**Medical and Health Journal**
Volume 5, Issue 2, 2026, pp. 396-402
e-ISSN: 2807-3541
Open Access: https://jos.unsoed.ac.id/index.php/mhj

# Exclusive Breastfeeding and the Risk of Complicated Pneumonia in Toddlers: A Literature Review

**Puja Rizkina Angelita[1*], Wayan Sulaksmana Sandhi Parwata[2], Titi Pambudi Karuniawaty[2]**
[1]Faculty of Medicine, Mataram University, Mataram, West Nusa Tenggara, Indonesia
[2]Department of Pediatric, Faculty of Medicine, Mataram University, Mataram, West Nusa Tenggara, Indonesia

**ARTICLE INFO**

**Article history:**
Received November 11, 2025
Revised January 27, 2026
Accepted February 2, 2026
Available online February 8, 2026

**Keywords:**
Exclusive breastfeeding, toddlers, risk factors, pneumonia, complications

***ABSTRACT***

*Pneumonia is a leading cause of morbidity and mortality in children under five worldwide. The World Health Organization (WHO, 2019) reports that pneumonia accounts for approximately 14% of all infant deaths, with more than 740,000 deaths per year. In Indonesia, the prevalence of pneumonia in infants remains high, including in West Nusa Tenggara Province, which recorded 32,128 cases in 2023, with 4,183 cases in West Lombok Regency. One protective factor believed to reduce the risk of pneumonia is exclusive breastfeeding during the first six months of life. Breast milk contains various immunological components such as secretory immunoglobulin A (sIgA), lactoferrin, lysozyme, and oligosaccharides, which play a role in protecting against lower respiratory tract infections (Lyons et al., 2020; Moraes-Pinto et al., 2021). This literature review was compiled using a narrative literature review method using relevant national and international sources, including journals from PubMed, ScienceDirect, and official WHO and UNICEF reports. The literature reviewed was published between 2015 and 2024, focusing on the relationship between exclusive breastfeeding and the incidence of pneumonia in toddlers. The analysis was conducted descriptively and thematically, reflecting the content of previous studies. Based on the study results, exclusive breastfeeding has been shown to have a significant protective effect against the incidence of pneumonia. Infants who are not exclusively breastfed have a two to five times higher risk of developing lower respiratory tract infections (Popovsky, E.Y. and Florin, T.A., 2021). A global study by Victora et al. (2016) found that exclusive breastfeeding reduces the risk of severe pneumonia by up to 64% and has the potential to prevent 820,000 child deaths annually. However, the incidence of complicated pneumonia is also influenced by other factors such as nutritional status, basic immunizations, exposure to cigarette smoke, and home environmental conditions (Dean & Florin, 2018; Saunders, 2017). Exclusive breastfeeding plays a crucial role in preventing pneumonia in toddlers through immunological mechanisms and protection of the respiratory mucosa. However, because pneumonia is a multifactorial disease, the effectiveness of exclusive breastfeeding needs to be supported by improved nutritional status, immunization coverage, and environmental improvements. Comprehensive promotive and preventive efforts are needed to reduce the incidence of pneumonia and its complications in the community..*

## 1. INTRODUCTION

Pneumonia, particularly severe pneumonia, remains a leading cause of morbidity and mortality in children under five. The World Health Organization (WHO, 2019) reports that pneumonia accounts for approximately 14% of global under-five deaths, with over 740,000 deaths per year. In Indonesia, under-five pneumonia remains a significant public health problem, particularly in areas with limited health resources. Data from the Indonesian Ministry of Health (2023) indicates more than 500,000 cases of under-five pneumonia per year, with a high burden in several provinces, including West Nusa Tenggara. In West Lombok Regency, 4,183 cases of under-five pneumonia were recorded in 2023, indicating a potentially high incidence of severe pneumonia or pneumonia with complications at the regional level.

*Corresponding author
E-mail addresses: pujarizkinaangelita@gmail.com (Puja Rizkina Angelita)

Exclusive breastfeeding during the first six months of life is a protective factor that plays a crucial role in preventing lower respiratory tract infections. The immunological components of breast milk, such as secretory immunoglobulin A (sIgA), lactoferrin, lysozyme, and oligosaccharides, serve to strengthen the airway mucosal barrier, suppress pathogen colonization, and modulate the inflammatory response that plays a role in the progression of pneumonia to severe forms or complications (Lyons et al., 2020; Moraes-Pinto et al., 2021). Several studies have reported that infants who are not exclusively breastfed have a higher risk of pneumonia and severe lower respiratory tract infections than infants who are exclusively breastfed (Popovsky & Florin, 2021).

However, evidence regarding the association between exclusive breastfeeding and the prevention of severe pneumonia or pneumonia with complications remains inconsistent. This variation in findings is thought to be influenced by the multifactorial nature of pneumonia, including nutritional status, immunization coverage, environmental exposures, and access to healthcare (Dean & Florin, 2018; Saunders, 2017). The inconsistency of these research findings constitutes a key research gap that underlies the need for this study, particularly in the context of areas with a high pneumonia burden.

This study aims to critically examine the relationship between exclusive breastfeeding and the incidence of pneumonia with complications in infants. The study focuses on the latest scientific evidence highlighting the protective role of breastfeeding against pneumonia severity and complications, within the context of West Lombok, a high-risk area. A clear separation between the study's objectives, analytical focus, and regional context is expected to strengthen the systematic flow of the introduction. The novelty of this study lies in its emphasis on the immunological contribution of exclusive breastfeeding in preventing pneumonia with complications in infants, which is analyzed through a synthesis of the latest and clinically relevant scientific evidence. Thus, the novelty lies not only in the geographic context but also in strengthening scientific understanding of the role of breastfeeding in suppressing disease progression.

Overall, this introduction confirms that a comprehensive understanding of the relationship between exclusive breastfeeding and pneumonia with complications has important clinical significance, particularly in efforts to reduce disease severity and hospital referral rates. The findings of this study are expected to be the basis for strengthening the policy of promoting exclusive breastfeeding as the main preventive strategy in controlling pneumonia with complications in toddlers, especially in areas with a high disease burden such as West Lombok. This study uses a narrative literature review approach, which aims to synthesize and discuss scientific findings related to the relationship between exclusive breastfeeding and the incidence of pneumonia with complications in infants. This approach is not intended to conduct a quantitative synthesis, meta-analysis, or causal assessment, but rather to provide conceptual and clinical understanding based on available evidence, so that readers' expectations regarding the study's outcomes can be managed appropriately.

## 2. METHOD

Data sources were obtained from online scientific databases, namely PubMed, ScienceDirect, Google Scholar, and ResearchGate, as well as from official sources from international organizations such as the World Health Organization (WHO) and the United Nations International Children's Emergency Fund (UNICEF). The included literature was published within the last ten years to ensure scientific freshness and relevance in line with current developments. The literature search was conducted using a combination of English and Indonesian keywords, including "exclusive breastfeeding," "pneumonia in children," "respiratory infection," "under-five," and "complicated pneumonia." The logical operators "AND" and "OR" were used to expand and focus the search results according to the study topic. The literature search and screening process was structured, but did not follow a systematic review framework like PRISMA. Initial screening was based on titles and abstracts to assess suitability for the study's focus. Articles that met the criteria were then subjected to a full review. This process resulted in 14 articles deemed

adequate to support the study's objectives, given the specific focus of the analysis on complicated pneumonia and the limited number of studies explicitly addressing this aspect.

The analysis was conducted narratively using a thematic approach. Each article was read in depth to identify the study design, population characteristics, key variables, and key findings. The review results were grouped into the following main themes: (1) epidemiology of pneumonia in infants, (2) immunological mechanisms of exclusive breastfeeding, (3) the relationship between exclusive breastfeeding and severe pneumonia or complicated pneumonia, and (4) other factors influencing pneumonia severity. To minimize selection and interpretation bias, article selection was based on consistently established criteria, and interpretation of results was based on comparisons between studies. Although narrative in nature, this review also considered the basic methodological quality of the reviewed articles, such as clarity of study design, variable definitions, and consistency of results, to enhance the credibility of the presented synthesis.

Inclusion criteria included original research articles with cohort and case-control designs, as well as relevant literature reviews involving children under five years of age, discussing pneumonia, specifically severe or complicated pneumonia, in relation to exclusive breastfeeding. The definition of complicated pneumonia refers to pneumonia with clinical severity or systemic complications as reported in each study. Exclusion criteria included articles discussing pneumonia in the adult population, non-exclusive breastfeeding without a clear distinction, publications with low methodological quality, and articles irrelevant to the focus of the review..

## 3. RESULT AND DISCUSSION

A literature review shows that pneumonia remains a leading cause of death in children under five years of age, especially when it develops into severe forms or complicated pneumonia. WHO data (2019) indicates that pneumonia accounts for approximately 14% of under-five deaths globally. Pathophysiologically, infection of the alveoli triggers an inflammatory response that disrupts gas exchange, and under certain conditions, progresses to systemic inflammation, increasing the risk of complications (Nascimento-Carvalho, 2020). The analyzed literature indicates that complicated pneumonia in children can originate from bacterial, viral, or fungal infections. The most common pathogens are Streptococcus pneumoniae, Haemophilus influenzae type b (Hib), Staphylococcus aureus, and respiratory viruses such as Respiratory Syncytial Virus (RSV) (Mani, 2017; Popovsky & Florin, 2021). Once the pathogen reaches the alveoli, an inflammatory reaction occurs, characterized by neutrophil infiltration, increased capillary permeability, and fluid exudation into the alveolar space. This results in impaired oxygenation, leading to symptoms of shortness of breath, tachypnea, and chest wall indrawings.

Clinically, pneumonia in toddlers is characterized by fever, cough, rapid breathing, chest wall indrawings, and even cyanosis in severe cases (Saunders, 2017). If not treated promptly, the infection can spread to surrounding tissues and lead to serious complications such as pleural effusion, empyema, lung abscess, sepsis, and Acute Respiratory Distress Syndrome (ARDS) (Ihtisyam et al., 2023). Complicated pneumonia often presents with more severe clinical signs, such as respiratory failure and impaired consciousness, and requires intensive care. According to Dean and Florin (2018), complicated pneumonia has a more severe clinical course due to the extensive inflammatory process and systemic involvement. Risk factors for complications include delayed treatment, poor nutritional status, incomplete immunizations, and unhealthy environmental conditions. This reinforces the importance of primary prevention through immune-boosting practices, including exclusive breastfeeding. Therefore, the severity of pneumonia is determined not only by the type of pathogen but also by the child's immunological capacity in the early stages of infection.

*Complications of Pneumonia*

Evidence synthesis indicates that complicated pneumonia has a more severe clinical course, characterized by hypoxemia, respiratory failure, and systemic involvement, often requiring intensive care. Dean and Florin (2018) emphasized that the accumulation of inflammatory exudate and pleural involvement play a significant role in worsening clinical

conditions. Several factors have consistently been identified as key determinants of complications: delayed diagnosis, inadequate treatment, poor nutritional status, incomplete immunizations, and unhealthy environmental conditions (WHO, 2019). In areas with limited health facilities, pneumonia is often treated at an advanced stage, increasing the risk of complications. National and regional data show that complicated pneumonia remains the leading cause of hospitalization for children in primary and referral healthcare facilities (Ministry of Health, 2023; West Nusa Tenggara Health Office, 2023).

Pneumonia in children can progress to more severe forms and cause various complications, especially in children with poor nutritional status, delayed treatment, or weakened immune systems. According to Ihtisyam et al. (2023), complications of pneumonia generally occur due to the inflammatory process spreading to surrounding tissues or due to a failure of the body's defense mechanisms against infection. Common complications include pleural effusion, empyema, lung abscess, pneumothorax, and sepsis and acute respiratory failure (ARDS). Dean and Florin (2018) explained that the clinical course of complicated pneumonia is caused by the accumulation of exudate and pus in the pleural cavity, which impairs lung expansion and reduces gas exchange. This condition triggers severe hypoxemia and increases the risk of mortality if not promptly treated. Furthermore, the spread of bacteria to the bloodstream can cause bacteremia and sepsis, the most serious systemic complications.

Factors contributing to complications include delayed diagnosis, inadequate treatment, low immunization status, and poor environmental conditions (WHO, 2019). In areas with limited health facilities, pneumonia is often only treated after it has reached an advanced stage, resulting in a high complication rate. Data from the Ministry of Health (2023) and the West Nusa Tenggara Health Office (2023) show that complicated pneumonia remains the leading cause of hospitalization for infants at community health centers (Puskesmas) and regional hospitals. Furthermore, Sutriana et al. (2021) emphasize that household nutritional and sanitation status also play a significant role. Children with malnutrition experience impaired humoral and cellular immunity, making them more susceptible to severe pneumonia, which has a longer course and a higher risk of complications.

*Components of Exclusive Breastfeeding*

Exclusive breastfeeding is defined by WHO and UNICEF (2021) as the provision of breast milk without additional fluids or other foods for the first six months of life. Breast milk is not only a source of nutrition but also contains various immunological components that function to protect infants from infections, including pneumonia. Breast milk also contains human milk oligosaccharides (HMOs), which play a role in maintaining the balance of the gut microbiota and enhancing mucosal immunity. These components work to strengthen the innate and adaptive immune systems and reduce excessive inflammatory responses in the respiratory tract. Thus, infants who are exclusively breastfed have a stronger mucosal defense system against lower respiratory infections.

Research results indicate that exclusive breastfeeding acts as an integrated immunological protection system against lower respiratory infections. The main components of breast milk: secretory immunoglobulin A (sIgA), lactoferrin, lysozyme, and human milk oligosaccharides (HMOs) work synergistically to strengthen mucosal immunity and control inflammatory responses. sIgA prevents pathogen adhesion to the airway epithelium, while lactoferrin and lysozyme have antibacterial effects against major pathogens that cause pneumonia, such as Streptococcus pneumoniae and Haemophilus influenzae (Lyons et al., 2020; Moraes-Pinto et al., 2021). HMOs support microbiota balance and immune system maturation, resulting in a more controlled infant immune response. This framework suggests that exclusive breastfeeding not only reduces the risk of infection but also limits disease progression to severe forms or complicated pneumonia.

*Relationship between Exclusive Breastfeeding and Pneumonia*

Most literature indicates that infants who are not exclusively breastfed have a two- to five-fold higher risk of lower respiratory tract infections than exclusively breastfed infants (Popovsky

& Florin, 2021). A global study by Victora et al. (2016) also reported a significant reduction in the incidence of severe pneumonia in infants who were exclusively breastfed. However, when focusing on complicated pneumonia, the results showed variation. A critical analysis suggests that this heterogeneity reflects the influence of contextual factors that modify the protective effect of breast milk. Exclusive breastfeeding provides basic protection against pathogen colonization and an exaggerated inflammatory response, but does not completely eliminate the risk of complications in children with additional risk factors, such as malnutrition, incomplete immunization, and poor environmental exposure (Dean & Florin, 2018).

Exclusive breastfeeding not only reduces the incidence of pneumonia but also plays a crucial role in reducing the risk of developing complicated pneumonia. Breast milk contains various immunological and anti-inflammatory factors that support the maturation of the infant's immune system. According to Moraes-Pinto et al. (2021), the secretory immunoglobulin A (sIgA) content in breast milk protects the respiratory tract mucosa by inhibiting the colonization of pathogens such as Streptococcus pneumoniae and Haemophilus influenzae.

Furthermore, lactoferrin and lysozyme in breast milk have bactericidal effects that can suppress the growth of microorganisms that cause severe pneumonia. Lyons et al. (2020) explain that human milk oligosaccharides (HMOs) support the development of a healthy gut microbiota that plays a role in modulating the systemic immune system, including respiratory tract immunity. Therefore, infants who are exclusively breastfed have a more balanced immune response to infection and a lower risk of systemic inflammation, thus reducing the likelihood of developing complicated pneumonia. In a social and public health context, UNICEF (2021) emphasized that exclusive breastfeeding is a key strategy for preventing severe infections in developing countries, particularly in areas with limited access to health services.

Several studies have shown a significant association between exclusive breastfeeding and a reduced incidence of pneumonia. According to Popovsky, E.Y. and Florin, T.A. (2021), infants who are not exclusively breastfed have a two to five times higher risk of lower respiratory tract infections than exclusively breastfed infants. A global review by Victora et al. (2016) in The Lancet Breastfeeding Series also reported that exclusive breastfeeding for the first six months reduces the risk of severe pneumonia by up to 64% and prevents approximately 820,000 under-five deaths annually.

Although the protective benefits of exclusive breastfeeding against pneumonia have been consistently demonstrated, the association with complicated pneumonia remains variable. Several studies suggest that other factors such as nutrition, immunization, and environmental conditions may modify the protective effect of breastfeeding. In other words, exclusive breastfeeding provides basic protection against infection, but does not completely prevent complications in conditions involving other risk factors. Therefore, efforts to increase exclusive breastfeeding coverage need to be carried out in conjunction with nutrition programs, complete basic immunizations, and improved environmental sanitation to optimally prevent pneumonia with complications (Dean & Florin, 2018).

*Other Factors Influencing Pneumonia Severity*

Pneumonia in toddlers is a multifactorial disease, meaning it is influenced not only by a single factor, such as breastfeeding status, but also by various biological, environmental, and socioeconomic aspects. Intrinsic factors, such as nutritional status, play a significant role because malnutrition causes impaired humoral and cellular immunity, which reduces the body's ability to fight infection (Sutriana et al., 2021). Children with malnutrition are at higher risk of developing severe pneumonia and complications.

The reviewed literature places nutritional status, immunizations, environmental sanitation, and socioeconomic factors as moderators or confounders in the relationship between exclusive breastfeeding and pneumonia with complications. Malnutrition leads to impaired humoral and cellular immunity, thereby weakening the protective effects of breast milk (Sutriana et al., 2021). Children who do not receive Hib and PCV immunizations are also more susceptible to severe pneumonia, even if exclusively breastfed (UNICEF, 2021). Exposure to cigarette smoke, poor home ventilation, and overcrowding increase the risk of respiratory pathogen transmission

(WHO, 2020). Furthermore, maternal education and family economic status influence breastfeeding practices, parenting practices, and delays in seeking health care (Saunders, 2017).

Immunization also influences the incidence of pneumonia. Children who do not receive complete basic immunizations, particularly the Haemophilus influenzae type b (Hib) and Pneumococcal Conjugate Vaccine (PCV), are more susceptible to bacterial infections that cause severe pneumonia (UNICEF, 2021). Furthermore, exposure to cigarette smoke in the home environment increases the risk of pneumonia by up to 1.5 times because it reduces ciliary function and damages the bronchial epithelium. Poor home ventilation and high occupancy rates contribute to increased transmission of respiratory pathogens (WHO, 2020).

Social factors such as maternal education and family economic status also play a role in determining the incidence of pneumonia. Mothers with low levels of education tend to have less knowledge about exclusive breastfeeding, child nutrition, and environmental hygiene. This increases the risk of recurrent infections and delays in seeking medical treatment (Saunders, 2017).

## 4. CONCLUSION

This review highlights that complicated pneumonia in children under five is primarily driven by an excessive inflammatory response and systemic involvement, resulting in severe clinical manifestations and increased mortality risk. Exclusive breastfeeding provides a critical immunological advantage by strengthening mucosal defenses, inhibiting respiratory pathogen colonization, and modulating inflammatory pathways through bioactive components such as secretory IgA, lactoferrin, lysozyme, and human milk oligosaccharides. Nevertheless, breastfeeding alone does not fully prevent disease progression in the presence of compounding risk factors, including malnutrition, incomplete immunization, delayed clinical management, and adverse environmental exposures. These findings underscore that the clinical severity of pediatric pneumonia reflects both pathogen-related factors and host immune competence in early life. Accordingly, optimal prevention of complicated pneumonia requires early-life immune support through exclusive breastfeeding, integrated with timely diagnosis, appropriate antimicrobial therapy, and comprehensive management of modifiable clinical risk factors.

## 5. ACKNOWLEDGE

Thank you to all parties who have supported the preparation of this literature review. The author thanks his supervisor and the educational institutions who provided valuable guidance, direction, and input throughout the writing process. Appreciation is also extended to colleagues and healthcare workers at the Sigerongan and Lingsar Community Health Centers for their insights and experiences that helped enrich the author's understanding of pneumonia and the importance of exclusive breastfeeding. Furthermore, the author would like to thank his family and friends for their prayers, motivation, and moral support, which have been a source of encouragement and encouragement for the successful completion of this literature review.

## 6. REFERENCES

Amalia, R., & Rizki, L. (2018). Faktor Faktor Yang Mempengaruhi Keberhasilan Ibu Bekerja Dalam Pemberian Asi Eksklusif. Mandala Of Health, 11(1), 44-51. doi:10.20884/1.mandala.2018.11.1.546

Dean, P. and Florin, T.A. (2018) 'Factors Associated With Pneumonia Severity in Children: A Systematic Review', Journal of the Pediatric Infectious Diseases Society, 7(4), pp. 323–334. Available at: https://doi.org/10.1093/jpids/piy046.

Ihtisyam, Z.H. et al. (2023) 'ARDS (Acute Respiratory Distress Syndrome) in Pediatric and Adult', Jurnal Biologi Tropis, 23(1), pp. 274–280. Available at: https://doi.org/10.29303/jbt.v23i1.5767.

Kementerian Kesehatan Republik Indonesia (2023), Rencana aksi nasional penanggulangan pneumonia dan diare indonesia 2023-2030, Kementerian Kesehatan.

Lyons, K.E. et al. (2020) 'Breast milk, a source of beneficial microbes and associated benefits for infant health, Nutrients, 12(4), pp. 1–30. Available at: https://doi.org/10.3390/nu12041039.

Mani, C.S. (2017) Acute Pneumonia and Its Complications. Fifth Edit, Principles and Practice of Pediatric Infectious Diseases. Fifth Edit. Elsevier Inc. Available at: https://doi.org/10.1016/B978-0-323-40181-4.00034-7.

Moraes-Pinto, M.I. de, Suano-Souza, F. and Aranda, C.S. (2021) 'Immune system: development and acquisition of immunological competence', Jornal de Pediatria, 97, pp. S59–S66. Available at: https://doi.org/10.1016/j.jped.2020.10.006.

Nascimento-Carvalho, C.M. (2020) 'Community-acquired pneumonia among children: the latest evidence for an updated management', Jornal de Pediatria, 96, pp. 29–38. Available at: https://doi.org/10.1016/j.jped.2019.08.003.

Popovsky, E.Y. and Florin, T.A. (2021) 'Community-Acquired Pneumonia in Childhood', Encyclopedia of Respiratory Medicine, Second Edition, 6, pp. 119–131. Available at: https://doi.org/10.1016/B978-0-08-102723-3.00013-5.

Putri, D., Patandianan, F., Latifa, N., Ramadhania, Y., Rofilah, A., Maharani, B., Yassa, I., & Arigi, L. (2025). Protective Role Of Human Breast Milk Against Necrotizing Enterocolitis In Preterm Infants. Mandala Of Health, 18(2), 234-246. doi:10.20884/1.mandala.2025.18.2.17753

Saunders, R. (2017) 'ASI Eksklusif sebagai Salah Satu Proteksi terhadap Pneumonia pada Anak', Cermin Dunia Kedokteran, 44(7), p. 2017. Available at: http://files.unicef.org/publications/files/APR_2014_web_15Sept14.pdf%0Ahttp://www.cdkjournal.com/index.php/CDK/article/view/755.

Sutriana, V.N., Sitaresmi, M.N. and Wahab, A. (2021) 'Risk factors for childhood pneumonia: a case-control study in a high prevalence area in Indonesia', Clinical and Experimental Pediatrics, 64(11), pp. 588–595. Available at: https://doi.org/10.3345/CEP.2020.00339.

UNICEF. (2021) Child pneumonia and diarrhoea: Progress report 2021. New York: United Nations Children's Fund.

World Health Organisation; UNICEF (2010) 'Indicators for assessing infant and young child feeding practices', World Health Organization, WHA55 A55/, p. 19. Available at: http://apps.who.int/iris/bitstream/handle/10665/44306/9789241599290_eng.pdf?sequence=1%0Ahttp://whqlibdoc.who.int/publications/2008/9789241596664_eng.pdf%5Cnhttp://www.unicef.org/programme/breastfeeding/innocenti.htm%5Cnhttp://innocenti15.net/declaration.

World Health Organization. (2019) Pneumonia fact sheet. Geneva: World Health Organization.

World Health Organization. (2020) Air pollution and child health: Prescribing clean air. Geneva: World Health Organization.