



## The Relationship Between Smoking Habits Among Pneumonia Patients and Length of Hospitalization

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### Abstract

Pneumonia is a respiratory tract infection caused by viruses, fungi or bacteria. The impact of pneumonia can be measured by the length of stay (LOS) in the hospital. One of the risk factors for pneumonia is smoking. Given the high prevalence of smokers in Indonesia, this study aims to examine the correlation between smoking habits and the duration of the length of stay in pneumonia patients at RSUD dr. Chasbullah Abdulmadjid Bekasi city. This study used an analytical observational design with cross sectional approach. The research population was pneumonia patients at RSUD dr. Chasbullah Abdulmadjid, with a total of 122 patients obtained through consecutive sampling. Secondary data from patients medical record were used. Data analysis was performed using the Chi Square statistical test to determine the relationship between variables. Out of 122 patients, it was found that 50.8% (62 patients) were non smokers and 42.2% (60 patients) were active smokers. The distribution of length of stay shows that 73.8% of patients had a short length of stay category. The Chi Square test result indicated a significant relationship between smoking habits and the length of stay in pneumonia patients ( $P$  – Value 0.000). There is a statistically significant relationship between smoking habits and length of stay (LOS) in pneumonia patients.

## Introduction

Pneumonia remains a major global public health concern, particularly as a leading cause of morbidity and mortality among vulnerable populations, including the elderly and individuals with underlying health conditions. It is defined as an acute respiratory infection affecting the alveoli and is caused by a wide range of pathogens, including bacteria, viruses, and fungi (Pramudya Indrastuti et al., 2023). The disease is commonly transmitted through airborne droplets expelled during coughing or sneezing, facilitating rapid spread in both community and healthcare settings. Bacterial pathogens such as *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae* are among the most frequent causes, while fungal infections—although less common—can occur in immunocompromised individuals, including those with acquired immunodeficiency syndrome (AIDS) (Saragih et al., 2022; Holmberg & Meyer, 1986; Lionakis et al., 2023; Azar, 2024).

Despite advances in diagnostic and therapeutic approaches, pneumonia continues to impose a substantial clinical and economic burden on healthcare systems worldwide. Mortality rates among hospitalized patients range from 5% to 15%, increasing dramatically to 30%–50% among patients requiring intensive care (Chebib et al., 2021; Tralhão & Póvoa, 2023; Stotts et al., 2023). Importantly, the impact of pneumonia extends beyond the acute phase of illness.

Evidence suggests that patients who survive pneumonia remain at elevated risk of long-term complications, particularly cardiovascular events, which may persist for months or even years following recovery (Meregildo-Rodriguez et al., 2023; Stotts et al., 2023). These findings underscore the importance of not only preventing pneumonia but also improving clinical management to reduce adverse outcomes.

One of the key indicators used to assess the clinical burden and healthcare impact of pneumonia is the length of hospital stay (LOS). LOS reflects the duration of inpatient care required for recovery and is widely recognized as a proxy for disease severity, treatment effectiveness, and healthcare efficiency. Shorter LOS is generally associated with timely diagnosis, appropriate treatment, and favorable clinical progression, whereas prolonged hospitalization may indicate complications, severe disease, or the presence of comorbid conditions (Lüthi-Corridori et al., 2023). In addition, extended LOS contributes to increased healthcare costs, higher risk of hospital-acquired infections, and greater strain on healthcare resources. Therefore, identifying factors that influence LOS in pneumonia patients is essential for improving clinical outcomes and optimizing resource allocation.

Among the various risk factors associated with pneumonia, smoking has been consistently identified as a significant contributor. Smoking is a major global health issue and is considered one of the leading causes of preventable disease and death. It is estimated that more than 80% of the world's 1.3 billion tobacco users reside in low- and middle-income countries, where the burden of smoking-related diseases is disproportionately high (Hernández-Pérez et al., 2023; Meregildo-Rodriguez et al., 2023). Tobacco smoke contains numerous toxic substances, including nicotine, which is the primary addictive component. Nicotine acts on cholinergic receptors in the brain, leading to neuroadaptation and dependence, thereby perpetuating smoking behavior and increasing long-term health risks (Hernández-Pérez et al., 2023).

The relationship between smoking and respiratory disease has been extensively documented in the literature. Smoking has been shown to impair mucociliary clearance, disrupt airway epithelial integrity, and alter both innate and adaptive immune responses, thereby increasing susceptibility to respiratory infections, including pneumonia (Zhang et al., 2024). Furthermore, smoking is associated with an increased risk of severe disease outcomes, including higher rates of hospitalization, intensive care unit admission, and mortality (Stattin et al., 2024). These biological and clinical effects suggest that smoking may not only contribute to the occurrence of pneumonia but also influence its progression and recovery.

In the Indonesian context, smoking prevalence remains high and continues to pose a significant public health challenge. Data from the Global Adult Tobacco Survey (GATS) indicate notable trends in smoking behavior over the past decade. The average age of smoking initiation increased from 17.6 years in 2011 to 18.7 years in 2021, although a substantial proportion of individuals still begin smoking during adolescence (Tjandrarini et al., 2024). Additionally, there has been an increase in the number of cigarettes consumed per day, rising from an average of 12.8 sticks in 2011 to 13.3 sticks in 2021. The proportion of individuals smoking 20 or more cigarettes per day has also increased, indicating a trend toward heavier smoking behavior (Tjandrarini et al., 2024; Xing et al., 2022; Ibukun et al., 2025; Szymański et al., 2022; Zottl et al., 2025).

These trends are particularly concerning given the well-established association between smoking and respiratory diseases. Increased smoking intensity and earlier initiation are likely to contribute to a higher burden of chronic and acute respiratory conditions, including pneumonia. Moreover, demographic variations in smoking behavior, such as differences by gender and age group, further complicate the epidemiological landscape. For instance, while men generally smoke more cigarettes per day than women, the rate of increase in smoking among women has been higher in recent years (Tjandrarini et al., 2024). Such patterns highlight

the need for targeted public health interventions and further research to understand the implications of smoking behavior on health outcomes.

Although numerous studies have examined the relationship between smoking and the risk of developing pneumonia, relatively fewer studies have focused on its impact on hospitalization outcomes, particularly LOS. Existing evidence suggests that smokers may experience more severe disease progression and slower recovery, potentially leading to longer hospital stays (Li et al., 2024; Ainsworth & Pillai, 2025). However, the findings are not always consistent, and variations may arise due to differences in study design, population characteristics, and healthcare settings. Furthermore, LOS is influenced by multiple factors, including age, comorbidities, disease severity, and treatment protocols, which may confound the relationship between smoking and hospitalization duration (Sitompul et al., 2023).

In Indonesia, research examining the association between smoking and LOS among pneumonia patients remains limited, particularly in hospital-based settings. Given the high prevalence of smoking and the significant burden of pneumonia, there is a need for context-specific evidence to inform clinical practice and public health policy. Understanding whether smoking behavior is associated with prolonged hospitalization could provide valuable insights into patient management, risk stratification, and resource planning.

Therefore, this study aims to analyze the relationship between smoking habits and the length of hospital stay among pneumonia patients treated at RSUD dr. Chasbullah Abdulmajid, Bekasi City, during the 2024–2025 period. By examining this relationship, the study seeks to contribute to the existing body of knowledge on pneumonia management and provide evidence that may support the development of more effective prevention and intervention strategies. In addition, the findings are expected to highlight the importance of addressing modifiable risk factors, such as smoking, in reducing the burden of pneumonia and improving patient outcomes.

## Methods

This study employed an analytical observational design with a cross-sectional approach to examine the relationship between smoking habits and the length of hospital stay (LOS) among pneumonia patients. The cross-sectional design was selected as it allows for the simultaneous assessment of exposure (smoking status) and outcome (length of hospitalization) within a defined population at a specific point in time. This design is widely used in clinical and epidemiological research to identify associations between variables, particularly when utilizing secondary data sources.

The study was conducted at RSUD dr. Chasbullah Abdulmajid, Bekasi City, Indonesia, a secondary-level referral hospital that provides comprehensive healthcare services to a diverse patient population. The research utilized medical record data of patients diagnosed with pneumonia and hospitalized during the 2024–2025 period. The use of hospital-based data enabled the study to capture real-world clinical conditions and treatment outcomes, thereby enhancing the practical relevance of the findings.

The study population consisted of all patients diagnosed with pneumonia and recorded in the hospital's medical records during the study period. Inclusion criteria were defined to ensure data completeness and relevance, including patients with a confirmed diagnosis of pneumonia and complete information regarding smoking status and length of hospital stay. Patients with incomplete or missing data on key variables were excluded from the analysis to maintain data integrity and reduce potential bias.

The minimum required sample size was calculated using the Lemeshow formula for estimating proportions in an unknown population, resulting in a minimum sample of 73 respondents. However, to improve the statistical power and representativeness of the study, a total of 122

patient records that met the inclusion criteria were included in the final analysis. The sampling technique applied was non-probability consecutive sampling, in which all eligible patient records encountered during the study period were included sequentially until the desired sample size was achieved. This approach is commonly used in hospital-based studies where random sampling may not be feasible due to the nature of available data.

The variables in this study were categorized into independent and dependent variables. The independent variable was smoking status, classified into two categories: non-smoker and active smoker. Smoking status was determined based on information documented in the patient's medical record. The dependent variable was length of hospital stay (LOS), defined as the duration (in days) from hospital admission to discharge. For analytical purposes, LOS was categorized into three groups—short, moderate, and long—based on hospital clinical criteria. Although categorization simplifies analysis and interpretation, it also allows for the identification of patterns in hospitalization duration across different patient groups.

Data collection was conducted using secondary data obtained from patient medical records through a structured document review process. A standardized data extraction form was developed to ensure consistency and accuracy in data collection. The extracted variables included patient demographic characteristics (such as age), smoking status, and length of hospital stay. The use of secondary data minimized the risk of recall bias and allowed access to clinically verified information. However, the study relied on the accuracy and completeness of existing medical records, which may introduce limitations related to data quality.

Data analysis was performed using statistical software and consisted of two main stages: univariate and bivariate analysis. Univariate analysis was conducted to describe the distribution of each variable in the study population. The results were presented in the form of frequency distributions and percentages to summarize patient characteristics, smoking status, and length of hospital stay. This descriptive analysis provided an overview of the study sample and facilitated the interpretation of subsequent analytical findings.

Bivariate analysis was conducted to examine the relationship between smoking status and length of hospital stay. The Chi-square test was used as the statistical method, as both variables were categorical in nature. The Chi-square test evaluates the association between two variables by comparing the observed frequencies with the expected frequencies under the assumption of no association. The level of statistical significance was set at  $p < 0.05$ . A p-value less than 0.05 was interpreted as indicating a statistically significant association between smoking status and length of hospital stay, leading to the rejection of the null hypothesis.

The hypotheses tested in this study were defined as follows: the null hypothesis (H<sub>0</sub>) stated that there is no relationship between smoking status and length of hospital stay among pneumonia patients, while the alternative hypothesis (H<sub>1</sub>) stated that there is a significant relationship between the two variables. The decision to accept or reject the null hypothesis was based on the p-value obtained from the Chi-square test.

To ensure methodological rigor, efforts were made to maintain data consistency and minimize bias throughout the research process. The use of a standardized data extraction form reduced variability in data collection, while clear inclusion and exclusion criteria enhanced the internal validity of the study. Nevertheless, several limitations inherent to the study design should be acknowledged. The cross-sectional nature of the study precludes the establishment of causal relationships, as exposure and outcome were assessed simultaneously. Additionally, the use of secondary data limits the availability of certain potentially relevant variables, such as disease severity, comorbid conditions, and detailed smoking history (e.g., duration and intensity of smoking), which may act as confounding factors.

Despite these limitations, the study provides valuable insights into the association between smoking habits and hospitalization outcomes among pneumonia patients in a real-world

clinical setting. The findings are expected to contribute to the evidence base supporting the role of modifiable risk factors in influencing healthcare outcomes and may inform future research employing more advanced analytical approaches, such as multivariable regression models, to further explore these relationships.

## Result and Discussion

### Univariate Analysis

Univariate analysis is a method used to summarize a dataset into meaningful information; one example is descriptive statistics. Descriptive statistics constitute an essential component of research, as they are used to describe the basic characteristics of the data under study. Data become meaningful when presented through a summary of descriptive statistics, with or without further analytical procedures, so that they can be easily understood. Descriptive statistics are employed to communicate information in a simple manner. One common form of descriptive statistical presentation is the frequency distribution. The results of the frequency distributions are presented in the tables below.

Table 1. Frequency Distribution of Age

Age	Total	Percentage (%)
Teenagers	16	13.1%
Adults	35	28.7%
Seniors	71	58.2%
<b>Total</b>	122	100%

Based on Table 1, the majority of pneumonia patients were classified in the senior age group, accounting for 71 respondents (58.2%). Adults represented 35 respondents (28.7%), while adolescents constituted the smallest proportion with 16 respondents (13.1%).

This distribution indicates that pneumonia cases in the observed sample were predominantly recorded among older individuals. The higher proportion of elderly patients reflects the increased vulnerability of aging populations to respiratory infections, which is often associated with declining immune function and a higher prevalence of chronic diseases.

Table 2. Frequency Distribution of Length of Stay

Treatment Duration	Total	Percentage (%)
Short	90	73.8%
Medium	16	13.1%
Long	16	13.1%
<b>Total</b>	122	100%

Regarding the length of hospital stay, the majority of patients experienced a short duration of hospitalization, with 90 respondents (73.8%). Meanwhile, 16 respondents (13.1%) had a moderate LOS, and another 16 respondents (13.1%) experienced prolonged hospitalization. This distribution suggests that most patients achieved clinical stability relatively quickly or presented with mild to moderate disease severity. Length of stay is widely recognized as an important indicator of healthcare efficiency and quality, reflecting both disease progression and treatment effectiveness. Shorter LOS is often associated with timely clinical intervention and fewer complications, whereas prolonged LOS may indicate severe illness or comorbid conditions (Lüthi-Corridori et al., 2023; Sitompul et al., 2023).

Table 3. Frequency Distribution of Smoking Status

Smoking Status	Total	Percentage (%)
Non-Smoker	62	50.8%
Active Smoker	60	49.2%

<b>Total</b>	122	100%
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In terms of smoking status, 62 respondents (50.8%) were identified as non-smokers, while 60 respondents (49.2%) were active smokers. The relatively balanced distribution suggests that smoking is a common characteristic among pneumonia patients in this setting. This finding aligns with national data indicating a high prevalence of smoking in Indonesia (Tjandrarini et al., 2024). Previous studies have shown that smoking contributes to increased susceptibility to respiratory infections due to its adverse effects on lung function and immune defense mechanisms (Zhang et al., 2024; Stattin et al., 2024).

### Bivariate Analysis

The Chi-Square test is used when the variables are measured on a categorical scale. It is a nonparametric statistical test that does not require a normality assumption. The Chi-Square test examines the association between two variables based on the difference between observed proportions and expected proportions.

The hypotheses for the Chi-Square test are as follows:

H0: There is no relationship between the independent and dependent variables.

H1: There is a relationship between the independent and dependent variables.

Decision rules for the Chi-Square test:

If  $p\text{-value} < 0.05$ , H0 is rejected and H1 is accepted.

If  $p\text{-value} > 0.05$ , H0 is accepted and H1 is rejected.

The following analysis results describe the relationship between the independent and dependent variables.

Table 4. Distribution of Length of Stay by Smoking Status

Smoking Status	Treatment Duration			Total	P value
	Short	Medium	Long		
Non-Smoker	62 (50.8%)	0 (0%)	0 (0%)	62 (50.8%)	0.000
Active Smoker	28 (23%)	16 (13.1%)	16 (13.1%)	60 (49.2%)	
<b>Total</b>	<b>90 (73.8%)</b>	<b>16 (13.1%)</b>	<b>16 (13.1%)</b>	<b>122 (100%)</b>	

The results showed a statistically significant association between smoking status and LOS ( $p\text{-value} = 0.000$ ;  $p < 0.05$ ). Among non-smokers, all 62 respondents (50.8%) experienced a short LOS, with no cases of moderate or prolonged hospitalization. In contrast, among active smokers, only 28 respondents (23%) had a short LOS, while 16 respondents (13.1%) experienced moderate LOS and another 16 respondents (13.1%) had prolonged hospitalization.

These findings indicate that smokers were more likely to experience longer hospital stays compared to non-smokers, suggesting a potential relationship between smoking behavior and delayed recovery among pneumonia patients.

## Discussion

### Univariate Analysis

#### Respondents' Age

Based on the analysis of pneumonia patients recorded in the medical records of RSUD dr. Chasbullah Abdulmadjid, Bekasi City, the majority of respondents were adults, totaling 35 individuals (28.7%). This distribution indicates that pneumonia cases within the observed sample were more frequently recorded among adult patients. The finding suggests that healthcare management and preventive strategies should consider the health needs of adults,

including the screening and management of comorbid conditions commonly observed in this age group (Cocchio et al., 2024).

This result is consistent with the study conducted by Cocchio et al. (2024), which reported that the incidence of pneumonia tends to increase with age and is often accompanied by higher hospitalization and mortality rates among older populations. These patterns emphasize the importance of preventive strategies, including vaccination and early detection of respiratory infections among adult and elderly populations. In addition, research by Sutriana et al. (2021) suggested that local environmental and behavioral factors such as indoor air pollution exposure, immunization coverage, and nutritional status may also be associated with pneumonia occurrence, highlighting the need to integrate clinical interventions with community-level prevention programs.

From a physiological perspective, the relationship between age and pneumonia risk has often been discussed in relation to immunosenescence, a gradual decline in immune system function that occurs with aging. Older individuals also tend to present a higher prevalence of chronic conditions such as cardiovascular disease, diabetes mellitus, and chronic obstructive pulmonary disease, which may increase vulnerability to respiratory infections and complications. These patterns have been widely documented in global reviews examining the burden of pneumonia among adult populations (Anderson & Feldman, 2023). Although this study did not directly measure immune function or comorbidity severity, the age distribution observed in the sample is consistent with trends reported in previous epidemiological studies.

### **Length of Hospital Stay**

The analysis of pneumonia cases in the medical records indicated that the majority of respondents experienced a short length of hospital stay, totaling 90 patients (73.8%). This finding suggests that many patients in the observed sample achieved clinical stability relatively quickly or were admitted with mild to moderate disease severity, allowing them to meet discharge criteria earlier.

Length of stay (LOS) is widely recognized as an important indicator of healthcare quality and clinical outcomes because it reflects both disease progression and treatment efficiency. Shorter LOS may indicate effective clinical management and timely treatment initiation, whereas prolonged hospitalization may increase healthcare costs and the risk of hospital-acquired complications (Lüthi-Corridori et al., 2023). These findings align with research conducted by Lüthi-Corridori et al. (2023), which reported that pneumonia patients with lower disease severity scores, timely antibiotic therapy, and minimal complications tended to experience shorter hospitalization periods. Conversely, patients with more severe clinical presentations or significant comorbid conditions often required longer treatment and monitoring.

The duration of hospitalization among pneumonia patients is influenced by multiple factors, including disease severity at admission, the speed at which clinical stability is achieved, the presence of comorbidities, and hospital discharge policies. Patients who rapidly achieve stable vital signs, improved respiratory function, adequate oral intake, and acceptable oxygen saturation levels are typically considered eligible for discharge earlier. Therefore, clinical strategies focusing on early severity assessment, timely antibiotic administration, and optimal management of comorbid conditions may contribute to maintaining efficient LOS while preserving patient safety (Sitompul et al., 2023).

### **Smoking Frequency**

The analysis of smoking behavior among pneumonia patients indicated that the majority of respondents were non-smokers (62 individuals or 50.8%), while 60 individuals (49.2%) reported a history of smoking. The relatively comparable proportion between smokers and non-smokers suggests that smoking status alone may not fully explain the occurrence of pneumonia

cases within the observed sample. Previous studies have shown that smoking is associated with an increased risk of respiratory infections, including pneumonia, although the distribution of smokers and non-smokers among hospitalized patients may vary depending on demographic characteristics, healthcare access patterns, and environmental exposure (Stattin et al., 2024). For example, McGeoch et al. (2023) reported that the proportion of smokers in pneumonia cohorts may differ across clinical settings due to differences in baseline population characteristics and smoking exposure patterns.

Biologically, cigarette smoke exposure has been associated with impairment of mucociliary clearance mechanisms and alterations in immune responses within the respiratory system. These physiological changes may increase susceptibility to respiratory infections and contribute to disease severity (Zhang et al., 2024). However, the present study did not directly measure these biological mechanisms. Therefore, the explanation of these pathways should be interpreted as theoretical support from previous literature rather than direct evidence derived from the current dataset.

## **Bivariate Analysis**

### ***The Relationship Between Smoking Status and Length of Hospital Stay***

The bivariate analysis showed a statistically significant relationship between smoking status and length of hospital stay among pneumonia patients at RSUD dr. Chasbullah Abdulmadjid, Bekasi City, with a p-value of 0.000 ( $< 0.05$ ). This result indicates that smoking status was statistically associated with hospitalization duration in the observed sample. These findings are consistent with previous studies that have reported associations between smoking behavior and clinical outcomes in respiratory diseases. For example, Li et al. (2024) reported that smoking status was associated with increased risk of respiratory infections and poorer clinical outcomes, including longer hospitalization in some patient populations. Similarly, Ainsworth and Pillai (2025) observed that smokers in respiratory disease cohorts tended to demonstrate longer LOS and higher readmission rates compared with non-smokers.

Several biological mechanisms proposed in previous research may help explain why smoking is frequently associated with poorer respiratory health outcomes. Cigarette smoke exposure has been linked to impaired mucociliary clearance, disruption of airway epithelial integrity, and modulation of both innate and adaptive immune responses (Jiang et al., 2020). These mechanisms may increase susceptibility to infection and influence disease progression in respiratory illnesses. However, it is important to emphasize that the present study used a cross-sectional observational design and bivariate analysis. Therefore, the results only demonstrate a statistical association between smoking status and length of hospitalization within the sample and cannot establish a causal relationship. In addition, the current study did not measure physiological indicators such as mucociliary function, inflammatory markers, or immune responses. Consequently, these biological mechanisms should be interpreted as theoretical explanations derived from prior literature rather than direct evidence from the present study.

Another important consideration is that the duration of hospitalization among pneumonia patients is influenced by multiple clinical factors simultaneously. Age, severity of illness at admission, comorbid conditions, treatment timing, pathogen type, oxygen requirements, complications, and hospital discharge policies may all contribute to differences in LOS. Because the present study did not control for these variables through multivariable analysis, the observed relationship between smoking status and LOS may partly reflect the influence of these potential confounding factors. For instance, smokers may present different baseline clinical profiles compared with non-smokers, including higher prevalence of chronic respiratory or cardiovascular conditions. These differences may influence recovery patterns and hospitalization outcomes independently of smoking behavior itself. Therefore, the association observed in this study should be interpreted cautiously.

Overall, the findings of this study indicate that smoking status was statistically associated with the length of hospitalization among pneumonia patients in the study setting. Future studies using multivariable analytical approaches and larger datasets are recommended to further examine the independent contribution of smoking behavior to hospitalization outcomes after adjusting for demographic and clinical factors.

## Conclusion

The results of the study examining the relationship between smoking habits among pneumonia patients and the length of hospitalization at RSUD dr. Chasbullah Abdulmajid, Bekasi City, lead to the following conclusions:

It was found that the majority of pneumonia patients in this study underwent hospitalization categorized as a short length of stay, totaling 90 patients (73.8%).

The majority of pneumonia patients in this study were non-smokers or passive smokers, accounting for 62 patients (50.8%). Nevertheless, the number of active smokers was not substantially different, totaling 60 patients (49.2%).

There was a significant relationship between smoking status and the length of hospitalization among pneumonia patients, as indicated by a p-value of  $0.000 < 0.05$ .

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