
**COLLEGE OF HEALTH SCIENCE**

**SCHOOL OF NURSING AND MIDWIFERY**

**DEPARTMENT OF NURSING**

# TIME TO RECOVERY FROM SEVERE COMMUNITY ACQUIRED PNEUMONIA AND ITS PREDICTORS AMONG PEDIATRICS PATIENTS IN SELECTED HOSPITALS, ADDIS ABABA, ETHIOPIA, 2021.

**BY: KALKIDAN MEKONNEN (BSC)**

**A RESEARCH PAPER TO BE SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCE, SCHOOL OF NURSING AND MIDWIFERY FOR PARTIAL-FULFILLMENT OF THE REQUIREMENTS FOR A MASTER'S OF SCIENCEIN PEDIATRICS AND CHILD HEALTH NURSING.**

**MAY, 2021**

**ADDIS ABABA, ETHIOPIA**


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**MAY, 2021**

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# APPROVAL SHEET

## APPROVAL BY THE REVIEW BOARD

This thesis by Kalkidan Mekonnen (BSc nurse) is accepted in its present form by board of examiners as satisfying thesis requirement for the degree of masters in pediatrics and child health nursing.

**EXAMINER**

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# ACRONYMS AND ABBREVIATIONS

ARTI Acute respiratory tract infection

BSCBachelor of Science

CAP Community-acquired pneumonia

CCAP Complicated community-acquired pneumonia

CHD Congenital heart disease

ETB Ethiopian birr

HAAD Hyper active airway disease

HMIS Health management information system

IQR Interquartile range

SCAP Severe community-acquired pneumonia

SAM Severe acute malnutrition

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## Abstract

**Background:**Community-acquired pneumonia is an important cause of morbidity in developed countries and an important cause of morbidity and mortality in developing countries. Ethiopia is ranked sixth out of 15 countries with the highest death rate due to pneumonia among children under five.

**Objective**: The aim of this study was to determine the median time to recover from severe community acquired pneumonia and its predictors among pediatric patients in selected hospitals, Addis Ababa, Ethiopia, 2021.

**Methods:** Institution based retrospective cohort study was conducted among407 pediatrics patients who were admitted with severe community acquired pneumonia in selected public hospitals in Addis Ababa. A systematic random sampling method was used to select eligible medical records. A structured checklist was used to collect data. Epi data version 4.2 was used to enter the dataand analyzed using STATA Version 16.0. The survival function and each predictor were described using the Kaplan Meier survival curve and the log-rank test.

**Result:**Out of the 407 selected medical charts, 388 of them found to be complete with a response rate of 95.5%. The overall median recovery time was 6 days.The rate of recovery from severe community-acquired pneumonia was 11.5 per 100 person day observation. Predictors significantly associated with recovery time include Age, being stunted, late presentation to seek care and co-morbidity

**Conclusion and recommendation:** The total recovery rate from severe community-acquired pneumonia was low and the median recovery time was long. Younger age and early presentation to the health care institution were proven to hasten recovery time.Therefore, measures thatincrease recovery rate and hasten recovery time should be strengthened.



**Keywords**: - Time to recovery, severe community acquired pneumonia, pediatrics

# 1. INTRODUCTION

## 1.1. Background

Pneumonia is an acute respiratory tract infection which primarily affects parenchymal tissues of the lungs. It is one of a major cause of morbidity and mortality in children which leads to over 156 million incidents and 14.9 million hospital admissions every year globally (1). It is an important cause of morbidity in developed countries and a significant cause of morbidity and mortality in developing countries as well(1,2).

The world health Organization (WHO) estimates that approximately 2 million children under the age of 5 years die due to pneumonia each year in the world. The majority of these deaths occur in developing countries. In contrast, the mortality rate in developed countries is less than 1 per 1000 per year(2).

Community acquired pneumonia (CAP) is an infection that starts before the person reaches the hospital and diagnosed within the first 48 hours of admission in a person who has not been previously hospitalized for 14 days or more (1). On the other hand, hospital-acquired pneumonia occurs after 48 hours of admission with no previous signs of infection by the time of admission. CAP is one of the leading infectious diseasesthat require hospital admission and it has been creating a major burden on health care resources and It is known as the most common inflammation of the lungs that affects millions of people worldwide (2,3).

Community-acquired pneumonia can be either bacterial or viral. But the leading cause of infection in all age groups is Streptococcus pneumoniae and it is known for being themost common bacterial cause of severe pneumonia in children across developing countries. The common viral causes of community-acquired pneumonia comprise respiratory syncytial virus, influenza virus, Para influenza virus and adenovirus. Bacterial pneumonia results in severe illness in children causing high fever and fast breathing. Whereas viral infections often come on gradually and might worsen over time(4). It is defined and classified using clinical signs by world health organization in 2014 and categorized as pneumonia and severe pneumonia(4,5).

Severe Pneumonia in a child age 2–59 months is defined as cough and/or difficult breathing,vomit everything, not able to drink or feed, convulsions, lethargic or unconscious, stridor in a calm child (5).

Evidences noted that most of childhood pneumonia deaths are caused by severe pneumonia and management of these diseases requires early identification, appropriate referral and availability of good quality care. Yet in many resource limited settings, referral is difficult and often does not take place soon(6). World health organization also reviewed literatures with the goal of developing a simplified approach that could increase the number of children receiving correct treatment for pneumonia which in return hasten their recovery time. The managements includes advice on home therapy, antibiotics for home treatment and referral to a higherlevel health care center(5).

Effective management of pneumonia is not only about the ratio of children recovered,but also the time of recovery. This is why children who are admitted for treatment of SCAP should recover as soon as possible. Most of the time children with community-acquired pneumonia improves within the first 48 hours of antibiotic therapy (7).

## 1.2. Statement of the Problem

Even though pneumonia is highly treatable and curable in most patients, there comes a time when it turns to be a serious medical condition that requirelong hospitalization and become life threatening speciallyin children. To this day it is one of the leading causes of morbidity and mortality among children globally specially in developing countries. Despite the carrying out effective,affordable and safe interventions and reducing mortality from 4 million in 1981 1 million in 2013, pneumonia still causes nearly one-fifth of childhood deaths in the world. It is the single largest infectious cause of death in children worldwide by killing 808 694 children under the age of 5 in 2017, which accounts for 15% of all deaths of children under five years old (1,5).

Africa loses thousands of children due to Pneumonia each year. It causes around 750 000 child deaths per year in sub-Saharan African countries (8).A recent World Health Organizations estimation suggests that, two thirds of the deaths occur within the first year of life and more than 90% occur in the developing world. Pneumonia is most abundant in South Asia,India, Pakistan, China, and sub Saharan Africa including Ethiopia. In Ethiopia 90% of the deaths in children under-five years of age are caused by Pneumonia, diarrhea, malaria, measles and problems of the newborn and pneumonia is the preceding one among them (8,9). Despite the increasing availability of preventive vaccines, pneumonia is still one of the leading cause of morbidity and mortality in children worldwide and in developing countries including Ethiopia (10). Though Ethiopia reduced mortality among under 5 children by 71% over the last several decades (from 191 deaths per 1000 live births in 1990 to 55 deaths per 1000 live births in 2015), to this day pneumonia causes 15 deaths per 1000 live birthsand the country is the 6th from the top 15 countries in the world that accounts the highest morbidity and mortality from pneumonia(11).According to WHO estimation in 2016, pneumonia accounts for 16.4% of under-five mortality in Ethiopia(12).

Longer period of hospitalization is known to raise the risk of local and systemic infection, which can lead to complicated community-acquired pneumonia (CCAP). It is characterized by severe illness and a complicated disease condition by causing one or more of Para pneumonic effusion, empyema, necrotizing pneumonia and lung abscess (13).

The mortality rate in developed countries is less than 1 per 1000 per year. However whether fatal or not, Pneumonia impose a great economic and financial burden on health systems and families due to varied length of hospital stay and unknown time of recovery. Inpatient treatment program of SCAP has huge economic disadvantages either directly through medical expenses or indirectly through loss of working hours by parents of sick children (13).

According to estimates by the World Health Organization, individuals in Ethiopia privately pay at a 34% level for treatment of pneumonia. The remaining 66% is covered by the government, the demand of which varies by income group(14). The total medical costs of community-acquired pneumonia are directly related to the costs of hospital admission, length of stay and the time of recovery.

The down side of prolonged hospitalization of children due to pneumonia goes beyond the children themselves, but also the mothers/ caregivers, the family, the society and the county as a whole. When mothers or caregivers spend more time with children, the entire family will lose its labor and economic productivity causing many challenges for the rest of children's at home. These negative impacts of impatient management of SCAP become more pronounced if the length of stay is prolonged and time of recovery is unpredicted(6,14).

Many scholarshad conducted studies on associated factors, prevalence and determinants of pneumonia among children(9,12,13,15). Yet, majority of those studies were conducted specifically in under-five children and they didn't identify the predictors of recovery time. Hence, recovery period and its predictors among children under 15 admitted due to severe community-acquired pneumonia are not well known. To the best of my knowledge and as far as my literature search, there are only limitedstudies in Ethiopia that reportedthe estimated time of recovery and predictors of SCAP. The reason Addis Ababa was chosen for this study was because there is no research conducted in the city regarding recovery time and predictors of pneumonia and many patients from different part of the country come to the city for better treatment which make it more representative.Therefore, considering the importance of the problem and the knowledge gap, additional research is required to estimate the time of recovery and its predictors of SCAP inpediatrics patients.

# 2. LITERATURE REVIEW

## 2.1. Treatment outcome and median recovery time from SCAP

When a child is admitted with pneumonia, identification of severe and very severe pneumonia should be enrolled within the first 24 hours of admission according to the WHO criteria. The case definition of severe and very severe pneumonia included children presenting with cough with difficulty in respiration, having increased respiratory rate (children < 2 months; > 60/minute, 2–11 months, > 50 per minute and 13 to 60 months, > 40 per minute) with chest indrawing with or without inability to drink or cyanosis or peripheral oxygen saturation <90% (15).

The possible treatment outcome of children with SCAP is recovery, death or treatment failure. Complicated pneumonia is associated with high rates of mortality and severe morbidity.However, in children who were previously healthy, complete recovery is usually expected without permanent sequelae. Despite this favorable prognosis, SCAP may have a protracted clinical course requiring prolonged hospitalization,but this is highly variable, and some children recover within a few days of treatment.
A study conducted on the Predictors of Duration and Treatment Failure of Severe Pneumonia in Nepal estimates that the Median time till recovery was 49 hours while time till discharge was 97 hours (16). Another prospective observational cohort study conducted in New York shows that the median time to stability was 2 days and recovery time was 4 days.The study also estimated that, the median time to overall clinical stability was 3 days and the median length of hospital satay was 6 days(17).

A retrospective study conducted in Gonder shows that, the median time to recovery from pneumonia was 3 days and among all study participants, 120 (36.36%) recovered, 74 (22.42%) children had died, while 136 (41.21%) children were censored.The study also reported that, the chance of survival was higher on the first day after a serious pneumonia diagnosis, but it decreased as followup time increased(18).Another study conducted in Debere Markos showed that, the median time to recovery was 4 days and among 352 observations, 313 (88.9%) of children recovered from their illness while the remaining 39 (11.1%) children were censored

observations(1). According to a study conducted in at Jimma specialized hospital, among the 107 children, 94 (87.9%) were discharged in improved conditions, 5 (4.7%) died during hospitalization and 4 (3.7%) left hospital against medical advice. Discharge information was unknown for 4 (3.7%) cases(19).

## 2.2. Predictors for a variable length of stay in hospital

Despite the establishment of multiple associations between socio-demographic variables, some factors are considered to be associated with a variable length of hospitalization in children admitted with severe community acquired pneumonia. Among those factors, nutritional and immunization statusof the child, presence of danger sing and comorbid diseases at admission, duration of seeking care and the type of medication used for management were the most important predictors(1,4,16). Treatment outcome and time of recovery in Childhood pneumonia is greatly determined by clinical manifestations that are a result of the complex interaction between the host, the pathogen and environmental risk factors. The most common risk factors that affect the incidence, time of recovery and treatment outcome of childhood CAP in developing countries include malnutrition, low birth weight, non-exclusive breastfeeding, lack of immunization, indoor air pollution and overcrowding (20).

A cohort study conducted on time to recovery and predictors of SCAP in Ethiopia shows that, the median recovery time of children from SCAP varied among various categories of socio-demographic predictors. For instance, the median recovery time of children's below age of one year and those one to five years of age was 4 days while children above five years were 7 days.Another study conducted at Jimma specialized hospital also shows that,In terms of various categories of nutritional status and clinical features, the median recovery period of SCAP in children was different.When it comes to duration prior to seeking care the study reportedmajority of children stayed less than 5 days before hospital visit and the duration of hospital stay was less than 4 days (19).

### 2.2.1 Socio-demographic characteristics

Some evidences show that, there is astrong correlation between socio demographic factors and the time to recovery from SCAP. Evidences have showed that, age is an independent predictor of SCAP. A study conducted in Nepal also showed that, An increment in age by one month (1.04 times) faster time of recovery and the their chance of treatment failure decreased by 7times (16). Another study conducted on the prediction of delayed recovery from pediatric SCAP in rural health center of Gambia reveled that, of the six patients with delayed recovery, fever continued >48 hours in four >7-year-old children, and two 3-year-old girls >2 weeks in hospital were treated for empyema (6).

A study conducted in Poland on trends in hospitalization of children with bacterial pneumonia reported that, the longest stays were recorded for the youngest children, under 2 years of age (from almost 11 days in 2007 to around 9 days in 2011). Length of hospital stay of children from the older age groups, on the other hand, was much shorter (9.7 days for 6-year-olds in 2007 and 7.4 days for 4-year-olds in 2011).

A retrospective cohort study conducted in Italy shows that, longer duration of hospital stay was observed among children above five years than belowand after starting of antibiotics, fever lasted for >24 hours in (14.7 %) children aged <5 years compared to (41.7 %) children aged >5 years. The mean duration of fever after beginning antibiotics was 23.0 ± 19.2 hours, 15.6 ± 13.4 hours for <2 years, 18.9 ± 14.9 hours for 2-4 years and 31.2 ± 23.1 hours for <5 years of age) (7).

A study conducted in Debre Markos, Ethiopia reveled that, the median recovery time of children from SCAP varied among various categories of socio-demographic predictors. This study reported that younger ones recover faster than older children hence, the median recovery time of under one and one to five years of children was 4 days whereas above five years children were 7 days (1). Another retrospective study conducted in Goder in under 5 children reported that, For a unit increment in age (2–3years), the time to recover recent from severe pneumonia was increased by 1.32 times as compared to age less than or equal to one year.

### 2.2.2.Duration prior to seeking care

In light of the obstacles to accessing formal health care, there were delays seeking professional care for children with severe community pneumonia. Delay in seeking appropriate care and access to multiple sources for treatment are the underlying risk factors for prolonged hospitalization and delayed recovery in children with SCAP. Prompt care seeking and adequate management have been consistently recommended as key factors to reduce the global burden of child mortality due to pneumonia. Seeking timely care in a formal health facility is very important; however, for this to occur, parents or caregivers need to be able to identify the warning symptoms and signs of pneumonia.

According to a study conducted in rural health center of Gambia, Fifty-three (30.3%) of the 175 late presenters had a prolonged hospital stay and long median time of recovery compared with 52 (22.2%) of the remaining 245 who presented early(6). Another mixed method study also reported that, children with a prolonged duration of illness (2–10 days) prior to seeking care were at more risk for prolonged hospitalization and poor treatment outcome by pneumonia than those who presented early. According to this study, children who died from pneumonia sought treatment 3.4-time more than children who died from other causes. Delayed treatment seeking ($\geq$ 2 days) behavior was 4.9-time more common in children who died from pneumonia than those who died from other causes. Children who died from pneumonia more often had access to care from multiple sources (5.7-time) than children who died from other causes(21).

A retrospective cohort study conducted in Debere Markos revealed that, one of the predictors which were significantly associated with median time to recovery was duration prior to seeking care. The study reported that, the rate of early recovery among children who sought care after five days of illness decreased by 36% as compared to their counterparts (1).

### 2.2.3.Vaccination status and sunlight exposure

Pneumonia is an important cause of influenza-associated morbidity and mortality. Influenza vaccination has been shown to reduce morbidity and mortality during influenza seasons. Protection from severe pneumonia may contribute to the beneficial effect of influenza vaccination. Efforts to improve childhood survival have included increasing access to vaccines against Streptococcus pneumoniae and Haemophilus influenza(19).

A study conducted in Morocco reported that, out of 150 patients 62% had received PCV vaccine. Among vaccinated patients 5.33% patients had received two doses of PCV vaccine and 85 had one dose. Majority (88%) developed complications. Para pneumonic effusion (43.33%) followed by diarrhea (23.33%) were the commonest complication and six patients (4%) expired(22).A randomized controlled trial conducted in Delhi reported that those who took at least 2 doses of PCV had a 1.4 times faster recovery compared to groups who did not take vitamin D supplementation (23).

Regarding sunlight exposure, a study conducted in Nepalese children with severe pneumonia reported that, there was a significant association between sunlight exposure and prolonged hospitalization. According to this study Children who didn't get adequate sunlight exposure had an increased risk for treatment failure and a longer duration of hospitalization compared with their counterparts. They were also at higher risk for not showing signs of clinical improvement after 96 hours of admission(16).

### 2.2.4.Nutritional status of children and recovery time

Evidence has shown that infants who were not exclusively breastfed during the first six months of life had a threefold rise in the risk of pneumonia and delayed recovery relative to children who were exclusively breastfed. A study in India has revealed that, children diagnosed with SCAP who weren't exclusively breast feed, were more likely to fail to respond to a primary antibiotic regimen and require antibiotic changes and extended hospital stay(24).

Another study done among Nepalese children on predictors of duration and treatment failure of severe pneumonia revealed that, wasting (21%), hypoxia (38%) and presence of any danger sign (24%) were associated with slower recovery time. The study also showed that in community acquired pneumonia; wasted children were twice the risk of extended hospitalization than average children (16).

A Cohort Study in Kenya has also revealed that, severe Malnutrition is strongly associated with post-discharge mortality longer recovery time. Among the 1979 children with no SAM, a total of 14 (0.7%), 20 (1.0%), and 24 (1.2%) children died during months 3, 6, and 12 of follow-up, respectively. While 22 (7.3%), 32 (11%), and 46 (15%) children died within months 3, 6, and 12 respectively among SAM children (15). Another study conducted in Gambia noted that, Children with lethargy, edematous protein-energy malnutrition and those who were underweight and severely wasted at presentation were found to be 6 times and 2 times more likely to remain in the hospital longer than those without such characteristics respectively (6).

A retrospective cohort study conducted in Gonder specialized hospital reported that,compared to normal children, the time it took for wasting children to recover from severe community acquired pneumonia was 0.11. Additionally, compared to children of normal weight, the median time to recovery from pneumonia for underweight children was 2.2 times longer.The study also reported that, in comparison to children who were fed cow's milk to those who were breastfed, the time to recover from severe pneumonia was 2.4 times longer in cow's milk fed children(18). Additionally, the time to recovery of formula fed children from severe pneumonia was decreased by 0.32 times as compared to breastfed children. This indicates that the median time to recovery was reduced by 32%.Another study conducted in south Ethiopia also showed that there was significant association between nutritional status and duration of hospital stay. 6 out of 10 children hospitalized for 10 days were severely malnourished and 2 were malnourished. 13 children were hospitalized for more than 3 days and they were associated with moderate malnutrition (11). Another study conducted on the time to recovery and predictors of SCAP in Ethiopia show that, compared to those of non-stunted, the recovery rate of stunted children from SCAP decreased by 38 % (1).

### 2.2.5. Danger sign at admission

Prognosis and the length of hospitalization of pediatric pneumonia are affected by the clinical factors like severity of illness and presence of danger signs at the time of admission. A prospective observational cohort study conducted in New York reveled that, the median time of stabilization was 2 days for 385 patients with increased heart rate and for 7% of patients with lower systolic blood pressure on admission. Similarly among patient admitted with abnormalities of increased respiration rate, decreased oxygen saturation and elevated temperature, the median time to stabilization was 3 days. The study also shows that, among 8% of the patients who were admitted with altered mental status the median time to regain baseline mental status was 3 days (17).

A comprehensive study conducted inNew Delhi showed that, children with severe pneumonia who has head nodding (8.34) altered sensorium (5.44), abnormal leukocyte counts (5.85) and pallor (10.88) times more likely to have worse outcome decreased recovery rate (24). Another study conducted on risk factors for a poor outcome among children in morocco shows that, children's who were severely ill at the time of admission with higher temperature, increased heart rate and respiratory rate, and lower oxygen saturation will likely have worse outcome. The study also indicates that taking antibiotics before admission or having a known comorbid condition has a big influence on a worse outcome and extended hospital stay (10).

Another study conducted on Predictors of prolonged hospitalization in childhood Pneumonia in rural Gambia showed that, Children who had grunting respiration (32.5%) had a longer hospital stay relative to those children without grunting (21.7%). The study also shows that, children who presented with head nodding had are (1.929) times more likely to have prolonged hospital stay than those without head nodding (6). A prospective observational research done in under five children on the severity of pneumonia has also shown that, duration of hospitalization days in children who developed hypoxemia and those who have not developed hypoxemia is different (1,22). In another study Hypoxemia at admission was also substantially associated

with prolonged hospitalization in children with severe pneumonia (38.3% v. 21.8%) (6).

Another study also revealed that as the severity of pneumonia increases, the median time of recovery increases, as well.The study also noted that, increased disease severity is associated with increased median time to recovery and longer time of recovery (17). A study conducted on Predictors of prolonged hospitalization shows that, pneumonia that is confirmed by radiological examination was more frequent (32.9%) amongst children with a poor outcome and hospitalizations were significantly more prolonged in this group (9.96 days vs. 4.31 days) (6). Another cohort study conducted in Nepal reveled that, Radiographic pneumonia is a significant predictor of delayed recovery. The study also shows that presence of Para influenza virus in the nasopharynax was associated with earlier recovery (16).

A study conducted on time to recovery and predictors of pneumonia in Debre Markos shows that,the recovery rate of children admitted with danger sign was 39 % lower than those admitted without danger sign the study also shows that compared to their counterparts.Another retrospective cohort study also reported that compared to children admitted without severe signs and symptoms of pneumonia to those admitted with severe signs and symptoms, the median time to recovery increased by 3.88.This indicates that children admitted with severity sign and symptoms had longer median time of recovery than those admitted with no severity signs and symptoms(18).

### 2.2.6. Comorbid medical conditions before or after admission

Prognosis and the length of hospitalization of pediatric pneumonia is affected by the clinical factors like underlying comorbid illness and the development of medical complications before or after admission. According to a study conducted in Spain, the cause of prolonged hospitalization of patients with community-acquired pneumonia is multifactorial, depending mainly on pneumonia and comorbid conditions. The study also showed that, clinical factors associated with continued hospitalization included initial hypoxaemia, anemia, neoplastic disease and complications within 72 h after admission(25).

A study conducted on time to recovery and predictors of pneumonia in Debre Markos shows that compared to children who did not have co-morbidity at admission, the rate of recovery for children admitted with comorbidity decreased by 55%. According to this study, among children admitted due to SCAP, half (50.57%) of them had co-morbidity and about 4.3% of children had more than one co-morbidities at admission. The most frequent comorbidity was hyperactive airway disease(childhood asthma)followed by acute gastroenteritis and the rate of recovery for children who sought treatment after five days of illness dropped by 36 percent (1).

Another retrospective cohort study conducted in Gonder also reported that, Children who were admitted to the hospital without comorbidity lower recovery as compared to children who were admitted with comorbidity. According to this study, hyperactive airway disease (HAAD), pertussis, tuberculosis, HIV infection, DM were the most frequent comorbid diseases with severe community acquired pneumonia(18).According to a study conducted at Jimma specialized hospital, Majority of children stayed less than 5 days before hospital visit and the duration of hospital stay was less than 4 days for the majority of this children (19).

### 2.2.7. Treatment related factors

Studies have showed the type of drug regimen used to treat patients with severe community-acquired pneumonia (SCAP) had a significant influence on the recovery time of the disease. A trial done on the comparison of intravenous benzyl penicillin and oral amoxicillin for community acquired pneumonia in children reveled that, the median length of hospital stay was significantly shorter in the oral group (1.77days) than in the IV group (2.1 days) respectively and the median of the differences was found to be 0.60 days. The study also shows that the duration of oxygen requirement was significantly longer in the IV group than in the oral group(26).

Another prospective observational cohort study conducted in New York shows that, among 648 patients who were treated with parenteral antibiotics, the median day of discontinuing the therapy was 6 days. The median period between treatment

discontinuation (conversion of parenteral antibiotics to oral antibiotics) and clinical stability was 3 days, and the median time between treatment discontinuation (conversion of parenteral antibiotics to oral antibiotics) and discharge was 3 days (17).

Another study conducted on Predictors of prolonged hospitalization in childhood Pneumonia in Nigeria shows that, Intravenous ampicillin was more effective than oral amoxicillin or macrolide. The study reported that, fever in just 1 (4.8 %) lasted for more than 24 hours, compared to 19 (28.8 %) patients treated with amoxicillin or 2 (50.0 %) treated with macrolide (6). A study conducted inEthiopiarevealed that,crystalline penicillin was given tomore than half (59.66 %) of children who were treated as inpatients. Among those children 88.9% developed the outcome,5.11% withdrew their treatment,2.27% died and 3.69% were referred(1).

## Conceptual framework

The conceptual framework of this studyshows relationship of dependent variable (time to recovery) withindependent variables based on the review and synthesis of concepts from deferent literatures.

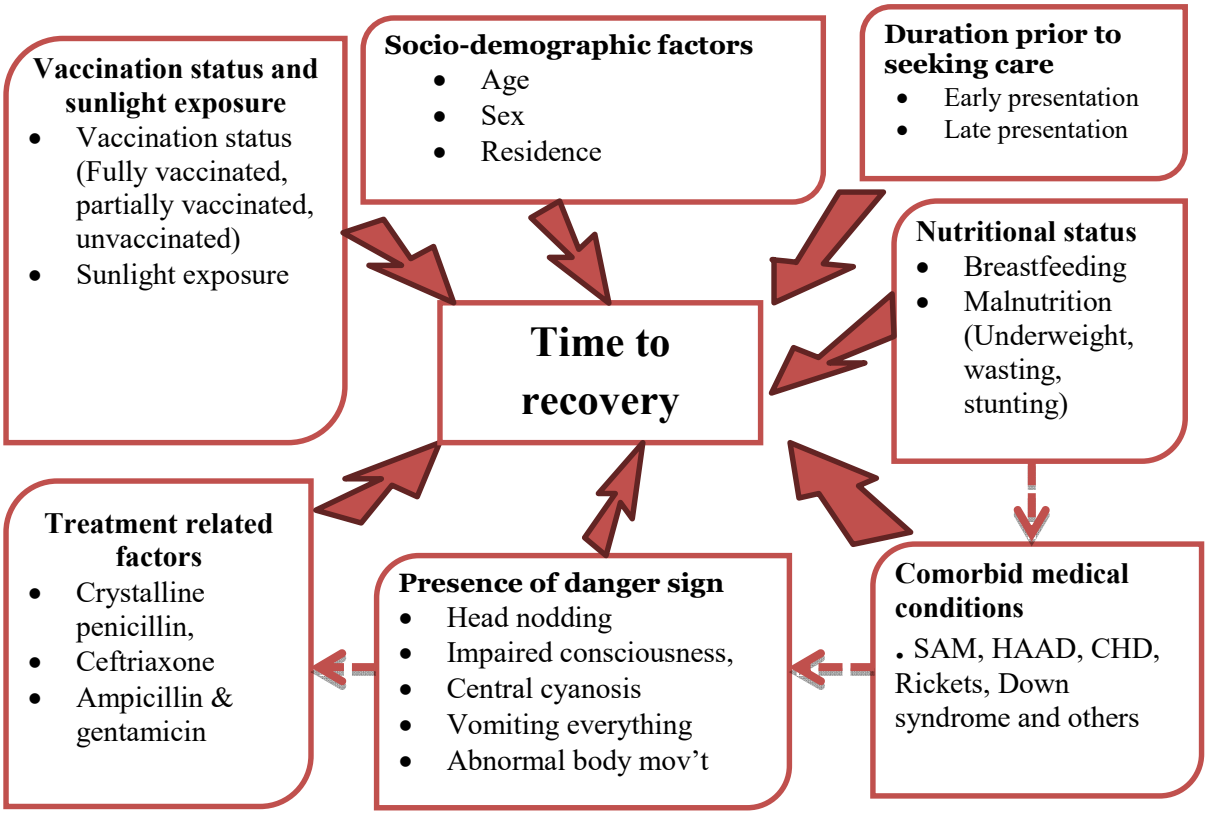


Figure 1: Conceptual frame that shows time to recovery from SCAP and predictors in Addis Ababa public hospitals, Ethiopia, 2021(1,6,7,17,27).

## Justification of the study

In countries like Ethiopia where little is spent on healthcare and hard priorities needed to be made, pneumonia killed thousands of children and remained the major cause of death in children.These deaths are easily preventable and treatable through simple and cost effective interventionswhen the length of hospitalization is estimated and predictors that affect time of recovery are well known.Even though several studies were conducted in different countries, these studies were undertaken specifically in under-five children to assess the magnitude, determinant and associated factors of pneumonia. On top of that, those studies focusedspecially in under-five children and there are only limited studies in Ethiopia that reported the estimated time of recovery and predictors of SCAP. Therefore, this study aims to provide valuable information about the median time of recovery and its predictors that can fill the knowledge gab.

## Significance of the Study

This study was done to estimate the time to recovery from SCAP and identify predictors of recovery time among children's who were admitted to selected hospitals in Addis Ababa. The reason the researcher is interested to conduct this study is because; the public burden of SCAP in children is increasing in developing countries like Ethiopia. Despite the interventions that have been done, it still causes huge economic burden due to long hospitalization to the family, the society and the country in general.This study will provide valuable information about the median time of recovery from severe community-acquired pneumonia and its predictors among patients who were admitted in the pediatric ward in selected hospitals at Addis Ababa, Ethiopia.

The input from the study will provide additional information to health care providers, on the choice of treatment in relation to recovery time and its predictors in harmony with the standard time of recovery from severe community acquired pneumonia. Additionally Early estimation of time of recovery in pediatric will offer them the opportunity to discuss the expected clinical course of disease with the parents and make informed decisions on treatment options. For policy makers, it will provide a baseline data to formulate guidelines; standards and strategies for updating the routine management of sever community acquired pneumonia for the purpose of speeding up recovery time from it. The hospital managers, can use it to design an interventional project towards improving SCAP management to shorten recovery time. Furthermore, information from this study will be used to update existing knowledge and skill of health care workers, pediatric and child health nurses in particular, regarding proper management of SCAP that shorten recovery time of children with SCAP in selected hospitals. And finally, the results from this study will serve as a base line data for further study.

# 3. OBJECTIVES

## 3.1. General objective

The general objective of this study was to determine the median time to recover from severe community acquired pneumonia and its predictors among pediatric patients in selected hospitals, Addis Ababa, Ethiopia, 2021.

## 3.2. Specific objectives were:

- To determine the median recovery time of children from severe community acquired pneumoniaamong pediatric patients in selected hospitals, Addis Ababa, Ethiopia, 2021.
- To identify predictorsaffecting recovery time from severe community acquired pneumoniaamong pediatric patients in selected hospitals, Addis Ababa, Ethiopia, 2021.

# 4. METHODS AND MATERIALS

## 4.1. Study Area and Period

The study was conducted in four randomly selected public hospitals of Addis Ababa Ethiopia from March 5 to March 30, 2021. Addis Ababa is the capital city of Ethiopia with population of 2,739,551 by the end of 2007 census(28). The city is divided into 11 sub-cities with 116 woredas at an altitude of 7,546 feet (2,300metres). The city has 12 hospitals run by the government. Five hospitals are operated by the Addis Ababa Health Bureau, 4 by the Federal Ministry of Health, 1 by the Ministry of Education (AAU), 2 by the Addis Ababa City Health Bureau's defense force. The study was conducted in Tikur Anbessa hospital, Menelik II hospital, Zewditu memorial hospital and Yekatit 12 hospital which were selected by lottery method.

## 4.2. Study design

Institution based retrospective cohort study was conducted.

## 4.3. Source Population

The source population comprised all under15 children with SCAP who were admitted for SCAP management and treated from January 1, 2018 to December 31, 2020 in public hospitals in Addis Ababa.

## 4.4. Study population

All randomly selected under 15 children's with SCAP who were admitted for SCAP management and treated in theselected four public hospitals of Addis Ababa from January 1, 2018 to December 31, 2020.

## 4.5. Inclusion and Exclusion criteria

### 4.5.1. Inclusion criteria

Children from 1 month to 15 years of age admitted to the pediatric ward from January 1, 2018 to December 31, 2020 with severe community-acquired pneumonia that is pneumonia with one of oxygen saturation <90% or central cyanosis or severe

respiratory distress or inability to drink or breastfeed or vomiting everything, altered consciousness, and convulsions during the study period were included in the inclusion criteria.

### 4.5.2. Exclusion criteria

The exclusion criterion was lost medical recordswhich weren't available at the time of data collection.

## 4.6. Sample size determination

By using a single proportion formula the total sample size was:-

$$n = \frac{(Z\ x/2)^2\ p\ (1\text{-}p)}{(d)^2}$$

Where:

n = the required sample size, P = the estimate of Recovery rate (assumed to be 16.25% as obtained from a retrospective study in Debere Markos city on time to recovery and predictors of SCAP among children (1)).d = margin of error (level of precision), taking 0.05. zx/2 = Standard normal variable at x/2 with confidence level of interval = (1.96)

$$n = \frac{(1.96)^2\ (0.1625)\ (1\text{-}0.1625)}{(0.05)^2} = 209$$

To determine sample a double population proportion formula was used by considering vaccination status as a major predictor based on the study conducted in Kersa district, South West Ethiopia (4) using the Kelsey formula in Epi info version 7 statistical package.

$$n_1 = \frac{\left[Z_{\frac{\alpha}{2}}\sqrt{\left(1 + \frac{1}{r}\right)P(1\quad P)} + Z_{\beta}\sqrt{\frac{p_1(1-p_1)+ r\, p_2(1-p_2)}{r}}\right]^2}{(p_1\quad p_2)^2}$$

Where:-

P1: the proportion of exposed (62.3%),

P2: the proportion of non exposed (47.4%),

ratio(1), power (80%) and 95% confidence level. The sample size for this study was 370.

By adding 10% for missing data, the final sample size was 407.

## 4.7. Sampling procedures

First, by using simple random sampling 4 hospitals were selected out of 12 public hospitals. The selected hospitals were(Tikur Anbessa, Menelik II, Zewditu memorial hospital and Yekatit 12 hospital). For record reviews, three consecutive years; 2020, 2019, and 2018 were chosen deliberately because they provide the latest data on the issue under investigation.Starting from the recent month backwards, based on the sequence of their card number, a systematic sampling procedure was used to select an adequate number of samples (patient charts) until the required sample size was obtained.During the three-year period, the total number of under-15 SCAP admissions was five thousand two hundred forty (5,240).By calculating the interval from the sampling frame, the total sample size for each year was proportionally allocatedN (Tikur Anbessa hospital, N=1272,Zewditu memorial hospital, N= 1583,Yekatit 12 hospitalN=1017 and Minelk II hospital N=1368) and sample size n (k=N/n). The interval(k=13) was similar for each hospital. The first chart to start with was selected randomly. Then, every $13^{th}$ medical chart within the three consecutive years was reviewed. When the $13^{th}$ chart is missed for some reason, the next $13^{th}$ chart was reviewed.

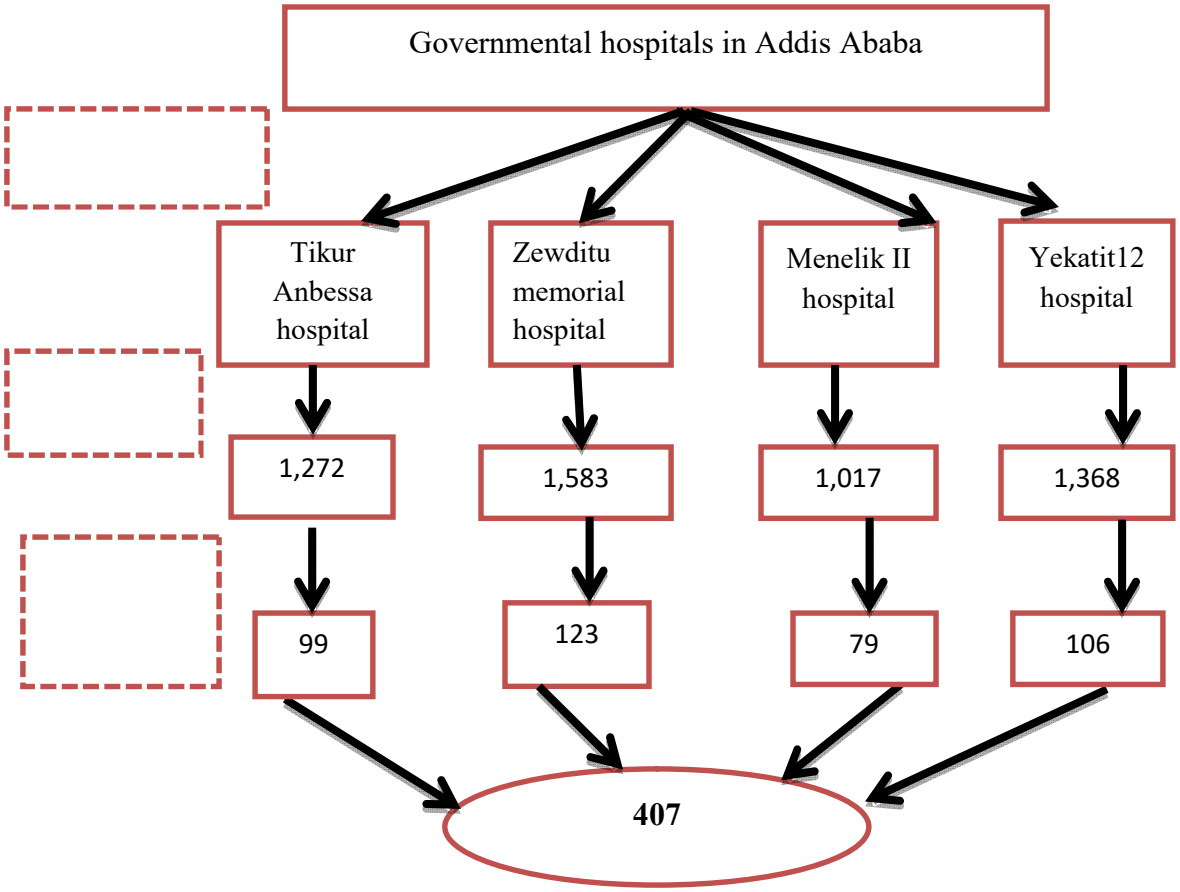


Figure 2: Schematic representation of sampling procedures of the study, Addis Ababa, Ethiopia, December 2021 G.C.

## 4.8. Variables

### 4.8.1. Dependent variable

Time to recovery from SCAP

### 4.8.2. Independent variables were:

Socio-demographic factors (Age of children, Sex of children)

Presence of co-morbid diseases

Nutritional status of children (stunting, wasting, underweight)

Presence of danger sign during admission/ (vomiting everything, abnormal body movement, impaired consciousness)

Time elapsed to seek care (duration)

Past history of ARTI

Breastfeeding

Immunization status of children

Drug regimen

## 4.9. Operational definitions

**Pediatrics:** refers tochildren from 1month to 15 years of age(1).

**Recovery:** children improved from SCAP as declared by the clinician(10).

**Event:** refers to recovery from an illness during the study period(6).

**Survival time:** refers to the time starting from the date of admission to recovery from SCAP determined for each participant(1).

**Censored:** referstochildren referred, died, or discharged for any reason without recovery during the study period(16).

**Danger sign:** if the child has loss of consciousness, abnormal body movement, vomiting everything, convulsions, and inability to feed in addition to SCAP(29).

**Co-morbidity:** if the child hadany disease condition (acute or chronic) present at admission in addition to SCAP which includes hyperactive airway disease (childhood asthma), severe acute malnutrition, congenital heart disease, congestive heart failure, rickets, down syndrome, retroviral infection, tuberculosis, acute gastroenteritis, pertussis, anemia, meningitis, measles, bronchitis, heart failure and others(1).

**Vaccination status:** full vaccination status was defined as children who had completed all forms of vaccinations; partially vaccinated (children who had taken at least one dose of PCV) and non-vaccinated (children who had never vaccinated PCV and other vaccines)(30).

**Severe community acquired pneumonia:**if the child acquired pneumonia before 48 hours of admission withoxygen saturation <90% or central cyanosis or severe respiratory distress or inability to drink or breastfeed or vomiting everything, altered consciousness and convulsions(5).

**Moderate acute malnutrition:** Z-scores of between -3SD and -2SD (31).

**Severe acute malnutrition:**Z-scores of -3SD and the presence of kwashiorkor (31).

**Early presentation:** refers toseeking medical care with in the first 5 days of illness (1).

**Late presentation:** refers to seeking medical care after 5 days of illness (1) .

## 4.10. Data Collection Procedure

### 4.10.1. Data collection tool

A data abstraction format was adopted from another peer reviewed article conducted in Ethiopia(1). Data abstraction was designed based on study objectives, and contains three parts; checklist related to socio-demographic information and base line nutritional and clinical informationwhich was collected from medical records.

### 4.10.2. Data collection procedure

All available information on patient records was checked. Then, appropriate data extractionformat was prepared in English in order to extract all the relevant variables to meet the study objectives from patient charts. The time from the diagnosed SCAP was the starting point for retrospective follow-up and the end point is the date of recovery, the date of lost to follow-up or the date of death. All SCAP charts admitted to the selected four hospitals from January 1, 2018 to December 31, 2020 were retrieved from the HMIS registration book. The records of all study participants were selected according to the eligibility criteria. Recovery was confirmed by discharge note complemented by registration and was identified by their medical record number.

Two BSC Nurse for supervision and four BSC Nurse for data collection were recruited. One day training was given to data collectors and supervisors regarding significance of the study and ways of data collection process. The supervisors monitor the data collection process.

## 4.11. Data quality Assurance

To ensure quality of the data, supervisor and data collectors was trained on how and whatinformation they should collect from the targeted data sources. Prior to data collection, data extraction formwere tested on 20 medical charts at TikurAnbessa hospital to ensure that the data abstraction format agrees with the needs of the study. Completeness of the collected data was checked onsite daily basis during data collection and give prompt feedback by the supervisor and the principal investigator.

During data management, storage, cleaning and review, all completed data collection forms werechecked for completeness and accuracy. The principal investigator examined consistency by selecting cards at random and comparing their similarity.

## 4.12. Data processing and analysis

Epi-Data version 3.02 Data was used for data entry and analysis was done using STATA Version 16.0 statistical software. Before analysis Data was cleaned and edited. The data were described in terms of central tendency (median) and dispersion (IQR), in frequency distribution, and graphically for categorical data. To calculate recovery time, days are used as a time scale. To estimate cumulative survival probabilities after admission, the life table was used.

Weight for height or length Z-score charts from the World Health Organizationwas used for the assessment of nutritional status of participants. Kaplan Meier survival curve and log-rank test was used to describe the survival function and for each predictor, the Bivariable Cox-proportional hazards regression model was adapted. Those variables in the bivariable analysis with a p-value of 0.25 were selected. Then, with a step by step backward variable selection technique using a p-value of 0.25 as a

cut point, further variable selection was carried out. For each covariate, Cox's proportional hazard assumption was checked using Schoenfeld residuals tests.

## 4.13. Ethical Considerations

Ethical clearance was obtained from the Institutional Review Board (IRB) of the School of Nursing and Midwifery of Addis Ababa Universityand Addis Ababa city public health research and emergency management directorate.After the approval of the proposal the letter was obtained from the school of nursing and midwifery to the selected hospitals, and then a written permission letter to access patient's charts was obtained from responsible body of each Institution.All information collected from patients' chart was kept strictly confidential and will not be revealed to any person other than principal investigator.

## 4.14. Dissemination of Results

The results of the study will be submitted to Addis Ababa University College of Health Science and Addis Ababa city public health research and emergency management directorate. The finding and recommendations will be distributed to all public hospitals, Addis Ababa city health bureau and other organizations working on related area to be used as a baseline for intervention.The result will be submitted to international or national peer reviewed journals for publication.

# 5. RESULT

## 5.1. Socio-demographic characteristics of the study participants

The study included records of under15 years children with the diagnosis of severe community acquired pneumonia admitted in three consecutive years (2018, 2019, and 2020) in selected governmental hospitals, Addis Ababa, Ethiopia. Out of the 407 selected medical charts, 388 of them found to be complete with a response rate of 95.5%. As it is illustrated in Table 1 more than half (57.73%) of themwere males and 346 (89.18%) of children were urban residents. The median age of the study participants was 11 month (Table1).

Table 1: Distribution of socio-demographic characteristics of children with SCAP admitted and treated in selected governmental hospital of Addis Ababa, Ethiopia from January 1, 2018 to December 30, 2020. (N=388)

| Variable | | Status | | Frequency |
|---|---|---|---|---|
| | | Recovered | Censored | (%) N=388 |
| **Age** | | 198(51.03%) | | 221(56.96) |
| | <1 | | 23(5.93%) | |
| | 1-5 | 146(37.63) | 9(2.32%) | 155(39.95) |
| | 5-14 | 11(2.84%) | 1(0.26%) | 12(3.09) |
| **Sex** | Male | 210(54.12%) | 14(3.61) | 224(57.73) |
| | Female | 145(37.37%) | 19(4.90%) | 164(42.27) |
| **Residence** | Urban | 318(81.96%) | 28(7.22%) | 346(89.18) |
| | Rural | 37(9.54%) | 5(1.29%) | 42(10.82) |

## 5.2. Baseline nutritional and vaccination status

For the first six months, the majority of the children (77.84%) were exclusively breastfed.To classify children's nutritional status, anthropometric measurements were compared to WHO child growth standards.From the overall study participants, 133(34%)of them were categorized under severe underweight,119(30.7) severe stunting and 120(30.9%)severe wasting. Regarding vaccination status 88.92 % were fully vaccinated and 11.08% partially vaccinated but there was nonon-vaccinated participant. Additionally, majority 339(87.4%) of the study participants were exposed to sunlight (Table 2).

Table 2: Distribution of baseline nutritional and vaccination status of pediatrics patients admitted with SCAP in selected governmental hospitals of Addis Ababa, Ethiopia from January 1, 2018 to December 30, 2020. (N=388)

| Variables | | Status | | Frequency (%) N=388 |
|---|---|---|---|---|
| | | Recovered | Censored | |
| **Exclusive Breastfeeding** | Yes | 279(71.91 %) | 23(5.93 %) | 302(77.8) |
| | No | 76(19.59 %) | 10(2.58 %) | 68 (22.2) |
| **Sunlight exposure** | Yes | 308(79.38) | 31(79.9%) | 399 (87.4) |
| | No | 47(12.11%) | 2(0.52%) | 49 (12.6) |
| **Vaccination status** | Fully vaccinated | 317(81.7%) | 28(7.22%) | 345(88.9) |
| | Partially vaccinated | 38(9.79%) | 5(1.29%) | 43(11.1) |
| **Weight for age** | Normal | 241(62.11%) | 14(3.61%) | 255(65.7) |
| | Under weight | 114(29.38%) | 19(4.90%) | 133(34.3) |
| **Height for age** | Normal | 251(64.69%) | 18(4.64%) | 269(69.3) |
| | Stunting | 104(26.80%) | 15(3.87%) | 119 (30.7) |
| **Weight for height** | Normal | 248(63.92%) | 20(5.15%) | 268 (69.1) |
| | Wasting | 107(27.58%) | 13(3.35%) | 120 (30.9) |

## 5.3. Clinical characteristics and drug regimen

At the time of admission,two third 261(67.2%) of children were febrile,with more than a quarter of them having a high-grade fever. Among all observations, 9.0% of them had danger signs at admission. With standard deviation of 12.9, the mean respiratory rate of children at admission was 56.5and non-invasive respiratory support was given for 362 (84%) children.Patients were treated with crystalline penicillin, Ceftriaxone, Ampicillin, Gentamicin, Vancomycin and Azitromycin. Of all children who were treated as an inpatient, majority 349(89.9%) of them received ceftriaxone and among those children who were treated with ceftriaxone, majority (82.99%) of them has recovered from their illness (Table 3).

Table 3: Clinical characteristics and drug regimen of pediatrics patients admitted with SCAP in selected governmental hospitals of Addis Ababa, Ethiopia from January 1, 2018 to December 30, 2020. (N=388)

| Variables | | Status | | Frequency (%) |
|---|---|---|---|---|
| | | Recovered | Censored | N=388 |
| **Duration (days)** | ≤ 5(Early presenters) | 280(72.16%) | 25(6.44%) | 305 (78.6) |
| | >5 Late presenters | 75(19.33%) | 8(2.06%) | 83(21.4) |
| **Past history of ARTI** | Yes | 153(39.43%) | 10(2.58%) | 163 (42) |
| | No | 202(52.06%) | 23(5.93%) | 225 (58) |
| **Oxygen saturation** | <90% | 251(64.69%) | 28(7.22%) | 279(71.9) |
| | >90% | 104(26.80%) | 5(1.29%) | 109(28.1) |
| **Fever** | Low grade fever | 167(43.04%) | 12(3.09%) | 179(46.1) |
| | High grade fever | 74(19.07%) | 8(2.06%) | 82(21.1) |
| **Danger sign** | Impaired consciousness | 5(14.29%) | 1(2.86%) | 6 (1.5) |
| | Central cyanosis | 3(8.57%) | 1(2.86%) | 4 (1.0) |
| | Vomiting everything | 3(8.57%) | 0(0%) | 3 (0.8) |
| | Abnormal body mov't | 16(45.71%) | 2(5.71%) | 18 (4.6) |
| | Head nodding | 2(5.71%) | 2(5.71%) | 4 (1.0) |
| **Drug regimen** | Crystalline penicillin | 2(0.52%) | 0(0%) | 2 (0.5) |
| | Ceftriaxone | 322(82.99%) | 27(6.96%) | 349(89.9) |
| | Ampicillin & gentamicin | 61(15.72%) | 14(3.61%) | 75 (19.3) |
| | Vancomycin | 30(7.73%) | 4(1.03%) | 34(8.8) |
| | Azitromycin | 37(9.54%) | 5(1.29%) | 42(10.8) |

## 5.4. Comorbid medical diseases before or after admission

Among children admitted due to SCAP, more than half (76%) of them had co-morbidity. Hyperactive airway disease (childhood asthma) was the most frequent comorbidity followed by severe acute malnutrition. Other medical conditions including moderate acute malnutrition, pertussis, tuberculosis, meningitis, HIV, congestive heart failure, Myelomeningocele, hydrocephalusand generalized developmental delay accounted 96(24.7%)(Table 4).

Table 4: Distribution of comorbid diseases among pediatrics patients admitted SCAP in selected governmental hospitals of Addis Ababa, Ethiopia from January 1, 2018 to December 30, 2020.(N=388)

| Variables | Status | | Frequency (%) N=388 |
|---|---|---|---|
| | Recovery | Censored | |
| **SAM** | 61(20.61%) | 14(4.73%) | 75 (19.3) |
| **Congenital heart diseases** | 52(17.57%) | 20(6.76%) | 72 (18.6) |
| **Anemia** | 25(8.45 | 4(1.35%) | 29 (7.5) |
| **Hyperactive airway disease** | 123(41.55%) | 7(2.36%) | 130 (33.5) |
| **Rickets** | 24(8.11%) | 1(0.34%) | 25 (6.4) |
| **Down syndrome** | 23(7.77%) | 7(2.36%) | 30(7.7) |
| **Others** | 78(26. 35%) | 18(7.05%) | 96(24.7) |

## 5.5. Treatment outcome and incidence rate of recovery fromSCAP

Majority of the study participants 355(91.5%) recovered from their illness, while17(4.4%) died, 10(2.6%) referred to other facilities and 6(1.5%) left against medical advice. The shortest and the longest length of hospital stay were 1 and 57 days and the total person-time risk was 3085. The overall rate of recovery was 11.5 per 100 person day(95% CI: 10.37-12.76).

## 5.6.Kaplan-Meir survival estimates for sever community acquired pneumonia recovery time

For all observations,the median time to recovery from sever community acquired pneumonia was 6 days IQR (4–10). The median recovery time for children with SCAP differed depending on the socio-demographic predictors. For example, children aged one to five years had a median recovery period of 5 days, while children aged under one and above five years had a recovery time of 7 and 6 days, respectively.On the other hand, the median time of recovery has no variation for both sexes.Regarding residence, children who resides in urban areas had a median recovery period of 6 days (95% CI: (5-6) and children who came from rural area 10 days (95% CI: (5-6).There was a substantial difference in median recovery time between children who had danger signs during admission 12 days(95% CI: 8-17)and those who did not6 days (95% CI: 5-6). For children who were exposed to sunlight, the median recovery time was 6 days, (95% CI: 5-6) which was significantly different compared to the other group 10 days, (95% CI: 7-12). Similarly, median time of recovery for fully vaccinated children was 6 days, (95% CI: 5-6) and 9 days, (95% CI: 7-12) for partially vaccinated children (Table 5).

Table 5: Kaplan-Meir survival estimates for sever acute community acquired pneumonia recovery time with different covariates in selected governmental hospitals of Addis Ababa, Ethiopia from January 1, 2018 to December 30, 2020.(N=388)

| Variables | Category | Median recovery time Point estimate(95%CI) | Log rank x2 value | p-value |
|---|---|---|---|---|
| **Age** | <1<br>1-5<br>5-15 | 7(6-7)<br>5(4-6)<br>6(3-12) | 8.33 | 0.0155 |
| **Sex** | Male<br>Female | 6(5-6)<br>6(5-7) | 0.85 | 0.3568 |
| **Residence** | Urban<br>Rural | 6(5-6)<br>10(6-24) | 3.45 | 0.0633 |
| **Exclusive breastfeeding** | Yes<br>No | 6(5-6)<br>7(6-9) | 4.28 | 0.0386 |
| **Vaccination status** | Fully vaccinated<br>Partially vaccinated | 6(5-6)<br>9(7-12) | 9.97 | 0.0016 |
| **Sunlight exposure** | Yes<br>No | 6(5-6)<br>10(7-12) | 9.17 | 0.0025 |
| **Weight for age** | Normal<br>Under weight | 5(5-6)<br>8(7-9) | 24.15 | 0.0000* |
| **Height for age** | Normal<br>Stunting | 5(5-6)<br>8(7-9) | 25.36 | 0.0000* |
| **Weight for height** | Normal<br>Wasting | 5(5-6)<br>8(6-9) | 8.15 | 0.0043 |
| **Duration** | ≤ 5days<br>>5 days | 6(5-6)<br>9(6-11) | 9.96 | 0.0016 |
| **Danger sign** | Yes<br>No | 12(8-17)<br>6(5-6) | 12.72 | 0.0004 |
| **Fever** | Normal<br>Low grade<br>High grade | 5(4-7)<br>6(5-7)<br>7(6-9) | 3.84 | 0.1464 |
| **Comorbidity** | Yes<br>No | 7(6-8)<br>4(4-8) | 33.68 | 0.0000* |

The Kaplan-Meier survival curve was used to estimate the survival status of children with SCAP. Within the first ten days, the curve has a tendency to decline rapidly, implying that most children recovered from their illness within this time frame(Figure 3). SCAP patients' survival estimates varied depending on their weight for age, height for age, and comorbidity.(Figure 4-6).

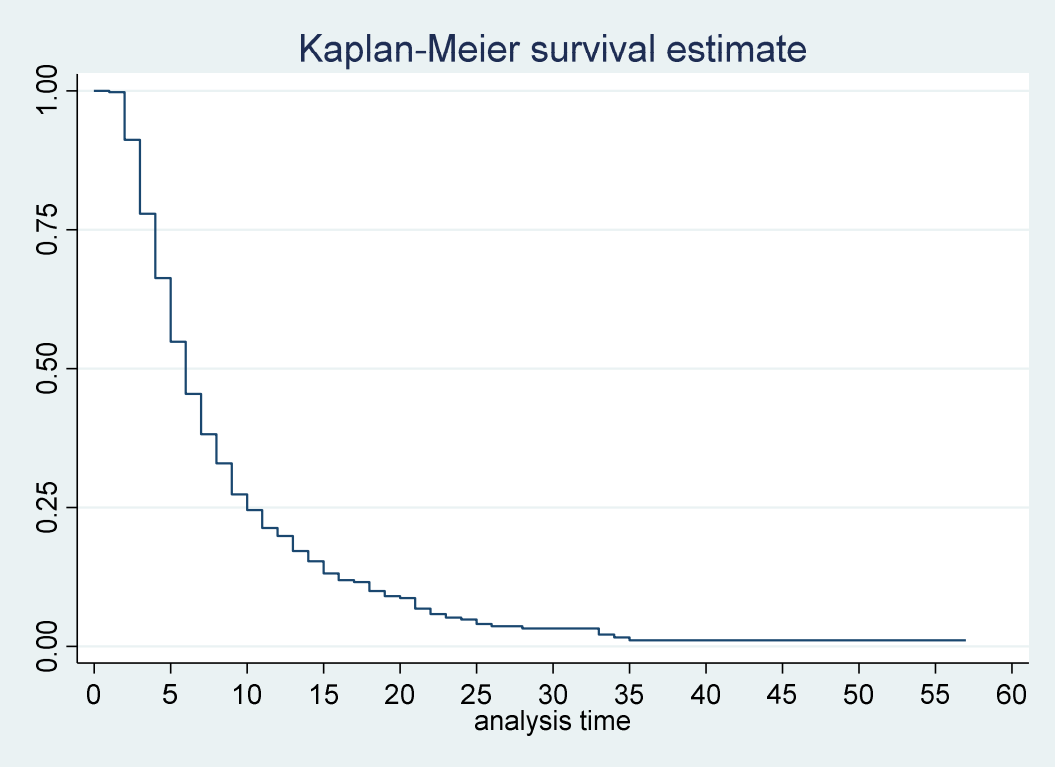


Figure 3: Overall Kaplan-Meier survival estimate of recovery time among children with SCAP admitted to governmental hospitals, 2018-2020, Addis Ababa, Ethiopia.

A significant recovery time difference has been observed between children, who are underweight 8 days, ((95% CI: 7-9)compared to their counter parts 5 days, (95% CI: 5-6)(Figure 4).Similarly, there was a significant difference in recovery time between stunted children and their counterparts 8days, (95% CI: 7-9) and 5 days, (95% CI: 5-6) respectively.This difference was statistically significant with p-value < 0.000(Figure 5).

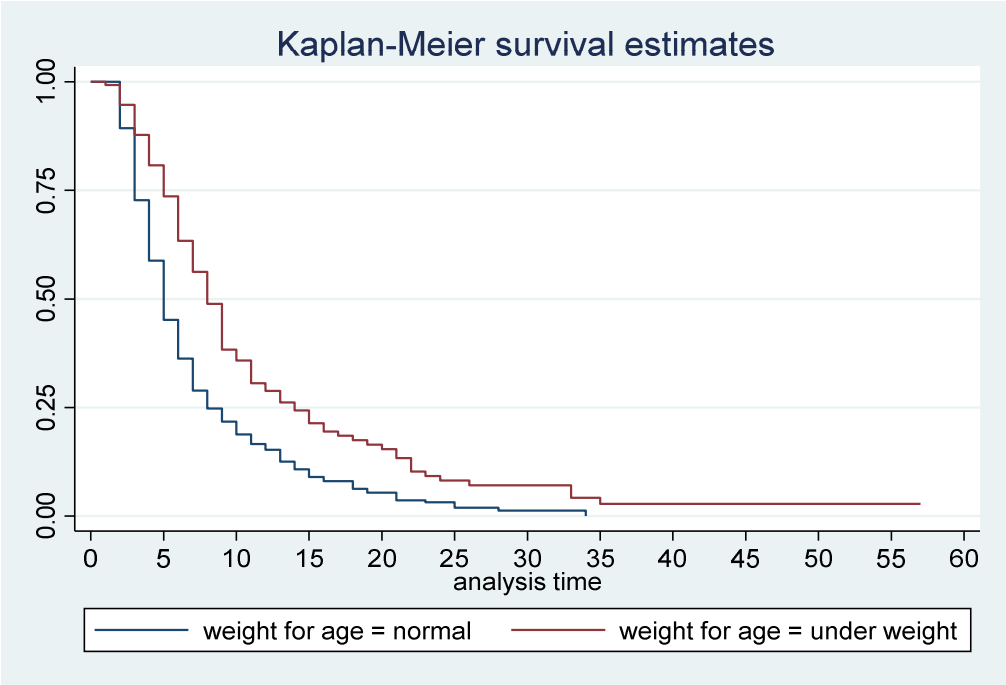


Figure 4: Kaplan-Meier survival estimate for time to recovery among SCAP children who are under weight.

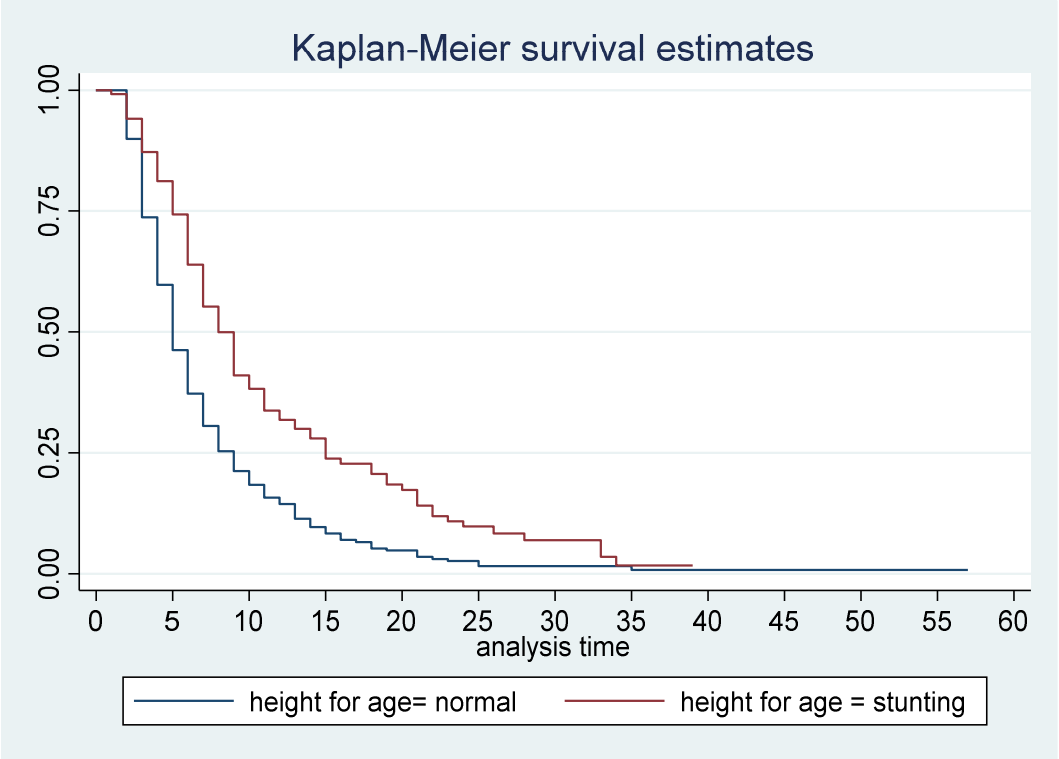


Figure 5: Kaplan-Meier survival estimate for time to recovery among SCAP children with stunting.

There was a significant difference between those children who had comorbidity, 7 days (95% CI: 6-8) and those who didn't have comorbidity during or after admission 4 days (95% CI: 4-8). This difference was statistically significant with a p-value < 0.000(figure 6).

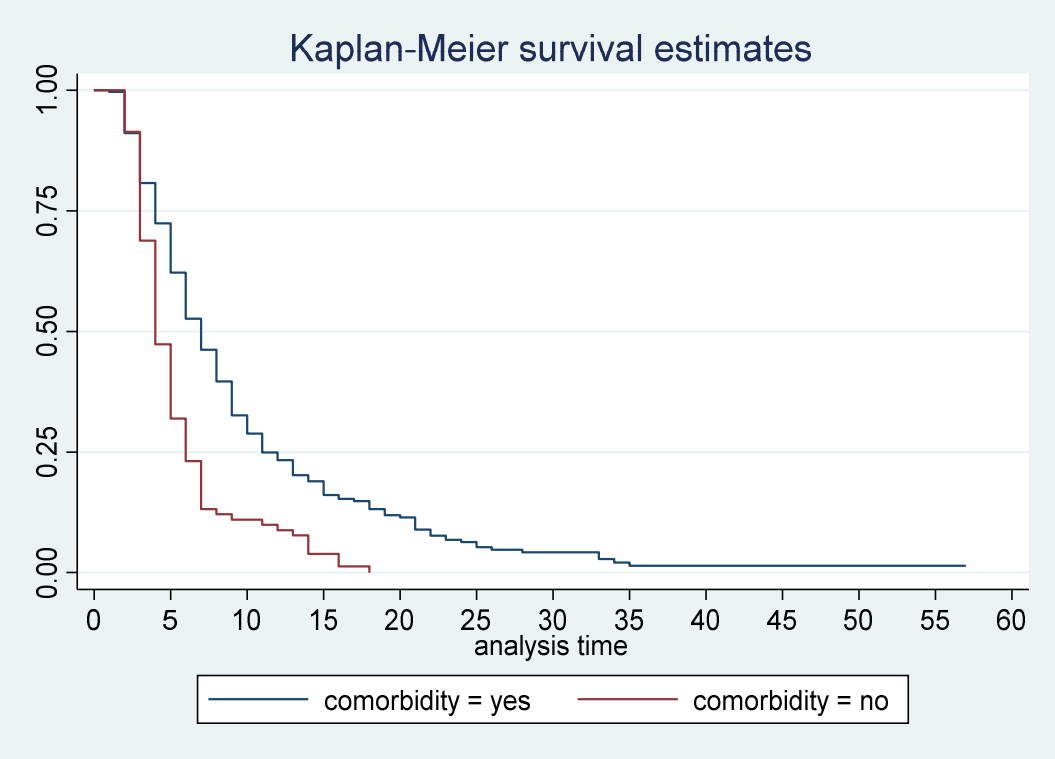


Figure 6: Kaplan-Meier survival estimate for time to recovery among SCAP children with comorbidity.

## 5.7. Test of proportional hazard assumption by Schoenfeld's residuals

For the interpretation and use of fitted proportional hazard models, the proportional hazard assumption must be checked.As a result, in this study the Schoenfeld residuals proportional hazard assumption test was used for individual covariates as well as global tests. The proportional hazard assumption is not met if the P-Value is less than 0.05. Each covariate (P-Value > 0.05) and all covariates (Global test for Cox proportional hazard P-Value=0.1733> 0.05) met the proportional hazard assumption, as shown in Table below.

Table 6:Test of proportional hazard by Schoenfeld residuals for each predictor and global test.

| Predictors | Rho | chi2 | Df | Prob>chi2 |
|---|---|---|---|---|
| **Age group** | -0.06778 | 1.48 | 1 | 0.2230 |
| **Residence** | 0.05614 | 0.15 | 1 | 0.2842 |
| **Exclusive breast feeding** | 0.02046 | 0.16 | 1 | 0.6894 |
| **Vaccination status** | 0.09656 | 3.40 | 1 | 0.0651 |
| **Weight for age** | -0.01468 | 0.08 | 1 | 0.7827 |
| **Height for age** | 0.05136 | 0.90 | 1 | 0.3437 |
| **Weight for height** | 0.00262 | 0.00 | 1 | 0.9592 |
| **Duration** | 0.10222 | 3.74 | 1 | 0.0532 |
| **Comorbidity** | 0.00521 | 0.01 | 1 | 0.9206 |
| **Saturation** | 0.02260 | 0.19 | 1 | 0.6665 |
| **Fever** | 0.00996 | 0.04 | 1 | 0.8514 |
| **Oxygen** | 0.01665 | 0.11 | 1 | 0.7429 |
| **Global test** | | 16.41 | 12 | **0.1733** |

## 5.8. Predictors of recovery time from SCAP

In this study, variables with a P value of < 0.25 were entered in to a multiple cox proportional hazard analysis and variables with p value of <0.05 at 95% confidence interval were presented as they have a significant association with the outcome variable. In multivariate cox proportional hazard regression analysisage, stunting, duration prior to seeking care and comorbiditywere statistically significant predictors.

From socio-demographic factors,Age was significantly associated with time to recovery from SCAP. The rate of early recovery from SCAP decreased 1.5 times for every unit increase in age(AHR; 1.463,95% CI (1.161-1.843)).The study also looked at the nutritional status of children.Compared to children who were not stunted, the recovery rate of stunted children from SCAP decreased by 32% (AHR; 0.685, 95% CI (0.517-0.908)). Likewise, compared to their counter parts, the rate of early recovery among children who sought care after five days of illness were 30% less likely to recover earlier (AHR; 0.705, 95% CI (0.532-0.936)).In this study, co-morbidity was significantly associated with time to recovery from SCAP. For children admitted without comorbidity, the rate of early recovery from SCAPincreased by 1.6 times as compared to children admitted with co-morbidity (AHR; 1.586, 95% CI (1.214-2.071)) (Table 7).

Table 7:predictors associated with recovery time from SCAP among pediatrics patents in selected governmental hospitals, Addis Ababa, Ethiopia.

| Variables | Category | p-value | CHR(95%CI) | AHR(95%CI) |
|---|---|---|---|---|
| **Age** | | 0.037 | 1.445(1.02- 2.042) | **1.463(1.161-1.843)*** |
| **Residence** | Urban<br>Rural | 0.086 | 1<br>0.740(.525-1.043) | 1<br>0.875(.608-1.259) |
| **Exclusive breastfeeding** | Yes<br>No | 0.055 | 1<br>0.779(.604-1.005) | 1<br>0.923(.704-1.212) |
| **Vaccination status** | Fully vaccinated<br>Partially vaccinated | 0.004 | 1<br>0.604(.430-0.848) | 1<br>0.918(.624-1.351) |
| **Sunlight exposure** | Yes<br>No | 0.005 | 1<br>0.643(.471-0.876) | 1<br>0.776(.551-1.093) |
| **Weight for age** | Normal<br>Under weight | 0.000 | 1<br>0.593(.473-0.7440) | 1<br>0.790(.577-1.082) |
| **Height for age** | Normal<br>Stunting | 0.000 | 1<br>0.577(.458-0.728) | 1<br>**0.685(.517-0.908)*** |
| **Weight for height** | Normal<br>Wasting | 0.008 | 1<br>0.735(.585-0.923) | 1<br>1.058(.802-1.396) |
| **Duration** | ≤ 5days<br>>5 days | 0.004 | 1<br>0.682(.528-0.882) | 1<br>**0.705(.532-0.936)*** |
| **Fever** | Low grade fever<br>High grade fever | 0.154 | 1<br>0.902(.783-1.039) | 1<br>0.879(.754-1.024) |
| **Saturation** | <90%<br>>90% | 0.122 | 1<br>1.198(.952-1.507) | 1<br>0.948(.688-1.306) |
| **Oxygen** | Yes<br>No | 0.121 | 1<br>1.249(.943-1.655) | 1<br>1.046(.699-1.565) |
| **Comorbidity** | Yes<br>No | 0.000 | 1<br>1.946(1.521-2.489) | 1<br>**1.586(1.214-2.071)**** |

**** =P-value<0.01**

***** =P-value<0.05**

# 6. DISCUSSION

Many measures have been taken to decrease child mortality due to pneumonia including developing treatment guidelines. Unfortunatelythese guidelines only provide with the diagnostic and treatment modalities for pneumonia but they do not provide a precise estimate of the median recovery time. So,the findings of this study will aid in estimating its actual time of recovery and reducing the length of hospitalization as well as filling a knowledge gap about poor treatment outcomes in pediatric patients.

The aim of the study was to determine recovery time from SCAP and to identify predictors of its recovery time.The overall median recovery time from SCAP was 6days.According to the guidelines of British Thoracic Society for the management of SCAPthe finding in this study was long (32). Compared to the studies conducted in Debere Markos and Gonder,the rate ofrecovery reportedinthis particular study was lower(1,18). This difference may be explained by the fact that in the current study area,due to the advancement of the health care set up and practice, debilitated children from all over the country with complicated, chronic and fatal caseswere referred to this hospitals which result longer time of recoveryand higher death rate.

Similarly, the median time to recovery was longer than what was reported in previous studies (1,18). The possible reason for variationmight bedue to the complication of cases referred to the study area, sample size difference and the age of the study participant as the other studies were conducted on under 5 children. In a study conducted in Jimma, southwest region of Ethiopia, the average hospital stay for 76% of children was 3 days, which is two times shorter than the findings in this study(19).The differences in sample size and socio-demography might be the possible reasons for discrepancy of this median recovery time.

The median time of recovery was 4.5 days in a study conducted in a rural health center in Gambia, which is shorter than what was observed inthis study(6).Differences in socioeconomic status, the quality of care given in each institute, and society's health seeking behavior may all be contributing factors for this gap. Likewise, the result of this study is higher than the findingsin Vanderbilt and Nepal which reported(2.3days) (2days) respectively (16,17). Differences in severity, case mix, and co-morbidity may explain this variation.On the other hand, the results of this studyare lower than the study about trends in the hospitalization of children with bacterial pneumonia in Poland which estimated 8.2 to 10.1 days(33). This may be explained by the fact that the study was done between the year of 2007 and 2011.

The age of children was an independent socio-demographic factor in this study, and it had a substantial impact on the time to recovery from SCAP. This study reported that younger children recover faster than older ones. Studieshave been sought to confirm the importance of microbiologic causes of pneumoniain recovery and treatment outcome of children. Mycoplasma and chlamydial infections become more prevalent with increasing age and intend to cause more sever disease condition with longer hospitalization period(34).This finding is consistent with the findings of studies in Debre Markos and Italy (1,7).This finding is also in line with the study conducted in Vanderbilt which reported longer hospital stay is more common in children above five years than below(17).

On the other hand, this study finding is not consistent with other previous study findings(16,18,33).According to a study conducted in Gonder, for a unit increment in age the time to recovery from severe pneumonia increased by 1.35 times.The longest hospital stay was recorded by younger children and the shortest time of hospitalization was recorded by older children according to the finding in Poland(33). Similarly, a study conducted in Nepal reported that, as the age of the patient increases, so does the time it takes to recover from illness(16). This discrepancy might be because more than half of the study participants in this study were in the lower age group. Additional possible reason for the difference may be due to variation in baseline health conditions and treatment protocols between the study areas.

The study looked at the nutritional condition of children who were admitted with SCAP. One of the significant predictors of time to recovery from SCAP is being stunted. Compared to children with normal nutritional status, stunted children take longer to recover. This is because malnutrition magnifies the effects of disease, resulting in more severe disease episodes, complications and longer recovery time(31). Additionally, malnutrition is often associated with weakened immune systemwhich aggravates the disease's prognosis and makes recovery more challenging (35).This finding is also in line with the study conducted in Debre markos and Gonder(1,18).

The other important predictor of the median time to recovery from SCAP was duration prior to seeking care. Children who presented to the health care institution early (<5 days) recovered faster than those who arrived later. This is because early diagnosis and managementof pneumonia reduce the likelihood of developing complications that lead to longer period of hospitalization and poor treatment outcomes. Similarly, as a disease progresses, the amount of time it takes to recover increases as well. This result is in line with the findings in Debre Markos and Gambia (1,6).

The presence of co-morbidity was the other important predictor which was significantly associated with recovery time from SCAP. Children who were admitted to hospital with co-morbidity take longer time to recover compared to children who were admitted without co-morbidity. This is due to the fact that when children acquire different illnesses at a time; their immune system significantly decreases, whichprolongs length of hospital stay and delays time of recovery.This result is relatively similar with another previous study findingsin Debre Markos, Gambia and Nepal(1,6,18).According to this study the most frequent comorbid diseases were hyper active airway disease followed by severe acute malnutrition, congenital heart diseases, Down syndrome, anemia, ricketsand others which was relatively similar with the findings in Debre Markos.

## 6.1. Strength and limitation of the study

### 6.1.1 Strength of the study

- Study participants were recruited from different health care institution as a result, the findings can be generalized.
- Using a 3-year record to increase representativeness

### 6.1.2 Limitation of the study

- Since the study was retrospective and centered on secondary data, it did not take into account all possible predictors of the outcome variable, such as parental, socio-demographic, socioeconomic and environmental factors.
- Since patients with incomplete records were removed from the study, selection bias may have occurred during data collection. As a result, the recovery time might be underestimated or exaggerated.

# 7. CONCLUSION AND RECOMMENDATION

## 7.1. Conclusion

In general, the median time to recovery from SCAP as well as possible predictors were assessed in this study.The overall median time to recovery from severe community acquired pneumonia was 6 days. From the multivariate Cox proportional hazard regression model, younger age and early presentation to the health care institution were proven to hasten recovery time.On the other hand, presence of comorbidity and being stunted were proven to prolong recovery time.

## 7.2. Recommendation

**To Federal Ministry of Health (FMOH)**

Measures thatshorten recovery time from SCAP(prompting strategies for primary prevention) specifically on immunization and early identification and management of SCAP in children must be strengthened.

**To the community**

In time of illness parents or caretakers shall take their children to the nearest health facility as soon as possible.

**To Health care providers**

When treating children with identified predictors, health care professionalsshould give due attention.

**To Future researchers**

For better knowledge, future researchers should conduct a prospective cohort study that includes other variables such as parental, socio-demographic and economic characteristics, as well as caregivers' perceptions towards SCAP.

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# ANNEXES

## Data extraction checklist

This tool is developed for the collection of data that are essential for the assessment of recovery time and its predictors among patients with severe community-acquired pneumonia admitted to selected public hospitals in Addis Ababa, Ethiopia, 2021. All relevant information to the study will be retrieved from the clients chart without stating their name. Health care professionals (BSc Nurses) working in the pediatric ward will collect this data and will be kept confidential.

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**Part-I Socio Demographic Characteristics**

| No. | **Socio demographic data of children** | **Possible answers** | **Skip** |
|---|---|---|---|
| 101 | Age | _____years or<br>_____months | |
| 102 | Sex | 1. Male<br>2. Female | |
| 103 | Residence | 1. Urban<br>2. Rural | |
| **Part-II** | **Base line nutritional and clinical information** | | |
| 201 | Was the child exclusively breast feed? | 1. Yes<br>2. No | |
| 202 | When was complementary feeding started? | _____ | |
| 203 | Weight for age | _____ | |
| 204 | Height for age | _____ | |

| | | | |
|---|---|---|---|
| 205 | Weight for height | _____ | |
| 206 | Vaccination status of children | 1. Fully vaccinated<br>2. Partially vaccinated<br>3. Up-to-date<br>4. None | |
| 207 | Was the child exposed to sunlight? | 1. Yes<br>2. No | |
| 208 | How many days elapsed prior to seeking care? | _____days | |
| 209 | Past history of ARTI | 1. Yes<br>2. No | |
| 210 | Does the child have history of asthma? | 1. Yes<br>2. No | |
| 211 | Clinical presentation during admission (danger signs) | 1. Impaired consciousness<br>2. Central cyanosis/hypoxia<br>3. Vomiting every thing<br>4. Abnormal body movement<br>5. Head nodding<br>6. Otherspecify_____<br>_____<br>_____<br>_____<br>_____. | |
| 212 | Body temperature of children | _____ | |
| 213 | Respiratory rate of children | _____ | |
| 214 | Oxygen saturation | _____ | |
| 215 | Was the child on oxygen? | 1. Yes<br>2. No | |
| 216 | Does the child have co-morbidity? | 1. Yes<br>2. No | If yes answer Q no-218 |

| | | | |
|---|---|---|---|
| 217 | What co-morbidity does the child have? | _____ | |
| 218 | Drug regimen | 1. Cristalyin pencillin<br>2. Ceftriaxon<br>3. Ampicillin & gentamicin<br>4. Other specify _____ | |
| 219 | What was the outcome of pneumonia? | 1. Recovery<br>2. Referral<br>3. Death<br>4. Refusal<br>5. Other specify_____ | |
| 220 | Date of admission | _____ | |
| 221 | Date of discharge | _____ | |
| 222 | For how long was the child admitted in the hospital? | _____days | |
| 223 | Qualification of the health care professional who provided care | _____ | |

Name of data collector _____signature _____ Date_____