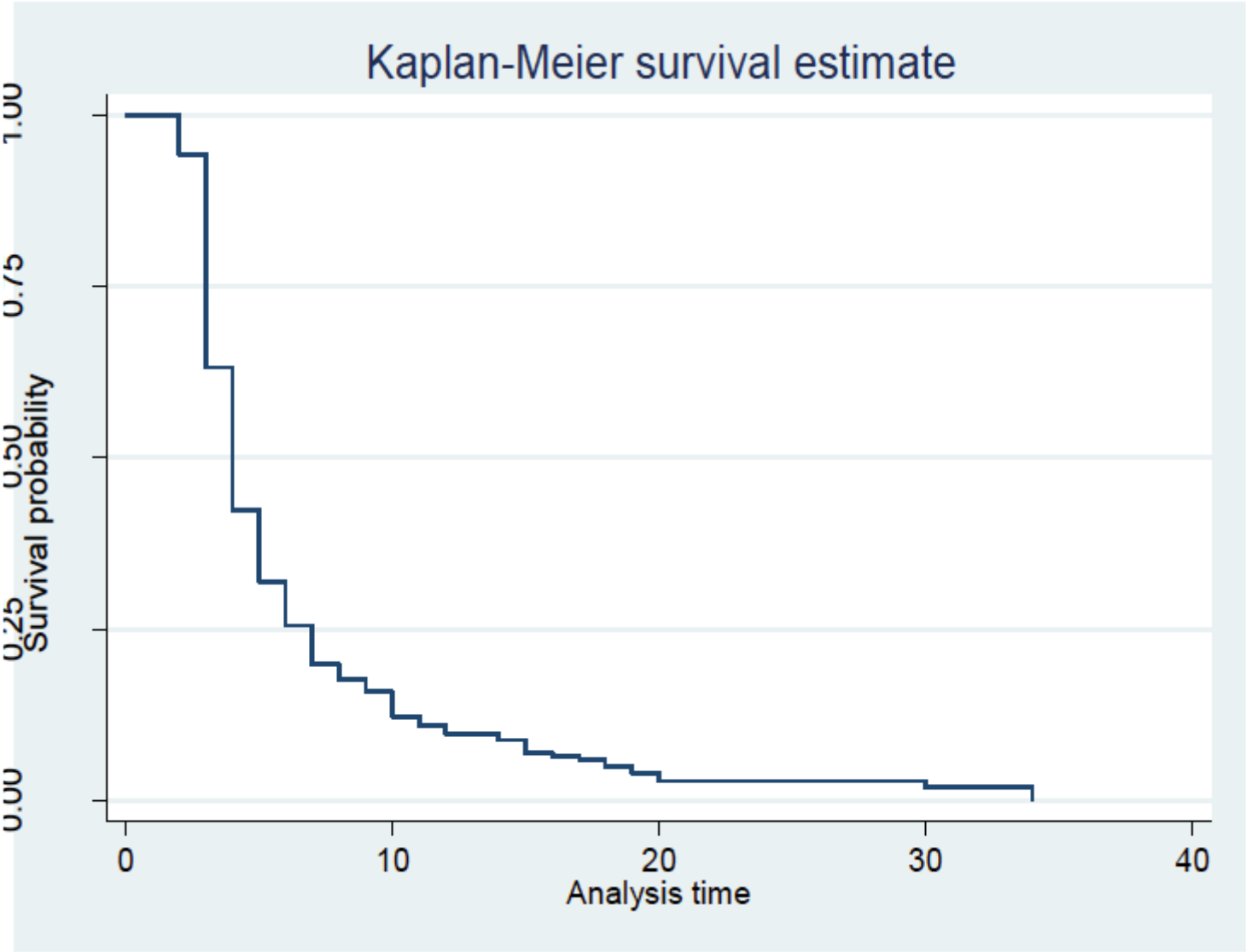


Figure 1

Kaplan-Meier survival estimate of recovery time among children with SCAP admitted to Debre Markos referral hospital, 2016 to 2018. As we see from figure, survival curve tend to decrease rapidly within the first ten days indicating that most children recovered from the disease within this time.