

Research Article

Nutritional Status and Severity of Pneumonia among Inpatient of Children Under Five Years

Dayu Swasti Kharisma¹, Balqis Al Sakina Zahra²

¹Department of Microbiology and Parasitology, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia

²Medical Doctor Professional Study Programs, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia

*Corresponding author: dayu.swastikharisma@umj.ac.id

ABSTRACT

Background: The prevalence of pneumonia in developing countries continues to increase, especially in Indonesia. One of the factors that influence the severity of pneumonia is nutritional status. Malnutrition increases susceptibility to infection. **Purposes:** This study aimed to determine the relationship between nutritional status and pneumonia severity in children under five. **Methods:** This research was an analytic study with a cross-sectional design. The data were taken from the medical records of pneumonia patients under five years of age who were hospitalized at the Infectious Disease Hospital Prof. Dr. Sulianti Saroso for January 2018 to October 2019. Bivariate analysis was performed using the chi-square test. **Results:** Out of 68 patients who met the inclusion criteria, the highest age range was 0-11 months (50%), the most gender was female (55.9%), the group with the highest cases was the severe pneumonia group (73.5%), the most nutritional status was abnormal nutrition (55.9%). There are 86.8% of patients with abnormal nutritional status suffer from severe pneumonia. **Conclusion:** There is a relationship between nutritional status and pneumonia severity.

Keywords: children, nutritional status, pneumonia

INTRODUCTION

Pneumonia is an acute respiratory infection that affects the lung parenchyma. It is the world's leading cause of death in children under five years, with an estimated 0.921 million deaths in 2015. Almost all cases of death that occur are severe pneumonia. This global disease is quite fatal in developing countries, although in developed countries it can be overcome (1–4). Pneumonia can be caused by various microorganisms, such as viruses, fungi, and bacteria. The most common cause in children is *Streptococcus pneumoniae* (1,5–10).

WHO stated that in 2017 there were 808,694 deaths in children under five years of age caused by pneumonia, and accounted for 15% of all causes of death in this age group. The highest incidence of deaths caused by pneumonia in children under five years occurs in developing countries. In Indonesia, based on the 2018 Basic Health Research data, the prevalence of pneumonia increased from 1.6% in 2013 to 2% in 2018. These data indicate a worsening of pneumonia for children under five years of age (5,11).

According to WHO (World Health Organization), the classification of the severity of pneumonia in children aged 2 - 59 months is divided into three classes, namely non-pneumonia, pneumonia, and severe or very severe pneumonia (11). The four main factors influencing the severity of pneumonia are environmental, health service, host, and pathogenic factors. Several host factors include age, immune status, history of the host's ability to transmit infections, previous or concurrent infections caused by other pathogens, and nutritional status. Undernutrition in a child with severe pneumonia requiring hospitalization can also be associated with a diminished metabolic capacity to overcome the illness's amplified physical and physiological demands, such as increased temperature, cardiac output, and work of breathing (12). Recurrent pneumonia occurs in 7.7-9% of children with community-acquired pneumonia. This condition is associated with malnutrition, anatomic defects, immunodeficiency, and other underlying diseases. The presence of severe acute malnutrition can increase mortality from pneumonia 15-fold. In undernourished or malnourished toddlers, the body's defense system decreases, making them susceptible to infection (12). The thymus is one of the primary lymphoid organs that produce T cells. Lack of protein can cause thymus atrophy, disrupting T cell production. Protein deficiency can also interfere with producing antibodies as humoral immunity (1,4,9,13-17). The purpose of this study was to analyze the relationship between nutritional status and severity of pneumonia in children under five years of age.

METHODS

This research is an analytic study with a cross-sectional design. The research period was from September to December 2019. The data were taken retrospectively from the medical records of pneumonia patients under five years old hospitalized at this hospital from January 2018 to October 2019. The inclusion criteria were pediatric patients under five years old with a diagnosis of pneumonia. The exclusion criteria were incomplete medical record data.

Sixty-eight patients aged 0 to 59 months met the inclusion criteria. Measurement of nutritional status was carried out using the WHO Z-Score weight for age curve because there was no height data in the medical record. There are three categories: wasting if the weight for age < -3 SD, undernutrition if -3 to < -2 SD, normal nutrition if -2 to $+2$ SD, and overnutrition if $> +2$ SD. We reclassified into two groups, normal and abnormal nutrition, where over nutrition, nutrition and wasting were included in the abnormal nutrition group. The classification of pneumonia was divided into mild and severe pneumonia, according to Rahajoe et al. 2018. Classified as severe pneumonia if there is shortness of breath. In contrast, mild pneumonia is if there is no shortness of breath and rapid breathing with a respiratory rate of more than 50 breaths per minute for ages two months to 1 year and more than 40 breaths per minute for ages older than one year to 5 years (18).

Univariate analysis was carried out to describe the characteristics of each variable and subject. Bivariate analysis was performed using the chi-square test.

Data were analyzed using SPSS 26 software. This research has received approval from the research ethics committee of the Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, with approval number 102A/PE/KE/FKK-UMJ/XII/2019 and the research ethics committee of the Infectious Disease Hospital Prof. Dr. Sulianti Saroso with approval number 53/XXXVIII.10/XI/2019.

RESULTS

Respondents with an age range of 0-11 months, 12-35 months, and 36-59 months were 34 (50%), 21 (30.9%), and 13 (19.1%) patients, respectively. Male and female sexes accounted for 30 (44.1%) and 38 (55.9%) patients, respectively.

Table 1. Characteristic of Subject

Characteristic	Frequency	Percent (%)
Age (month)		
0-11	34	50.0
12-35	21	30.9
36-59	13	19.1
Total	68	100.0
Sex		
Male	30	44.1
Female	38	55.9
Total	68	100.0
Classification of Pneumonia		
Mild	18	26.5
Severe	50	73.5
Total	68	100.0
Nutritional Status		
Normal	30	44.1
Abnormal	38	55.9
Abnormal nutritional status		
Over	1	3
Under	12	31
Wasting	25	66

Classification of mild and severe pneumonia accounted for 18 (26.5%) and

50 (73.5%) patients, respectively. The nutritional status for overnutrition, normal nutrition, under nutrition and wasting are 1, 30, 12, and 25 patients, respectively. This nutritional status group was reclassified into normal and abnormal nutrition with 30 (44.1%) and 38 (55.9%) patients. The results of the cross-tabulation test with the Chi-square test showed a p-value of 0.005, so there was a statistically significant relationship between nutritional status and pneumonia severity.

Table 2. Cross Tabulation Data of Nutritional Status and the Severity of Pneumonia

Nutritional Status	Severity of Pneumonia				p-value	95% CI
	Mild		Severe			
	N	%	N	%		
Normal	13	43.3	17	56.7	0.005	1.542-16.521
Abnormal	5	13.2	33	86.8		
Total	18	26.5	50	73.5		

DISCUSSION

Pneumonia is an infectious disease of the lung parenchyma caused by bacteria, viruses, or fungi. It is estimated that 150.7 million cases of pneumonia are found annually in children under five years of age, 20 million of which require hospitalization. In Europe and North America, the incidence of pneumonia was 34-40 cases per 1000 population of children under-five age group but decreased to 7 cases per 1000 population in children 12-15 years, age group. Pneumonia causes 18% of deaths in children under five years of age, a number that is more common in developing countries than in developed countries (19).

In this study, the age range with the highest incidence of pneumonia was 0-11 months. This result is in line with the research conducted by F. Firdaus et al. at M. Djamil Hospital, Padang, where the most age range with pneumonia was two months to 24 months, which was 73.3% (20). Research conducted by A. Artawan et al. in

Sanglah Hospital also obtained similar results, namely the highest age range was 0-12 months, which was 63.2% (19). The younger the child, the more susceptible to infection due to an immature immune system (1).

The gender in this study was female, namely 54.4%. This result is similar to Nurnajiah et al.'s study at M. Djamil Hospital, Padang, where most pneumonia patients were women (1). Immune status was not influenced by gender but by genetics, age, metabolic, environmental and nutritional, anatomical, physiological, and microbiology (21). The most cases of pneumonia in this study were severe pneumonia, which was 73.5%. While the most nutritional status was abnormal nutrition as much as 55.9% consisting of groups of over nutrition, under nutrition and wasting.

In cross-tabulation, patients suffering from mild pneumonia with normal and abnormal nutritional status were 43.3% and 13.2%, respectively. Patients were suffering from severe pneumonia with abnormal nutritional status (86.8%) more than normal (56.7%). The chi-square test results showed a statistical relationship between nutritional status and the severity of pneumonia in children under five years of age. This result is similar to the study conducted by Purnama YM et al. on patients aged under five years at Al-Ihsan Hospital where patients with malnutrition mainly experienced severe or very severe pneumonia. There was a significant relationship between nutritional status and pneumonia severity with a p-value <0.05 (4). Research conducted by Firdaus et al. at M. Djamil Hospital Padang also obtained similar results that there was a relationship between nutritional status and the severity

of pneumonia in children under five years of age (20). A similar result was also obtained by Andriani et al. in their research on children under five years who were hospitalized with pneumonia in UKI hospital, that undernutrition was strongly associated with the severity of pneumonia (22). Ruwandasari et al. also obtained a similar result that the number of severe malnutrition cases has a positive correlation with the number of pneumonia cases among under five-year-old children per regency/city in East Java in 2015 – 2017 (8).

Infection and malnutrition always have a close relationship (23). Malnutrition is the leading cause of immunodeficiency worldwide. Five infectious diseases (pneumonia, diarrhea, malaria, measles, and AIDS) cause more than half the deaths of children under five years of age worldwide, most of whom suffer from malnutrition. Micronutrient deficiency affects poor growth and impaired intelligence and increases mortality and susceptibility to infection. Malnutrition makes children underweight, weak, and susceptible to infection, mainly because of epithelial integrity and inflammation (17,24–29). Malnutrition often involves multiple nutrient deficiency syndromes. Single nutrients such as amino acids, lipids, vitamins, and minerals, have specific effects on host cell resistance (8,25,30).

Malnutrition can cause dysfunction of various organ systems. The severity of these organs depends on several factors, including the amount and rate of protein synthesis, the rate of cell proliferation, and the role of individual nutrients in metabolic pathways. Lymphoid tissue is particularly vulnerable to the effects of this damage. Many immune system cells, whose function

is dependent on metabolic pathways, use nutrition as an essential factor (25). Malnutrition is associated with intestinal barrier function, reduced exocrine secretion of protective substances, and decreased plasma complement levels. Lymphatic tissue, especially the thymus, is atrophic, and the delayed-type hypersensitivity response is diminished. Levels of antibodies produced after vaccination decreased in malnourished children, but levels remained at moderately malnourished (25,26).

CONCLUSION

There is a relationship between nutritional status and pneumonia severity in inpatients under five years of age at Infectious Disease Hospital Prof. Dr. Sulianti Saroso. Malnutrition is closely related to infection, especially Pneumonia.

ACKNOWLEDGMENTS

We thank the Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta and the Infectious Disease Hospital, Prof. Dr. Sulianti Saroso for allowing us to research there.

CONFLICT OF INTEREST

There is no conflict of interest in this research.

REFERENCES

1. Nurnajiah M, Rusdi R, Desmawati D. Hubungan Status Gizi dengan Derajat Pneumonia pada Balita di RS. Dr. M. Djamil Padang. *Jurnal Kesehatan Andalas*. 2016;5(1):250–5.
2. Nascimento-Carvalho CM. Community-acquired pneumonia among children: the latest evidence for an updated management. *J Pediatr (Rio J)*. 2020;96:29–38.
3. Awasthi S, Rastogi T, Pandey AK, Roy C, Mishra K, Verma N, et al. Epidemiology of Hypoxic Community-Acquired Pneumonia in Children Under 5 Years of Age: An Observational Study in Northern India. *Front Pediatr*. 2022;9.
4. Johar D, Day AG, Ziegler EE. Clinical Presentation of Malnourished Patients with Pneumonia Requiring Prolonged Ventilatory Support. *International Journal of Clinical Pediatrics*. 2016;5(2):19–28.
5. Purnama MY, Farchiyah EN. Hubungan Status Gizi dengan Derajat Keparahan Pneumonia pada Pasien Balita Rawat Inap di Rumah Sakit Al-Ihsan. 2017;341–7.
6. Syahniar R, Nabila AN, Kharisma DS, Akbar MA. Comparison between monotherapy and combination therapy among inpatients with community-acquired pneumonia. *Jurnal Ilmiah Farmasi*. 2021;17(1):56–63.
7. Susila INW, Suryawan IWB, Widiassa AAM. Association between Nutritional Status and Severity of Pneumonia among Children under Five Years attending Wangaya District Hospital. *Warmadewa Medical Journal*. 2021;6(1):30–6.
8. Ruwandasari N. Correlation between Severe Malnutrition and Pneumonia among Under-Five Children in East Java. *Jurnal Berkala Epidemiologi*. 2019;7(2):120.
9. Chowdhury F, Shahid ASMS Bin, Ghosh PK, Rahman M, Hassan MZ, Akhtar Z, et al. Viral etiology of

- pneumonia among severely malnourished under-five children in an urban hospital, Bangladesh. *PLoS One*. 2020;15(2):6–18.
10. Akuzawa N, Naito H. Nutritional parameters affecting severity of pneumonia and length of hospital stay in patients with pneumococcal pneumonia: A retrospective cross-sectional study. *BMC Pulm Med*. 2015;15(1):1–7.
 11. WHO. Pneumonia [Internet]. 2021. Available from: <https://www.who.int/news-room/fact-sheets/detail/pneumonia#:~:text=In children under 5 years,the chest expands during inhalation.>
 12. Ngaisyah RD, Avianty S. The Implementation of Complimentary Food on Stunted Children. *Muhammadiyah Medical Journal*. 2020;1(1):1-9
 13. Ginsburg AS, Foundation MG, Box PO, Berkley JA, Walson JL. Europe PMC Funders Group Undernutrition and pneumonia mortality. 2019;3(12):15–7.
 14. Ginsburg AS, Izadnegahdar R, Berkley JA, Walson JL, Rollins N, Klugman KP. Undernutrition and pneumonia mortality. *Lancet Glob Health*. 2015;3(12):e735–6.
 15. Kirolos A, Blacow RM, Parajuli A, Welton NJ, Khanna A, Allen SJ, et al. The impact of childhood malnutrition on mortality from pneumonia: A systematic review and network meta-analysis. *BMJ Glob Health*. 2021;6(11):1–8.
 16. Dewi PRA, Biantara IGYP, Windiyanto R. Recurrent pneumonia in malnourished children. *Int J Res Med Sci*. 2022;10(2):519.
 17. M R DrS, M R DrP, B. DrT. The severity of malnutrition among children with pneumonia and diarrhoea: moderate acute malnutrition- a neglected entity. *Pediatric Review: International Journal of Pediatric Research*. 2020;7(2):80–6.
 18. Rahajoe NN. *Buku Ajar Respiriologi Anak*. 1st editio. Jakarta Pusat: Ikatan Dokter Anak Indonesia; 2018.
 19. Artawan A, Purniti PS, Sidiartha IGL. The Relationship between Nutritional Status with Pneumonia Severity in Children at Sanglah Hospital, Bali, Indonesia. *Sari Pediatri*. 2016;17(6):418.
 20. Firdaus FS, Chundrayetti E, Nurhajah S. Hubungan Status Gizi, Umur, dan Jenis Kelamin dengan Derajat Pneumonia pada Balita di RSUP Dr. M. Djamil Padang Periode Januari 2018 – Desember 2018. *Jurnal Ilmu Kesehatan Indonesia*. 2021;2(1):143–50.
 21. Darwin E. *Immunologi dan Infeksi*. Padang: Andalas University Press; 2006.
 22. Adriani A, Simarmata VP. The Relationship between Nutritional Status and Degree of Pneumonia in Toddlers at Universitas Kristen Indonesia General Hospital. *Journal of Drug Delivery and Therapeutics*. 2022;12(3-S):129–33.
 23. Andini L, Nurfadly N. Correlation between Soil Transmitted Helminth Infection with Nutritional Status in Elementary School at Deli Serdang Regency North Sumatera. *Muhammadiyah Medical Journal*. 2021 May 31;2(1):7-14.

24. Katona P, Katona-Apte J. The interaction between nutrition and infection. *Clinical Infectious Diseases*. 2008;46(10):1582–8.
25. Masrizal MA. Effects of Protein-Energy Malnutrition on the Immune System. *MAKARA of Science Series*. 2010;7(2):69–73.
26. Rytter MJH, Kolte L, Briend A, Friis H, Christensen VB. The immune system in children with malnutrition - A systematic review. *PLoS One*. 2014;9(8).
27. Walson JL, Berkley JA. The impact of malnutrition on childhood infections. *Curr Opin Infect Dis*. 2018;31(3):231–6.
28. Elsayh KI, Sayed DM, Zahran AM, Saad K, Badr G. Effects of pneumonia and malnutrition on the frequency of micronuclei in peripheral blood of pediatric patients. *Int J Clin Exp Med*. 2013;6(10):942–50.
29. Susanti M, Juliaty A. Marasmus and stunting in 2-month-old boy with pneumatocele. *Universa Medicina*. 2021;40(3):263–9.
30. Rahman S, Khatun A, Azhar B, Rahman H, Hossain S. A Study on the Relationship between Nutritional Status and Prevalence of Pneumonia and Diarrhea among Preschool Children in Kushtia. *Pediatrics Research International Journal*. 2014;2014:1–10.