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Association between nutritional status and exclusive breastfeeding and the incidence of pneumonia in toddlers: a-case control study

Kadek Gita Dian Savitri[1], Made Budiawan[2*]

[1]Bachelor of Medicine Program, Faculty of Medicine, Universitas Pendidikan Ganesha
[2]Physiology Department, Faculty of Medicine, Universitas Pendidikan Ganesha

*Correspondence:
Made Budiawan; Physiology Department, Faculty of Medicine, Universitas Pendidikan Ganesha;
made.budiawan@undiksha.ac.id

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ABSTRACT

Pneumonia remains the leading infectious cause of death in children under five worldwide. Nutritional status and exclusive breastfeeding (EBF) are recognized risk factors, yet evidence on their association with childhood pneumonia in the Indonesian context remains inconsistent. This study aimed to examine the relationship between nutritional status, EBF, and the incidence of pneumonia among under-fives (aged 12–59 months). A case-control study was conducted using retrospective medical record data. Children aged 12–59 months were enrolled via purposive sampling: cases were under-fives with a confirmed diagnosis of pneumonia, and controls were non-pneumonia inpatients matched 1:1. Nutritional status was assessed using the Weight-for-Age (W/A) index per national standards, and EBF status was ascertained from medical records. Fisher's Exact Test was used for bivariate analysis. A total of 28 participants were enrolled (14 cases, 14 controls). Most children in both groups had a normal nutritional status (26 children, 92.9%) and had received EBF (26 children, 92.9%). The distribution of both exposure variables was identical across case and control groups. No statistically significant association was found between nutritional status and pneumonia ($p = 0.759$), nor between EBF and pneumonia ($p = 0.759$). These findings are likely attributable to methodological limitations, particularly the small sample size. Larger, prospective, multivariable studies are needed to more definitively characterize risk factors for childhood pneumonia in this setting.

Keywords: breastfeeding, children, nutritional status, pneumonia.
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INTRODUCTION

Pneumonia is the single leading infectious cause of death among children worldwide. In developing countries alone, more than 150 million new cases occur each year, resulting in over 1.3 million deaths annually.[1] According to data from the WHO and the Maternal and Child Epidemiology Estimation (MCEE) group, approximately 700,000 children die from pneumonia each year, equivalent to nearly 2,000 deaths every day, with the highest burden documented in South Asia (2,500 cases per 100,000 children) and West and Central Africa (1,620 cases per 100,000 children).[2] The World Health Organization (WHO) and UNICEF have described childhood pneumonia as "the forgotten killer," reflecting the disproportionately high toll it exerts on under-five mortality relative to the attention it receives globally.[3]

In Indonesia, the national detection rate of pneumonia in under-fives has been fluctuating over the past decade. In 2021, the national coverage reached 31.4%, with the highest provincial rates recorded in East Java (50.0%), Banten (46.2%), and Lampung (40.6%).[4] In the province of Bali, Bangli Regency consistently reported the lowest pneumonia management coverage from 2013 to 2017, reaching only 2.60%.[5] In 2021, 1.2% of under-fives in Bangli were classified as underweight or severely underweight, while the exclusive breastfeeding (EBF) rate stood at 77%, rising to 85.5% by 2022.[6]

Several risk factors have been identified for pneumonia in under-fives, including nutritional status, EBF history, age, sex, birth weight, vaccination status, vitamin A supplementation, and environmental and maternal factors.[7] Among these, nutritional status and EBF status are closely linked to immune function. Undernutrition impairs pulmonary physiological defences, increasing susceptibility to infectious agents and placing malnourished children at significantly higher risk of pneumonia compared with their well-nourished peers.[8] Correspondingly, EBF confers passive immunity through immunoglobulins, cytokines, and antimicrobial peptides present in breast milk, reducing the risk of respiratory infection in infancy and early childhood.[9,10]

Despite this biological plausibility, published evidence on these associations is inconsistent. Regarding nutritional status, some studies have reported a significant relationship with pneumonia incidence,[11] while others, including studies conducted in Indonesia, found no statistically significant association.[12] Similarly, several studies have identified EBF as a protective factor against pneumonia,[13,14] whereas other investigations failed to demonstrate a significant relationship.[15,16] This inconsistency in findings may reflect differences in study design, sample size, population characteristics, and the extent to which confounders were controlled.

Given the persistently low pneumonia management coverage in Bangli Regency and the unresolved nature of these associations in the local context, this study aimed to examine the relationship between nutritional status and EBF and the incidence of pneumonia in under-fives (aged 12–59 months) hospitalised at Bangli Regional General Hospital during 2021–2022.

METHODS

Study Design and Setting

This was an observational analytic study with a case-control design. Cases were under-fives with a confirmed diagnosis of pneumonia, and controls were under-fives without pneumonia, enrolled at a 1:1 ratio. Data were collected retrospectively from hospital medical records, covering the period from January 1, 2021 to December 31, 2022. Data extraction was carried out between August 7 and September 22, 2023, at Bangli Regional General Hospital, located in Bangli Regency, Bali, Indonesia. Bangli Regional General Hospital is the sole public district-level referral hospital serving the Bangli Regency population.

Study Population

The target population was all under-fives (aged 12–59 months) admitted to the Paediatric Ward of Bangli Regional General Hospital during the study period. Participants were selected using purposive sampling. The case group comprised all under-fives with a confirmed inpatient diagnosis of pneumonia from January 1, 2021 to December 31, 2022, with complete medical record data on nutritional status and EBF history. The control group comprised under-fives admitted for other diagnoses during the same period, with comparable characteristics and complete data for both exposure variables.

Children were excluded from either group if they had incomplete immunisation records, a documented history of immunocompromising conditions (such as HIV infection, malignancy, or congenital immunodeficiency), or missing data for the exposure variables. Immunisation status and immunocompromising conditions were controlled through these eligibility criteria to reduce confounding from factors known to independently increase pneumonia risk.

To ensure internal validity, we selected controls from the same healthcare facility who were admitted during the identical study period for diagnoses other than pneumonia. We employed frequency matching to align the control group with cases based on three specific variables: age group (± 6 months), biological sex, and the timing of admission. By utilizing these criteria, we aimed to minimize the confounding effects of age-related immunity and seasonal variations in pathogen prevalence, thereby allowing for a more focused analysis of the specific risk factors under investigation.

All case records meeting the inclusion criteria during the study period were enrolled, yielding 14 cases and 14 matched controls, for a total sample of 28 participants. A formal a priori sample size calculation was not performed, which is acknowledged as a limitation given its implications for statistical power.

Data Sources and Measurement

All data were obtained from inpatient medical records at Bangli Regional General Hospital. No additional measurements or examinations were performed by the investigators. Variables extracted included age, sex, body weight, EBF history, immunisation status, and history of immunocompromising illness. The outcome variable was pneumonia status, defined as a clinical diagnosis of pneumonia documented by the attending physician in the medical record, categorised as present (case) or absent (control).

Nutritional status was assessed using the Weight-for-Age (W/A) index in accordance with the Indonesian Ministry of Health's Anthropometric Standards for Children (Permenkes No. 2 of 2020).[17] Based on the corresponding W/A z-score, nutritional status was dichotomised into two categories: normal weight, defined as a z-score between −2 SD and +1 SD; and abnormal weight, defined as a z-score below −2 SD or above +1 SD, encompassing underweight, severely underweight, risk of overweight, overweight, and obesity. Exclusive breastfeeding was defined as the provision of breast milk only, without any supplementary food or drink, from birth to six months of age, consistent with the WHO definition,[18] and was recorded as a binary variable (yes/no) based on maternal history documented at the time of admission. As EBF status relied on retrospective maternal self-report captured in the medical record, some degree of misclassification cannot be excluded. Age was grouped into four intervals (12–23, 24–35, 36–47, and 48–59 months) for descriptive purposes. Both exposure variables were treated as binary nominal variables. Similarly, other known risk factors for pneumonia, including low birth weight, vitamin A deficiency, household environmental conditions, and parental smoking, were not recorded in the available records and therefore could not be adjusted for, representing a source of potential residual confounding.

Statistical Analysis

Descriptive statistics were used to summarise the frequency and percentage distribution of all variables across the case and control groups. The association between each exposure variable and pneumonia was assessed using Fisher's Exact Test, employed as an alternative to the Pearson Chi-square test after it was confirmed that more than 20% of cells had expected counts below five.[19] A p-value of less than 0.05 was considered statistically significant. Multivariable binary logistic regression was planned as a third analytical step; however, as neither exposure variable achieved the $p < 0.25$ threshold required for model entry in the bivariate selection stage,[20] multivariable analysis was not performed. All analyses were conducted using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA).

RESULTS

Medical records of under-fives admitted to the Paediatric Ward of Bangli Regional General Hospital between January 1, 2021 and December 31, 2022 were screened for eligibility. A total of 14 children with a confirmed diagnosis of pneumonia met the inclusion criteria and were enrolled as cases. An equal number of non-pneumonia inpatients (n = 14) were selected as controls, matched by ward and study period. No participants were excluded after enrolment due to missing data, as completeness of exposure data was a prerequisite for inclusion. The final analytical sample comprised 28 participants with no missing values for any study variable.

Characteristics of Study Participants

The sociodemographic characteristics of the case and control groups are presented in Table 1. The sex distribution was identical across both groups: 12 males (85.7%) and 2 females (14.3%) in each group. In the case group, the most common age interval was 12–23 months (35.7%), followed by 36–47 months and 48–59 months (28.6% each), and 24–35 months (7.1%). In the control group, the majority were aged 12–23 months (42.9%), followed by 24–35 months (35.7%), 36–47 months (14.3%), and 48–59 months (7.1%).

The distribution of nutritional status and EBF across both groups is shown in Table 2. In the case group, 13 children (92.9%) had normal nutritional status and 1 (7.1%) had abnormal nutritional status (underweight). An identical distribution was observed in the control group. Similarly, 13 children (92.9%) in the case group had received EBF, with 1 child (7.1%) not having received it, a proportion that was again identical in the control group. No missing data were present for either variable.

Association between Exposure Variables and Pneumonia

The results of bivariate analysis for both exposure variables are presented in Table 3. Fisher's Exact Test for the association between nutritional status and pneumonia yielded a p-value of 0.759, indicating no statistically significant association ($p > 0.05$). Likewise, the association between EBF and pneumonia produced an identical p-value of 0.759, also indicating no significant association. The symmetrical distribution of both exposure variables across the case and control groups resulted in an observed odds ratio of 1.0 for both analyses, precluding any meaningful effect size estimation.

Table 1. Sociodemographic characteristics of study participants

Characteristic	Case (n = 14)		Control (n = 14)	
	n	%	n	%
Sex				
Male	12	85.7	12	85.7
Female	2	14.3	2	14.3
Age group (months)				
12–23	5	35.7	6	42.9
24–35	1	7.1	5	35.7
36–47	4	28.6	2	14.3
48–59	4	28.6	1	7.1

Table 2. Distribution of nutritional status and exclusive breastfeeding by group

Variable	Case (n = 14)		Control (n = 14)		Total (n = 28)	
	n	%	n	%	n	%
Nutritional status (W/A index)						
Normal (−2 SD to +1 SD)	13	92.9	13	92.9	26	92.9
Abnormal (<−2 SD or >+1 SD)	1	7.1	1	7.1	2	7.1
Exclusive breastfeeding						
Yes	13	92.9	13	92.9	26	92.9
No	1	7.1	1	7.1	2	7.1

W/A = Weight-for-Age.

Table 3. Association between nutritional status, exclusive breastfeeding, and pneumonia

Variable	Cases n (%)	Controls n (%)	p-value*
Nutritional status			
Normal	13 (92.9)	13 (92.9)	0.759
Abnormal	1 (7.1)	1 (7.1)	
Exclusive breastfeeding			
Yes	13 (92.9)	13 (92.9)	0.759
No	1 (7.1)	1 (7.1)	

*Fisher's Exact Test (one-sided)

DISCUSSION

This case-control study found no statistically significant association between nutritional status and the incidence of pneumonia in under-fives hospitalised at Bangli ($p = 0.759$), nor between EBF and pneumonia incidence ($p = 0.759$). The distribution of both exposure variables was identical across the case and control groups, 92.9% normal nutritional status and 92.9% EBF receipt in both groups, yielding an observed odds ratio of 1.0 for each analysis. Multivariable logistic regression could not be performed because neither variable met the $p < 0.25$ threshold required for model entry at the bivariate selection stage.

Nutritional Status and Pneumonia

The predominance of normal nutritional status among pneumonia cases (92.9%) in this study is consistent with findings from comparable Indonesian studies. Subandi (2020) reported that 77.8% of under-fives with pneumonia in Jatiwangi had good nutritional status,[12] and a study in Puskesmas Cibodasari by Sangadji et al. (2021), using a case-control design with 50 participants, also found no significant association between nutritional status and pneumonia (p = 0.53).[21] These concordant findings may partly reflect an increasing awareness among Indonesian caregivers of the importance of adequate child nutrition, resulting in higher proportions of well-nourished children across both pneumonia and non-pneumonia populations, thereby reducing the statistical contrast necessary to detect an association.

Conversely, other studies have reported a significant relationship between undernutrition and pneumonia. Amru et al. (2021) demonstrated a significant association (p = 0.000) and noted that children with poor nutritional status carry a higher risk of pneumonia due to impaired immune defences.[11] Wigunawati et al. (2023), using a larger case-control study with 96 participants, found nutritional status to be a significant risk factor for pneumonia (p = 0.032; OR = 6.129).[22] The bidirectional relationship between malnutrition and infection is well established: undernutrition impairs immunological responses and mucosal defences, while infectious illness further disrupts nutritional absorption and appetite, creating a cycle of vulnerability.[11] The absence of this association in the present study is most plausibly explained by the very small sample size and the near-uniform distribution of nutritional status in both groups, which precluded sufficient statistical power to detect a difference even if one existed in the population.

Exclusive Breastfeeding and Pneumonia

The high EBF rate observed in both case (92.9%) and control (92.9%) groups mirrors the improving EBF coverage documented in Bangli Regency, which rose from 77% in 2021 to 85.5% in 2022.[6] This convergence in EBF rates between groups is consistent with findings by Rahima et al. (2022), who found no significant association between EBF and pneumonia in 80 under-fives (p = 0.223),[15] and by Fikri (2017), who similarly observed no significant relationship.[16] When EBF rates approach uniformity across cases and controls, as occurred in this study, the statistical capacity to detect an association is fundamentally compromised, independent of the true underlying effect.

In contrast, Hutapea et al. (2023) identified a significant protective association between EBF and pneumonia (p = 0.005),[14] and a meta-analysis by Karmany et al. (2020) concluded that non-EBF significantly increases the risk of pneumonia in under-fives.[9] Biologically, breast milk confers passive immunity through secretory immunoglobulin A (sIgA), lactoferrin, and anti-inflammatory cytokines that protect the respiratory mucosa against pathogen invasion.[9,10] The failure of the present study to detect this protective effect should therefore be interpreted in the context of its methodological constraints rather than as evidence against the biological plausibility of the association.

Limitations

Several important limitations must be considered when interpreting these findings. First, and most critically, the sample size of 28 participants (14 per group) was very small and no formal a priori power calculation was conducted. The symmetrical distribution of both exposure variables across groups, an odds ratio of exactly 1.0, suggests that the study was fundamentally underpowered to detect any true difference, and may indicate inadvertent matching of cases and controls on the exposure variables themselves. Future studies should conduct formal power calculations and recruit substantially larger samples to achieve adequate statistical power.

Second, the retrospective reliance on medical records introduced the risk of information bias. Exclusive breastfeeding status was based on maternal self-report recorded at the time of admission rather than prospectively verified, raising the possibility of recall misclassification. Third, several known risk factors for pneumonia, including low birth weight, vitamin A deficiency, household air pollution, parental smoking, overcrowding, and maternal education, were not available in the medical records and could therefore not be controlled for, representing a source of residual confounding. Fourth, the hospital-based setting and purposive sampling limit the representativeness of the sample and preclude generalisation to community-level populations.

Generalisability

The findings of this study should be interpreted within the specific context from which they were drawn: hospitalised under-fives at a single district-level referral hospital in Bangli Regency, Bali. The relatively high nutritional status and EBF rates observed in this population, which may exceed national averages, mean that the results cannot be extrapolated to settings with different nutritional or breastfeeding profiles, nor to community-based populations where the full spectrum of nutritional status is more likely to be represented. Multisite studies enrolling larger, more diverse samples across different health facility levels and regions of Indonesia are needed to more definitively characterize the role of nutritional status and EBF in childhood pneumonia risk.

CONCLUSION

This study found no statistically significant association between nutritional status and the incidence of pneumonia, nor between EBF and the incidence of pneumonia, in under-fives hospitalised at Bangli Regional General Hospital; the combined effect of the two variables on pneumonia incidence could likewise not be determined due to the failure of both variables to meet the threshold for multivariable model entry. These findings do not negate the established biological plausibility of either association, but rather reflect the substantial methodological constraints of the present study, most notably its small sample size and near-uniform distribution of exposure variables across both groups. Future research should employ larger, community-based, prospective designs with formal sample size calculations and should extend the scope of measurement to include other established risk factors such as low birth weight, vitamin A status, household environmental conditions, and maternal characteristics, so as to provide a more comprehensive and generalisable account of the determinants of childhood pneumonia in the Bangli Regency context.

CONFLICT OF INTEREST

All authors declared that there is no conflict of interest regarding this article.

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ETHICS APPROVAL

Not applied.

AUTHOR'S CONTRIBUTION

All authors contributed equally in the writing process of this article.

REFERENCES

1. Mani C. Acute Pneumonia and Its Complications. Dalam: Principles and Practice of Pediatric Infectious Diseases. 2018. hlm. 238–49.
2. United Nation Inter-agency Group for Child Mortality Estimation. Level & Trends in Child Mortality 2019. 2019.
3. UNICEF/WHO. Pneumonia The Forgotten Killer Of Children. 2006.
4. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia 2021. 2022.
5. Dinas Kesehatan Provinsi Bali. Rencana Strategis 2018-2023. 2019.
6. Dinas Kesehatan Kabupaten Bangli. Profil Kesehatan Kabupaten Bangli Tahun 2021. 2022.
7. Rigustia R, Zeffira L, Vani A. Faktor Risiko yang Berhubungan dengan Kejadian Pneumonia pada BalitaDi Puskesmas Ikur KotoKota Padang. Health & Medical Journal. 2019;1(1):22–7.
8. Maya L, Saffrina M. Faktor Risiko Pneumonia Berdasarkan Asi Eksklusif Dan Status Gizi Balita Di Kecamatan Benowo Surabaya. Jurnal Ilmiah Kesehatan Mediahusada. 2016;05(02):143–56.
9. Karmany P, Rahardjo S, Murti B. The Effects of Non-Exclusive Breastfeeding on the Risk of Pneumonia in Children under Five: Meta-Analysis. Journal of Epidemiology and Public Health. 2020;5(4):393–401.
10. Dina R, Djuwita R. The Role of Exclusive Breastfeeding in Reducing Pneumonia Prevalence in Children Under Five. J Gizi Pangan. 2021;16:89–98.
11. Amru D, Putri Y, Selvia A. Hubungan Status Gizi Dengan Kejadian Pneumonia Pada Balita. 2021.
12. Subandi E. Hubungan Status Gizi Balita Dengan Kejadian Pneumonia Pada Balita Di Desa Sutawangi Wilayah Kerja Uptd Puskesmas Dtp Jatiwangi Tahun 2019. Jurnal Syntax Admiration. 2020;1(2).
13. Ayu Mardani R, Fatimah Pradigdo S, Mawarni A. Faktor Risiko Kejadian Pneumonia Pada Anak Usia 12-48 Bulan (Studi di Wilayah Kerja Puskesmas Gombong II Kabupaten Kebumen Tahun 2017). 2018.
14. Hutapea M, Roza N, Hayat N. Hubungan Pemberian Asi Eksklusif Dan Vitamin A Dengan Kejadian Pneumonia Pada Balita Di Kelurahan Kibing Wilayah Kerja Puskesmas Batu Aji Kota Batam Tahun 2022. SAINTEKES. 2023;2(1):12–8.
15. Rahima P, Hayati S, Hartinah N. Hubungan Kejadian Pneumonia Dengan Pemberian Asi Eksklusif Pada Balita. Jurnal Keperawatan BSI. 2022;10(1).
16. Fikri B. Analisis Faktor Risiko Pemberian Asi Dan Ventilasi Kamar Terhadap Kejadian Pneumonia Balita. The Indonesian Journal of Public Health. 2017;11(1):14.
17. Kementerian Kesehatan Republik Indonesia. Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2020 Tentang Standar Antropometri Anak. 2020.
18. Jama A, Gebreyesus H, Wubayehu T, Gebregyorgis T, Teweldemedhin M, Berhe T, dkk. Exclusive breastfeeding for the first six months of life and its associated factors among children age 6-24 months in Burao district, Somaliland. International Breastfeeding Journal. 2020;15(1).
19. Notoatmodjo S. Metodologi Penelitian Kesehatan. Rineka Cipta; 2010.
20. Ghozali I. Aplikasi Analisis Multivariate dengan Program IBM SPSS 25. 2018.
21. Sangadji NW, Vernanda LO, Muda CAK. Hubungan Jenis Kelamin, Status Imunisasi dan Status Gizi Dengan Kejadian Pneumonia Pada Balita (0-59 Bulan) di Puskesmas Cibodasari Tahun 2021. Jurnal Civitas Academica of Health Science. 2022;2(2).
22. Wigunawanti RA, Nazila JR, Prastika MK. Hubungan Antara Status Gizi dan Riwayat ASIEksklusif Dengan Kejadian Pneumonia Pada Balita Usia 12-59 Bulan di Wilayah Kerja Puskesmas Kecamatan Taman Kota Madiun. Jurnal Penelitian Kesehatan Suara Forikes. 2023.