ORIGINAL ARTICLE

Pediatrics Sciences Journal (*PedScij*) 2024, Volume 5, Number 2: 52-55
P-ISSN: 2722-0427, E-ISSN: 2722-1474

Pediatric Sciences Journal

Published by
Pediatrics Sciences Journal

Correlation of leukocyte count with length of hospitalization in bronchopneumonia patients

Rizqi Amalia Arumsari[1*], Cristian Bungin[2], Sayyid Muhammad Sahil Haikal[3], Joda Isham Satriadi[4], Nia Ramadhanurrosita[1], Achmad Munif[3], Mildawati[3], Andhika Amran[3], Izdihar Nafi'u Hamidah[3], Ina Uli Tondi Tarigas Siahaan[3], Novia Priska[3], Nurfatimah Aprillianda Simatupang[3], Tiara Arista[3], Hanna Zahra[3], Astra Yudha Tagamawan[3]

[1]Labanan Community Health Centre, Berau, East Kalimantan, Indonesia
[2]Biatan Community Health Centre, Berau, East Kalimantan, Indonesia
[3]Abdul Rivai Regional Hospital, Berau, East Kalimantan, Indonesia
[4]Tirta Medical Centre, Berau, East Kalimantan, Indonesia

*Corresponding email:
Rizqi Amalia Arumsari; Labanan Community Health Centre, Berau, East Kalimantan, Indonesia
raarumsari@gmail.com

Received: 2024-07-10
Accepted: 2024-10-08
Published: 2024-11-04

ABSTRACT

Introduction: Pneumonia is a disease characterized by inflammation or infection of the lung parenchyma. In the process of inflammation or infection, there are agents involved that serve as the body's defense against infection, such as leukocytes. Leukocytes can be used as a parameter to assess the severity of the disease, which is one of the factors affecting the length of hospital stay for pneumonia patients, particularly in young children. This study aims to determine the correlation between the leukocyte count and the length of hospital stay in patients with bronchopneumonia at RSUD dr. Abdul Rivai Berau.

Methods: This research was an analytical observational study with a retrospective cohort approach and used consecutive sampling for data collection.

Result: The results indicate that 935 subjects meet the inclusion and exclusion criteria. Data analysis using the Pearson correlation test yielded a p-value of 0.029 and an R-value of 0.072.

Conclusion: There is a correlation between leukocyte count and the length of hospital stay in bronchopneumonia patients.

Keywords: *Leukocyte Count, LOS, Bronchopneumonia.*
Cite This Article: Arumsari, R.A., Bungin, C., Haikal, S.M.S., Satriadi, J.I., Ramadhanurrosita, N., Munif, A., Mildawati., Amran, A., Hamidah, I.N., Siahaan, I.U.T.T., Priska, N., Simatupang, N.A.S., Arista, T., Zahra, H., Tagamawan, A.Y. 2024. Correlation of leukocyte count with length of hospitalization in bronchopneumonia patients. *Pediatrics Sciences Journal* 5(2): 52-55. DOI: 10.51559/pedscij.v5i1.89

INTRODUCTION

Pneumonia is a significant cause of death among young children. In East Kalimantan, there were 17,490 cases of pneumonia in children.[1] According to UNICEF, it is estimated that around 19,000 children in Indonesia died from pneumonia in 2018, with 71 children contracting pneumonia every hour. Pneumonia also imposes a significant financial burden, with approximately 2.5 million cases each year, and one-third to fifty percent of these cases requiring hospitalization.[2]

Pneumonia is an inflammatory or infectious disease affecting the lung parenchyma. During the inflammation or infection process, leukocytes act as the body's defense against the infection.[3] Leukocytes can also be used as a parameter to assess the severity of the disease, which influences the length of hospital stay for pneumonia patients, particularly in young children. A study conducted at RSUP Prof. Dr. R. D. Kandou Manado found a significant relationship between increased leukocyte count and the length of hospital stay. Prolonged hospitalization adds to the hospital's burden and becomes a cost issue.[4] Based on this explanation, the researchers will investigate the correlation between leukocyte count and the length of hospital stay in patients with bronchopneumonia at RSUD dr. Abdul Rivai Berau.

METHOD

This study used a retrospective cohort design to determine the correlation between leukocyte count and the length of hospital stay in patients with bronchopneumonia at RSUD dr. Abdul Rivai. This research used secondary data taken from patient medical records. The sample size calculation used a total sampling method, which is a technique where the sample size equals the population size.

This study was done from February to November 2023, using inclusion criteria for children admitted to RSUD dr. Abdul Rivai was diagnosed with a diagnosis of bronchopneumonia in 2022 and aged one month to 14 years. The exclusion criteria for this study were incomplete medical records, patients with other comorbidities, and infants and children who died during treatment. The variables assessed in this study were the white blood cell count and the length of hospital stay. The research instrument used secondary data in the form of medical records as the data source.

The sampling technique used was consecutive sampling, involving the selection of all subjects who met the inclusion criteria and did not meet the exclusion criteria until the required sample size was achieved. The data from the medical records were recorded on a patient extraction form.

The collected data was analyzed using statistical software. The results were presented descriptively for the characteristics of the study subjects. The white blood cell count and length of hospital stay data were tested for normality using the Kolmogorov-Smirnov test. Since the data distribution was normal, the Pearson correlation statistical test was conducted. The significance of the test was determined based on a p-value<0.05.

Table 1. Characteristics of subjects

Characteristic	Total N = 935
Age, year (SE)	2,61 (0,09)
Hospital stay, day (SE)	5,78 (0,08)
Gender	
Male, n (%)	568 (60,7)
Female, n (%)	367 (39,3)
Temperature	
Febreze, n (%)	515 (55,1)
Normal, n (%)	420 (44,9)

Table 2. Results of the correlation between leukocyte count and the length of hospital stay

Variable	Mean (SE)	Kolmogrov-Smirnov Test
Leukocyte count	12.721 (202)	p = 0,000
Length of hospital stay	5,78 (0,08)	p = 0,000
Pearson Correlation Test	p = 0,029	r = 0,072

RESULT

During the study period, 958 subjects met the inclusion criteria. However, 9 subjects were excluded due to incomplete data, 12 subjects were excluded because they were under 1 month or over 14 years of age, and 14 subjects were excluded for meeting both exclusion criteria. The characteristics of the subjects in this study were as follows: the mean age was 2.61 ± 0.09 years, the mean length of hospital stay was 5.78 ± 0.08 days, and the majority of subjects were male, comprising 568 subjects (60.7%). Additionally, 515 subjects (55.1%) experienced fever. The detailed characteristics of the respondents can be seen in Table 1.

The results of the correlation analysis between leukocyte count and the length of hospital stay for pediatric patients with bronchopneumonia are presented in Table 2. The study found a significant relationship between leukocyte cell count and the length of hospital stay (p = 0.029). The analysis was done using Pearson's correlation test, which revealed a significant but weak correlation between leukocyte count and length of hospital stay, with a correlation coefficient of r = 0.072.

DISCUSSION

Bronchopneumonia is an inflammation of the lung parenchyma that localizes in the bronchi, bronchioles, and alveoli, characterized by a patchy distribution. It frequently affects children under five years old, especially males, and is often associated with fever. Our study found that the median age was 2 years old (ranging from 2 months to 14 years), with 60% being male and 55.1% experiencing fever during illness. These findings are consistent with research conducted at Dr. Sardjito General Hospital, which reported that pneumonia cases in young children frequently occur in males. This may be due to the smaller airway diameter in males compared to females or differences in immune response, increasing the risk of pneumonia exposure.

Our study found that the highest prevalence of bronchopneumonia in young children occurred at an average age of 2.61 ± 0.09 years. Pneumonia is the leading infectious cause of death among children worldwide. In 2019, pneumonia killed 740,180 children under the age of 5, accounting for 14% of all deaths in this age group, with 22% of deaths occurring in children aged 1 to 5 years. Childhood pneumonia is responsible for a significant global mortality burden. However, most guidelines focus on pneumonia in children under 5 years of age. The 2022 Indonesian Health Profile reported that the national coverage of pneumonia in children under five years old was 31.4%. The mortality rate due to pneumonia in infants is nearly twice as high as in children aged 1–4 years. Pneumonia is one of the leading causes of death among children aged 12-59 months, second only to diarrhea, with a mortality rate of 217 cases or 9.4% of the total child mortality in Indonesia.[2]

The study done by Roselany and Surjono at Atma Jaya Hospital found that the number of pneumonia cases was higher in the 1–4 years age group compared to the < 1 year age group (9). The study done by Kasundriya et al. stated that the global prevalence of pneumonia in children under five was highest in the 1–4 years age group.[10] The highest number of hospitalized children with pneumonia had a length of stay of ≤ 5 days, with a total of 538 subjects (60.4%). The average length of stay for pediatric pneumonia patients in this study was 5.78 ± 0.08 days. This finding aligns with the research conducted by Casman and Nurhaeni, which also showed that most patients were hospitalized for ≤ 5 days.[11] Each year, the number of children with pneumonia being treated in hospitals increases. Several sources mention that the typical length of hospital stay for pneumonia patients is generally 5-8 days.[12-13]

Several factors, including age, nutritional status, and severity of the condition, influence the length of hospital stay. The more severe the pneumonia, the longer the patient tends to be hospitalized. Therefore, it is essential to control risk factors in patients carefully.

Providing adequate therapy, including oxygenation, inhalation therapy, and rational antibiotic use, can decrease the length of hospital stay.[11] This infection is often characterized by an increase in body temperature, commonly known as a fever. Bronchopneumonia is usually preceded by an upper respiratory tract infection for several days, followed by a rise in body temperature as an inflammatory response. The temperature can suddenly increase to 39-40°C.[14]

Fever is a condition that occurs due to an increase in the set point caused by infection or an imbalance between the production and dissipation of body heat. Gram-negative bacterial endotoxins, with their pyrogenic component known as lipopolysaccharides, are the most potent exogenous pyrogens. Fever caused by infection occurs because microorganisms stimulate macrophages or PMNs (polymorphonuclear leukocytes) to produce endogenous pyrogenic factors such as TNF (tumor necrosis factor), IL-1, IL-6, and IFN (interferon). Endogenous pyrogens are transmitted to the central thermoregulatory hypothalamus with the aid of the enzyme cyclooxygenase, particularly the organum vasculosum of the lamina terminalis (OVLT), leading to the formation of prostaglandin PGE2, which plays a crucial role in initiating the fever response.[14]

The mechanism by which a child's body experiences a fever in response to infection is highly dependent on the individual's age. The younger the child, the less capable they are of changing the set-point and producing heat. In young infants, severe infections often occur without accompanying symptoms of increased body temperature, which requires careful attention. Additionally, if the body temperature exceeds 41°C, tissue damage can occur, especially in the brain and muscle tissues, which can be irreversible. Therefore, it is crucial to monitor the temperature closely to prevent it from exceeding 41°C. Some consequences of such damage include brainstem injury, coma, seizures, and even paralysis.[15]

In our study, we found a correlation between leukocyte levels and the length of hospital stay in patients with bronchopneumonia. The median length of stay was 5 days, with an average leukocyte count of 12,721 ± 202 / µl. The positive correlation indicates that higher leukocyte levels are associated with more extended hospital stays. This is because, during a respiratory tract infection, there is an increase in pro-inflammatory cytokines, which in turn stimulates an increase in leukocytes. Other studies have shown different results, suggesting no relationship between high leukocyte levels and the length of hospital stay. This may be due to patients with bronchopneumonia who have normal leukocyte levels, possibly being more likely to have viral infections, which do not affect the length of stay.[16-17] Another study by Furer et al. found that leukocytosis was present in most patients with pneumonia upon admission, but 21% of patients did not experience leukocytosis. Toikka et al. also found that 17% of pneumonia patients presented with a normal leukocyte count. Normal or even low leukocyte counts in pneumonia patients can occur depending on the timing of the examination after the onset of pneumonia. Initially, the body's response involves releasing an excessive number of leukocytes, but if treatment is inadequate or the pneumonia progresses, the leukocyte count might decrease.[18-20]

In community-acquired bronchopneumonia, it has been observed that leukocyte levels in pediatric patients increase significantly. This is thought to be due to ongoing myelopoiesis, which correlates with age in children. It has also been found that leukocyte levels in children are associated with increased levels of cytokines IL-6 and IL-8.[21] In this study, there was no distinction made regarding the timing of leukocyte count measurements from the onset of pneumonia, resulting in no significant difference in leukocyte counts between the two groups. The study has several limitations, including the inability to identify the cause of pneumonia, which prevents determining whether patients had bacterial pneumonia or not. Additionally, body temperature measurements were taken only upon arrival at the hospital (potentially higher temperatures might have been recorded before or after hospital arrival). The history of prior antibiotic use was not explored, and the sample size was relatively small, which might have influenced the results. Other predictive factors related to the length of hospital stay in patients with bronchopneumonia include thrombocytosis, anemia, and elevated CRP levels.[22]

Thrombocytosis is a better predictive factor for the length of hospitalization and severity in pneumonia patients compared to leukocytosis. This is because platelets are involved in the early stages of inflammation and are more numerous, experiencing chemotaxis and releasing many pro-inflammatory molecules compared to leukocytes. However, leukocytes remain an important indicator, especially in severe cases of bronchopneumonia. It is worth noting that children often have higher leukocyte counts than adults. Other factors influencing the length of hospital stay in patients with bronchopneumonia include the type of therapy administered and the radiological findings in patients with pneumonia.[23]

CONCLUSION

It can be concluded, based on the result of the study conducted, that there is a correlation between leukocyte count and the length of hospital stay of patients with bronchopneumonia at RSUD dr. Abdul Rivai, but with weak correlation strength. The majority of patients with bronchopneumonia were male, had fever, an average age of 2.61 ± 0.09 years, and an average hospital stay of 5.78 ± 0.08 days.

AUTHOR CONTRIBUTION

All authors contributed equally to preparing this manuscript.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

ETHICAL APPROVAL

The protocol of the study was approved by The Research Ethics Committee, RSUD dr. Abdul Rivai.

REFERENCES

1. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia 2022. 2023.
2. UNICEF. Pneumonia [Internet]. 2022 [cited 2023 Aug 27]. Available from: https://data.unicef.org/topic/child-health/pneumonia/
3. Guyton AC, Hall JE. Buku Ajar Fisiologi Kedokteran. 12th ed. Jakarta: Elsevier; 2017.
4. Rumokoy RP, Warouw SM, Mantik MFJ, Manado SR, Kesehatan BI, Fakultas A, et al. Hubungan jumlah monosit dengan lama hari rawat pada anak penderita diare akut di RSUP Prof. Dr. R. D. Kandou Manado tahun 2014. Vol. 4, Jurnal e-Clinic (eCl). 2016.
5. Van Vught LA, Scicluna BP, Wiewel MA, Hoogendijk AJ, Klouwenberg PMCK, Franitza M, et al. Comparative analysis of the host response to community-acquired and hospital-acquired pneumonia in critically ill patients. Am J Respir Crit Care Med. 2016 Dec 1;194(11):1366–74.
6. World Health Organization. Pneumonia in children [Internet]. 2022 [cited 2023 Oct 16]. Available from: https://www.who.int/news-room/fact-sheets/detail/pneumonia
7. Subanada IB, Purniti NPS. Faktor-Faktor yang Berhubungan dengan Pneumonia Bakteri pada Anak. Sari Pediatri. 2016 Nov 23;12(3):184.
8. Latumahina ASN, Triasih R, Hermawan K, Ilmu B, Anak K, Kedokteran F, et al. Skor Prediksi Kematian Pneumonia pada Anak Usia di Bawah Lima Tahun Pneumonia Mortality Prediction Score for Children under Five Years of Age. Vol. 18, Sari Pediatri. 2016.
9. Roselany R, Surjono E. Pneumonia Clinical Features in Under-Five Children Treated in Atma Jaya Hospital in 2017-2020. Majalah Kedokteran Bandung. 2023 Mar 30;55(1).
10. Kasundriya SK, Dhaneria M, Mathur A, Pathak A. Incidence and Risk Factors for Severe Pneumonia in Children Hospitalized with Pneumonia in Ujjain, India. Int J Environ Res Public Health. 2020 Jun 27;17(13):4637.
11. Casman C, Nurhaeni N. Determinant Factors of Length of Stay Among Under-Five Children With Pneumonia Diseases: A Literature Review. International Journal of Nursing and Health Services (IJNHS). 2019 Sep 9;2(3):80–8.
12. Akahoshi S, Morikawa Y, Sakakibara H, Kaneko T, Sekine A, Obonai T, et al. Risk factors of bacteremia in children hospitalized with community-acquired pneumonia: A nested case-control study. Journal of Infection and Chemotherapy. 2021 Aug;27(8):1198–204.
13. Mirsaeidi M, Peyrani P, Aliberti S, Filardo G, Bordon J, Blasi F, et al. Thrombocytopenia and Thrombocytosis at Time of Hospitalization Predict Mortality in Patients With Community-Acquired Pneumonia. Chest. 2010 Feb;137(2):416–20.
14. Ross PA, Hendrickson JE, Bart III R, Wetzel RC. Pediatric Intensive Care. In: Gregory GA, Androlus DB, editors. Gregory's Pediatric Anesthesia. 6th ed. Wiley; 2020. p. 946–92.
15. Chang TH, Liu YC, Lin SR, Chiu PH, Chou CC, Chang LY, et al. Clinical characteristics of hospitalized children with community-acquired pneumonia and respiratory infections: Using machine learning approaches to support pathogen prediction at admission. Journal of Microbiology, Immunology and Infection. 2023 Aug;56(4):772–81.
16. Williams DJ, Hall M, Auger KA, Tieder JS, Jerardi KE, Queen MA, et al. Association of White Blood Cell Count and C-Reactive Protein with Outcomes in Children Hospitalized for Community-acquired Pneumonia. Pediatric Infectious Disease Journal. 2015 Jul;34(7):792–3.
17. Monita O, Yani FF, Lestari Y. Profil Pasien Pneumonia Komunitas di Bagian Anak RSUP DR. M. Djamil Padang Sumatera Barat. Jurnal Kesehatan Andalas. 2015 Jan 1;4(1).
18. Furer V, Raveh D, Picar E, Goldberg S, Izbicki G. Absence of leukocytosis in bacteraemic pneumococcal pneumonia. Primary Care Respiratory Journal. 2011 Apr 21;20(3):276–81.
19. Toikka P, Virkki R, Mertsola J, Ashorn P, Eskola J, Ruuskanen O. Bacteremic pneumococcal pneumonia in children. Clin Infect Dis [Internet]. 1999 [cited 2024 Jul 20];29(3):568–72. Available from: https://pubmed.ncbi.nlm.nih.gov/10530449/
20. Quinton LJ, Walkey AJ, Mizgerd JP. Integrative Physiology of Pneumonia. Physiol Rev [Internet]. 2018 Jul 7 [cited 2024 Jul 20];98(3):1417. Available from: https://pmc/articles/PMC6088146/
21. Ballin A, Osadchy A, Klivitsky A, Dalal I, Lishner M. Age-related leukocyte and cytokine patterns in community-acquired bronchopneumonia. Isr Med Assoc J. 2006 Jun;8(6):388–90.
22. Choudhury J, Rath D. Thrombocytosis in Under-Five Children with Lower Respiratory Tract Infection. Arch Pediatr Infect Dis. 2017 Sep 27;In Press(In Press).
23. Fernando G, Lourdes E, Gabriela S, Antonio A. Duration of fever in pediatric patients hospitalized with Community Acquired Pneumonia in a reference center for infectious diseases. Open Journal of Tropical Medicine. 2020 Sep 5;023–7.