Original Article

THE INDONESIAN
JOURNAL OF INFECTIOUS DISEASES

p-ISSN: 2354-6077), e-ISSN: 2599-1698

Association of Nutritional Status with Pneumonia Among Children Aged 6–24 Months Hospitalized in Pelalawan District, Indonesia

Riska Epina Hayu[1*], Adek Trisnawati Harahap[2], Eva Mayasari[1]

[1] Al Insyirah Institute of Health and Technology, Riau, Indonesia
[2] Selasih Regional General Hospital, Riau, Indonesia

ARTICLE INFO

Received: 13 October 2025
Reviewed: 19 December 2025
Accepted: 26 February 2026

Keywords:
Nutritional status, pneumonia, children under two years, risk factors, child health.

*Corresponding author:
Riska Epina Hayu
Email: riska.epina@ikta.ac.id

ABSTRACT

Background: *Pneumonia remains one of the leading causes of morbidity and mortality among children under five years of age, particularly those younger than two years. Malnutrition is an important risk factor that can impair immune function and increase susceptibility to respiratory infections, including pneumonia. Hospital records at Selasih Regional Hospital, Pelalawan District, indicated an increase in pneumonia cases and malnutrition among children under two years of age. This study aimed to determine the relationship between nutritional status and the incidence of pneumonia among children aged 6–24 months.*
Methods: *This study employed a cross-sectional design using secondary data obtained from inpatient medical records at Selasih Regional Hospital. The study population consisted of all children aged 6–24 months who were hospitalized between 2017 and 2022. A total of 393 medical records met the inclusion criteria and were included using a total sampling technique. Data were analyzed using the Chi-square test.*
Results: *A significant relationship was found between nutritional status and the incidence of pneumonia ($p<0.001$). Children with poor nutritional status were 28.7 times more likely to develop pneumonia than children with normal nutritional status (OR=28.7; 95% CI: 13.5–60.7).*
Conclusion: *Poor nutritional status is strongly associated with an increased risk of pneumonia among children aged 6–24 months. Efforts to improve nutritional status may help reduce the burden of pneumonia among young children.*

INTRODUCTION

Acute respiratory infections, particularly pneumonia, were still the leading cause of morbidity and mortality among infants and young children in both developed and developing countries [1]. In 2019, pneumonia was the cause of death of 740,180 infants. This death toll was equivalent to 14% of total infant deaths globally, but reached 22% when calculated only for the 1-5 years age group [2].

Pneumonia often triggers serious complications, leading to a high risk of death, such as respiratory failure, especially in infants [3]. In 2017, more than 800,000 children under 5 years old died from pneumonia worldwide; most of these deaths occurred in low- and middle-income countries, often in settings of underlying undernutrition, which is a major risk factor for mortality [4].

The World Health Organization (WHO), in collaboration with the United Nations Children's Fund (UNICEF), established the Integrated Management of Childhood Illness (IMCI). This initiative aimed to reduce child mortality and morbidity from diseases, including pneumonia [5]. The WHO recommended that children with severe pneumonia be treated in a hospital for supportive care, including oxygen therapy for hypoxemia, airway suction, antibiotics, and close monitoring. In contrast, children with non-severe pneumonia could usually be treated at home. In low- and middle-income countries, the number of children hospitalized for pneumonia increased by 187%, from 5.7 million in 2000 to 16.4 million in 2015. Overall, hospital admissions for childhood pneumonia increased by a factor of 2.9 over the 15 years [6].

Chronic and acute malnutrition significantly increased the risk of developing pneumonia and worsened the severity of the disease. In Indonesia, including Riau Province, malnutrition was still a major challenge, especially among children under two years of age, with 25,617 infants affected. Data from the Riau Provincial Health Department showed an increase in pneumonia incidence in this age group in recent years, with 1,581 infants (8.8%) diagnosed and treated for pneumonia in 2021. One of the largest contributors to pneumonia cases in Riau Province was Pelalawan Regency, with 157 cases (11.6%) [7]. Selasih District General Hospital was one of the largest hospitals in Pelalawan Regency, located in the center of Pangkalan Kerinci. A preliminary study conducted at Selasih District General Hospital revealed an increase in pneumonia cases among children aged 6-24 months in 2022 [8].

Previous studies have shown a relationship between nutritional status and the occurrence of pneumonia. According to Chen et al.'s study, there was an association between nutritional status and pneumonia incidence among the elderly [9]. Most of these studies had a limited scope and employed diverse methodologies, particularly in their age categories. Therefore, the researcher was interested in conducting a study focused on children under 2 years of age, as they are particularly susceptible to health problems, especially infectious diseases. The health of infants and young children is of utmost importance, as this is a period of rapid physical and mental growth and development. One of the efforts to improve infant and child health is through the prevention of infections and long-term rehabilitation and care for chronic/rare diseases. Furthermore, the lack of specific studies examining the relationship between nutritional status and pneumonia in 6-24-month-old children hospitalized in rural areas of Riau Province motivated the author to conduct this research.

METHODS

This was an observational, analytic, cross-sectional study conducted at Selasih Regional General Hospital in Pelawawan Regency. The study obtained official research permission from the Director of Selasih Regional General Hospital (Approval No. 445/BLUD-RSUD/VI/2023/2525). Ethical approval was not sought because this study used secondary data from hospital medical records. Nevertheless, official permission was obtained from the hospital, and all data were analyzed anonymously with no patient names or personal identifiers included, thereby ensuring confidentiality and privacy. The study population comprised all hospitalized patients aged 6–24 months during 2017–2022. The sample included the entire population (total sampling), consisting of 393 patients.

The data collected included nutritional status, pneumonia, gender, and age. The dependent variable in this study was the incidence of pneumonia; the operational definition of pneumonia was all pediatric patients who, based on the doctor's clinical symptoms and X-ray results, tested positive for pneumonia. The independent variable in this study was nutritional status; the operational definition of nutritional status was determined based on the nutritional status category of weight/height and the threshold (Z-Score) by referring to the Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2020 concerning Child Anthropometry Standards, with details in Table 1.

Table 1. Nutritional Status Categories Based on W/H

Index	Nutritional Status Category	Z-Score Threshold
Weight-for-Length or Weight-for-Height (W/L or W/H) of Children Aged 0-60 Months	Malnutrition	< -3 SD
	Underweight	- 3 SD sd <- 2 SD
	Normal	-2 SD sd +1 SD
	At Risk of Overweight (*possible risk of overweight*)	> + 1 SD sd + 2 SD
	Overweight	> + 2 SD sd + 3 SD
	Obese	> + 3 SD

Age was defined as the child's age in months, calculated from the date of birth to the date of hospital admission, and categorized into two groups: 6–12 months and 13–24 months. Sex was defined as the biological sex of the child as recorded in the hospital medical records and classified as male or female.

The statistical test used was the Chi-Square test using SPSS software version 23.0. Univariate analysis was performed to describe sample characteristics, and bivariate analysis was

conducted using the Chi-square test to examine the association between nutritional status and pneumonia incidence. The level of significance was set at $p < 0.05$.

RESULTS

The following are the results of univariate analysis based on the variables studied in this study. The results of the univariate analysis showed that, among children hospitalized from 2017 to 2022, those with poor nutritional status numbered 72 (18.3%), while those with good nutritional status numbered 321 (81.7%), for a total of 393 children. The number of children with pneumonia was 126 (32.1%), and those without pneumonia were 267 (67.9%). The number of boys was 209 (53%), and the number of girls was 184 (47%). (Table 2)

Table 2. Univariate Analysis Results

Variable	Category	Number	Percentage
Nutritional Status	Malnutrition+underweight	72	18.3
	normal	321	81.7
Pneumonia	Pneumonia	126	32.1
	other diagnoses	267	67.9
Age	6-12 months	164	41.7
	13-24 months	229	58.3
Gender	Male	209	53
	Female	184	47

From 2017 to 2022, pneumonia cases among hospitalized children aged 6–24 months showed an overall increasing trend, rising from 14 to 41 cases. Malnutrition cases remained relatively stable between 2017 and 2019, declined during the COVID-19 pandemic in 2020, and then increased substantially, reaching 21 cases in 2022. Similarly, pneumonia cases decreased in 2020 before rising sharply through 2022. Both conditions peaked in 2022, suggesting a potential relationship between malnutrition and pneumonia among hospitalized pediatric patients (Figure 1).

Figure 2 shows the trend in the number of hospitalized children aged 6–24 months from 2017 to 2022. The number of inpatients increased from 49 in 2017 to 75 in 2018, then declined slightly to 69 in 2019. A substantial decrease was observed in 2020, with only 45 hospitalized cases, likely reflecting the impact of the COVID-19 pandemic on healthcare utilization. Subsequently, inpatient admissions increased markedly to 74 cases in 2021 and reached a high of 81 cases in 2022, indicating a recovery and continued rise in pediatric hospitalizations after the pandemic period.

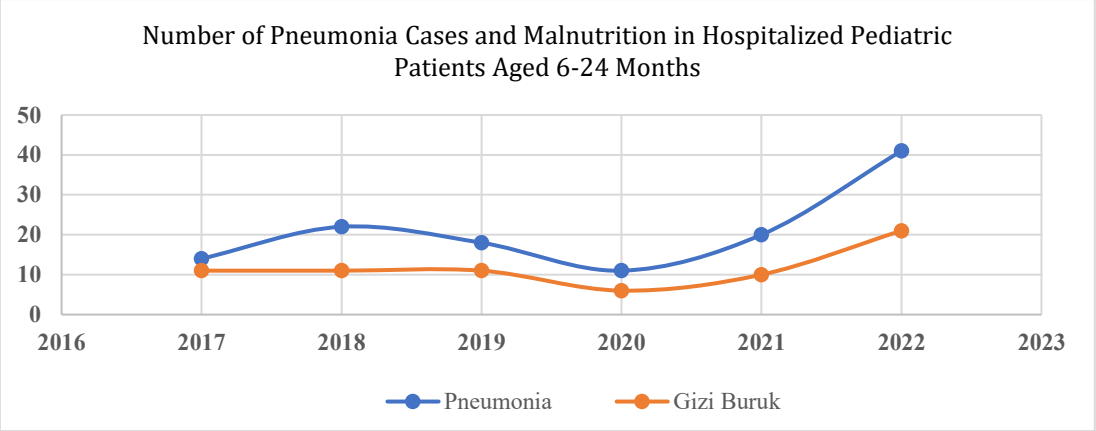

Figure 1. Incidence of Malnutrition and Pneumonia in Children Aged 6-24 Months from 2017 to 2022.

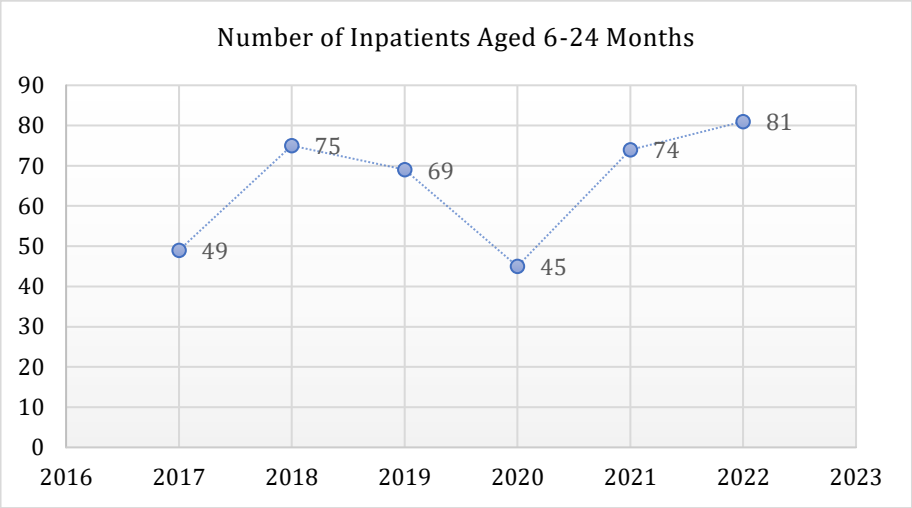

Figure 2. Number of Inpatients Aged 6-24 Months from 2017 to 2022.

Bivariate analysis demonstrated that nutritional status was significantly associated with the incidence of pneumonia among children aged 6–24 months. Children with malnutrition or underweight status had substantially higher odds of developing pneumonia compared with those with normal nutritional status (OR = 28.7; 95% CI: 13.5–60.7; $p < 0.001$), indicating a strong and statistically significant association, as the confidence interval did not include 1. This finding suggests that poor nutritional status is a major contributing factor to pneumonia occurrence in this age group. In contrast, age and sex were not significantly associated with pneumonia incidence. Children aged 6–12 months had lower odds of pneumonia than those aged 13–24 months (OR = 0.74; 95% CI: 0.48–1.13; $p = 0.194$); however, the confidence interval crossed 1, and the association was not statistically significant. Similarly, male children had nearly the same odds of developing pneumonia as female children (OR = 1.04; 95% CI: 0.68–1.60; $p = 0.915$),

indicating no significant relationship between sex and pneumonia incidence in this study (Table 3).

Table 3. Results of Bivariate Analysis of Nutritional Status on the Incidence of Pneumonia

Variables	Pneumonia	Other diagnoses	OR (95% CI)	P-Value
Nutritional Status				
Malnutrition+underweight	63 (16.03%)	9 (2.2.9%)	28.7 (13.5-60.7)	0.000*
normal	63 (16.03 %)	258 (65.6%)		
Age				
6-12 months	59 (15%)	105 (26.7%)	0.74 (0.48-1.13)	0.194
13-24 months	67(17.1%)	162 (41.2%)		
Gender				
Male	68 (17.3%)	141 (35.9%)	1.04 (0.68-1.60)	0.915
Female	58 (14.8%)	126 (32.1%)		

DISCUSSION

The study on the relationship between nutritional status and pneumonia among hospitalized young children found a significant association. These findings are consistent with Amru's research, which also reported a significant association between nutritional status and pneumonia in infants [10]. Based on Afriani's research, nutritional status was identified as a risk factor for pneumonia in infants [11]. Underweight infants were 3.28 times more likely to experience pneumonia compared to well-nourished infants [12]. Sutriana's research on risk factors for pneumonia in Indonesia found that undernourished children had a 2.77 times higher risk of pneumonia, with a p-value of 0.028 [13].

Underweight and malnourished infants were at a higher risk of developing pneumonia [14]. Shampa's research showed that children with pneumonia could be classified based on the location of inflammation, namely bronchiolitis and pneumonia. Poor nutritional status could impair the immune system [15]. Immune cells are located in specific tissues and organs, namely the lymphoid tissue. The thymus is one of the primary lymphoid organs. T cells produced by the thymus in infants play a crucial role in the body's defense mechanism against foreign substances. Therefore, undernourished infants had weakened immune systems, making them more susceptible to infections [16]. Poor or malnourished conditions could exacerbate a child's ability to fight off infectious diseases compared to well-nourished children. Pneumonia is one of the most common infectious diseases in children and can be fatal in malnourished children [17].

Based on Merlinda et al.'s analysis, the Odds Ratio (OR) for the association between nutritional status and pneumonia cases was 3.8 (2.182-6.818), indicating that undernourished infants were 3.8 times more likely to develop pneumonia than well-nourished infants.

Malnutrition impairs the body's defense systems against microorganisms and mechanical defenses, making it more susceptible to infectious diseases such as pneumonia. This is due to the breakdown of body tissues to obtain the protein needed by viruses/bacteria. Theoretically, malnourished children are more susceptible to diseases, including pneumonia. Malnutrition, resulting from nutrient deficiencies, decreases the body's ability to fight various infectious diseases. Malnutrition is a major contributing factor to pneumonia in infants [18].

Nutritional deficiency, particularly protein–energy malnutrition, leads to atrophy of the thymus and lymphoid tissues, a reduction in T and B lymphocyte counts, and impaired cytokine production. Consequently, cell-mediated immune responses, including phagocytosis and T-cell activation, are weakened, reducing the body's ability to control bacterial invasion such as *Streptococcus pneumoniae* [19].

In this study, 90% of respondents had infants suffering from pneumonia with poor nutritional status. The researchers assumed this was because most respondents had low family incomes, which could affect their infants' nutritional status. It is likely that if family income were high, the family's purchasing power would be good. Undernourished infants are more susceptible to pneumonia compared to well-nourished infants due to their weaker immune systems. Infectious diseases themselves can cause infants to lose their appetite and lead to malnutrition. In a state of malnutrition, infants are more susceptible to pneumonia.

This study also found respondents whose infants had normal nutritional status but were suffering from pneumonia. Researchers assumed that this occurred due to environmental factors in the infants' living environment that contributed to pneumonia, such as the presence of household members (parents) who smoked indoors, exposing infants to secondhand smoke and increasing their risk of pneumonia. Therefore, it is necessary to enhance nutritional counseling for mothers to increase their knowledge and enable them to improve their infants' diets by providing nutritious, varied, balanced, and safe foods. Additionally, to prevent pneumonia in infants, parents are encouraged to create a safe environment for their babies, such as opening windows for ventilation, avoiding smoking near infants, and maintaining a distance if they have pneumonia.

This study found that pneumonia was more prevalent among male children than among female children, although the difference was not significant. These findings are consistent with the research conducted by Wuerth et al., which showed that hospitalization rates and mortality rates for pneumonia were higher in males (especially the elderly) compared to females [20]. However, in contrast to the findings of A'yuni's study, which employed a Chi-Square test, there was no significant association found between gender and the occurrence of pneumonia in infants [21]. In this study, age was one of the variables analyzed, as the researchers assumed it is a primary risk factor for several diseases and can reflect an individual's health condition. Children

aged 0-24 months were more susceptible to pneumonia compared to children over 2 years old due to their underdeveloped immune systems and relatively narrow airways.

Several lines of scientific evidence indicate biological differences in immune responses to infection between males and females, which may contribute to observed trends in respiratory disease incidence. A review published in *Biology of Sex Differences* reported that males are more susceptible to bacterial respiratory tract infections and pneumonia. The anti-inflammatory effects of testosterone and the pro-inflammatory and immunoenhancing effects of estrogen on the immune system partly explain this phenomenon [22].

Childhood malnutrition remains a major global health concern with a profound impact on child morbidity and mortality. The interplay between undernutrition and infectious diseases significantly contributes to poor health outcomes among children. Anthropometric indicators of malnutrition have been linked to a higher risk and greater severity of infections caused by various pathogens, including viruses, bacteria, protozoa, and helminths. Because childhood malnutrition often results from insufficient intake of macronutrients (protein and energy) accompanied by micronutrient deficiencies, the specific mechanisms leading to weakened host defense are not always well defined. This review highlights previous studies examining how primary malnutrition in children affects immune function and increases susceptibility to infectious diseases [23].

Cases of pneumonia and malnutrition in hospitalized children aged 6 to 24 months experienced a fluctuating trend but showed a consistent increase from 2020 to 2022, the post-COVID-19 pandemic period. Selasih Regional General Hospital is located in Pangkalan Kerinci subdistrict. Pangkalan Kerinci is the capital of Pelalawan Regency and its administrative and economic center. This subdistrict has development potential due to its location on the Trans-Sumatra highway [8]. This indicates that this hospital will be a preferred choice for the community to obtain healthcare services.

A limitation of this study is that it only tests the relationship between nutritional status and the occurrence of pneumonia. There is a need to monitor children with poor nutritional status who receive interventions, and then analyze the condition of children with pneumonia to determine whether providing interventions to malnourished patients can reduce the incidence of infectious diseases such as pneumonia.

CONCLUSION

This study demonstrated a significant association between nutritional status and the incidence of pneumonia among hospitalized children aged 6–24 months in Pelalawan District. Children with malnutrition or underweight status had substantially higher odds of developing pneumonia compared with those with normal nutritional status. These findings highlight the

important role of adequate nutrition in supporting immune function and reducing susceptibility to respiratory infections during early childhood. Given the high burden of both malnutrition and pneumonia, strengthening nutritional monitoring, growth surveillance, and early nutritional interventions should be integrated into child health programs. Such efforts may help reduce pneumonia incidence and improve health outcomes among young children, particularly in resource-limited settings.

DECLARATIONS

Ethics approval

This study was approved by Selasih General Hospital in Pelalawan Regency and had obtained research permission from the director of Selasih Hospital with number 445/BLUD-RSUD/VI/2023/2525.

Conflict of interest.

The authors declare no conflict of interest.

Funding

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

Acknowledgments

The authors would like to express their sincere gratitude to the Al Insyirah Institute of Health and Technology and the Selasih Regional General Hospital.

REFERENCES

[1] Kemenkes RI. Infeksi Emerging. Media Informasi Resmi Terkini Tentang Penyakit Infeksi Emerging 2020. https://infeksiemerging.kemkes.go.id/document/Pedoman-WHO---Pusat-Pengobatan-Infeksi-Saluran-Pernapasan-Akut-Berat-SARI-912/view (accessed May 31, 2026).

[2] WHO. Pneumonia in children. World Health Organization 2022. https://www.who.int/news-room/fact-sheets/detail/pneumonia (accessed May 31, 2026).

[3] Shaima SN, Alam T, Bin Shahid ASMS, Shahrin L, Sarmin M, Afroze F, et al. Prevalence, Predictive Factors, and Outcomes of Respiratory Failure in Children With Pneumonia Admitted in a Developing Country. Front Pediatr 2022;10:841628. https://doi.org/10.3389/FPED.2022.841628.

[4] Alam NH, Faruque AS, Ashraf H, Chisti MJ, Ahmed T, Sultana M, et al. Effectiveness, safety, and economic viability of daycare versus usual hospital care management of severe pneumonia with or without malnutrition in children using the existing health system of Bangladesh: a cluster randomized controlled trial. EClinicalMedicine 2023;60. https://doi.org/10.1016/j.eclinm.2023.102023.

[5] Kosai H, Tamaki R, Saito M, Tohma K, Alday PP, Tan AG, et al. Incidence and Risk Factors of Childhood Pneumonia-Like Episodes in Biliran Island, Philippines—A Community-Based Study. PLoS One 2015;10:e0125009. https://doi.org/10.1371/JOURNAL.PONE.0125009.

[6] McAllister DA, Liu L, Shi T, Chu Y, Reed C, Burrows J, et al. Global, regional, and national estimates of pneumonia morbidity and mortality in children younger than 5 years between 2000 and 2015: a systematic analysis. Lancet Glob Health 2019;7:e47–57. https://doi.org/10.1016/S2214-109X(18)30408-X.

[7] Dinas Kesehatan Provinsi Riau. Profil Kesehatan Provinsi Riau. 2021.
[8] Badan Pusat Statistik Kabupaten Pelalawan. Statistik Kesejahteraan Rakyat Kabupaten Pelalawan 2023. https://pelalawankab.bps.go.id/id/publication/2023/12/28/7f203e211a1ac92d420db420/statistik-kesejahteraan-rakyat-kabupaten-pelalawan-2023.html (accessed May 31, 2026).
[9] Chen B, Liu W, Chen Y, She Q, Li M, Zhao HY, et al. Effect of Poor Nutritional Status and Comorbidities on the Occurrence and Outcome of Pneumonia in Elderly Adults. Front Med (Lausanne) 2021;8. https://doi.org/10.3389/FMED.2021.719530.
[10] Amru DE, Putri YD, Selvia A, Kesehatan I, Batam MB. Hubungan Status Gizi Dengan Kejadian Pneumonia Pada Balita. Jurnal Keperawatan 'Aisyiyah 2021;8:1–6. https://doi.org/10.33867/JKA.V8I1.230.
[11] Afriani B, Oktavia L. Faktor Risiko Kejadian Pneumonia Pada Bayi. Babul Ilmi. Jurnal Ilmiah Multi Science Kesehatan. 2021;13:126. https://doi.org/10.36729/BI.V13I2.895.
[12] Andriyani R, Ristica OD. Hubungan Status Imunisasi, Asi Eksklusif, dan Status Gizi dengan Kejadian Pneumonia pada Balita di Puskesmas Rejosari. Jurnal Dunia Kesmas 2017;6. https://doi.org/10.33024/JDK.V6I2.485.
[13] Sutriana VN, Sitaresmi MN, Wahab A. Risk factors for childhood pneumonia: a case-control study in a high-prevalence area in Indonesia. Clin Exp Pediatr 2021;64:588. https://doi.org/10.3345/CEP.2020.00339.
[14] 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. https://doi.org/10.25077/JKA.V5I1.478.
[15] Shampa NN, Mollah MAH, Billah MM, Kabir AL, Saha NC. Comparative Study of Nutritional Status of Children (02-24 Months) with Acute Bronchiolitis and Pneumonia. J Bangladesh Coll Phys Surg 2017;35:9–14. https://doi.org/10.3329/JBCPS.V35I1.32565.
[16] Almatsier S. Prinsip Dasar Ilmu Gizi. Jakarta: Gramedia Pustaka Utama; 2010.
[17] Andriani M, Wirjatmadi B. Gizi & Kesehatan Balita: Peranan Mikro Zinc pada Pertumbuhan Balita. Jakarta: Kencana Prenadamedia Group; 2022.
[18] Mustikarani YA, Rahardjo SS, Qadridjati I, Prasetya H. Contextual Effect of Village on the Risk of Pneumonia in Children Under Five in Magetan, East Java. Journal of Epidemiology and Public Health 2019;4:117–26. https://doi.org/10.26911/JEPUBLICHEALTH.2019.04.02.07.
[19] Ibrahim MK, Zambruni M, Melby CL, Melby PC. Impact of Childhood Malnutrition on Host Defense and Infection. Clin Microbiol Rev 2017;30:919–71. https://doi.org/10.1128/CMR.00119-16.
[20] Wuerth BA, Bonnewell JP, Wiemken TL, Arnold FW. Trends in Pneumonia Mortality Rates and Hospitalizations by Organism, United States, 2002–2011. Emerg Infect Dis 2016;22:1624. https://doi.org/10.3201/EID2209.150680.
[21] A'yuni ZQ, Mamesah LSS, Marhana IA. Faktor Jenis Kelamin dan Status Imunisasi terhadap Kejadian Pneumonia pada Balita di RSUD dr. Soedarso. Jurnal Bidan Cerdas 2022;4:224–31. https://doi.org/10.33860/JBC.V4I4.1635.
[22] Vázquez-Martínez ER, García-Gómez E, Camacho-Arroyo I, González-Pedrajo B. Sexual dimorphism in bacterial infections. Biology of Sex Differences 2018 9:1 2018;9:27-. https://doi.org/10.1186/S13293-018-0187-5.
[23] Ibrahim MK, Zambruni M, Melby CL, Melby PC. Impact of Childhood Malnutrition on Host Defense and Infection. Clin Microbiol Rev 2017;30:919. https://doi.org/10.1128/CMR.00119-16.