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Household Cigarette Smoke Exposure and Bronchopneumonia Among Children Under Five: A Cross-Sectional Study at RSU Bunda Padang

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Abstract

Bronchopneumonia remains a significant cause of respiratory morbidity among children under five, particularly in low- and middle-income countries. Household cigarette smoke exposure is considered an important environmental factor that may increase children's susceptibility to respiratory infections. This study aimed to determine the association between household cigarette smoke exposure and bronchopneumonia among children under five hospitalized at RSU Bunda Padang, Indonesia. A hospital-based cross-sectional study was conducted among 56 children under five from February to March 2026. Data on cigarette smoke exposure were collected through structured interviews with parents or guardians using a questionnaire, while bronchopneumonia diagnosis was obtained from medical records. Data were analyzed using the Chi-square test with a significance level of 0.05. The results showed that 37 children (66.1%) were diagnosed with bronchopneumonia, and 24 children (42.9%) experienced high cigarette smoke exposure. High cigarette smoke exposure was more common among children with bronchopneumonia than those without bronchopneumonia (59.5% vs. 10.5%). Statistical analysis demonstrated a significant association between household cigarette smoke exposure and bronchopneumonia occurrence ($p < 0.001$). These findings indicate that reducing children's exposure to cigarette smoke within the household is important as part of preventive strategies to decrease the risk of bronchopneumonia among children under five.

Keywords: *Household Cigarette Smoke Exposure, Bronchopneumonia, Children Under Five, Respiratory Infection, Passive Smoking*

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1. Introduction

Bronchopneumonia remains an important public health concern among children under five years of age, as it continues to contribute substantially to morbidity, mortality, and pediatric hospitalization, particularly in low- and middle-income countries. Although the disease burden has declined following the expansion of vaccination programs and improvements in clinical management, substantial disparities remain in disease burden, healthcare access, and clinical outcomes among the most vulnerable pediatric populations (M & Vaithilingan, 2024; Pfurtscheller et al., 2024; Yan et al., 2025). Children under five years are biologically more susceptible to lower respiratory tract infections because their immune defenses and airway protective mechanisms are not yet fully developed, making them more vulnerable to environmental and behavioral risk factors that may progress into severe infections (Widiastuti et al., 2024; Riestiyowati et al., 2020; Syarli et al., 2025).

The occurrence of pneumonia and bronchopneumonia in children is influenced by multiple host, environmental, and social determinants, including young age, malnutrition, inadequate immunization, indoor air pollution, household crowding, and exposure to tobacco smoke at home (Marangu & Zar, 2019; Wilkes et al., 2023; M & Vaithilingan, 2024; Ayuk, 2024). In low- and middle-income countries, these factors are also associated with increased disease severity, treatment failure, and mortality, particularly when accompanied by hypoxemia, poor nutritional status, chronic comorbidities, or delayed access to healthcare services (Wilkes et al., 2023; Yan et al., 2025).

Household cigarette smoke exposure represents one of the most preventable risk factors for childhood respiratory infections; however, it remains highly prevalent in many child populations. A global burden of disease analysis estimated that in 2019, approximately 6.94% of lower respiratory tract infection deaths among children under five years worldwide were attributable to secondhand smoke exposure, with a greater burden observed among infants and populations with lower sociodemographic development levels (Xiang et al., 2023).

From a biological perspective, children exposed to household cigarette smoke inhale a complex mixture of toxic substances that may impair mucociliary clearance, suppress local immune function, and increase susceptibility to pathogen colonization and lower respiratory tract infections (Khujaefah & Prayogo, 2025; Syarli et al., 2025; Putri et al., 2022). Such exposure is not determined solely by the presence of smokers within the household but is also influenced by the number of smokers, smoking intensity, smoking location, and the child's proximity to smokers. Therefore, the magnitude of risk may vary across populations and healthcare settings (Widiastuti et al., 2024; Syarli et al., 2025; Khujaefah & Prayogo, 2025; Salsabila et al., 2026).

Accumulating evidence consistently demonstrates that passive cigarette smoke exposure increases the risk of respiratory infections among children under five years. A meta-analysis reported a 39% increased risk of acute respiratory infections among children exposed to cigarette smoke (adjusted odds ratio [aOR]=1.39; 95% confidence interval [CI]: 1.22–1.58). Another meta-analysis focusing on pneumonia outcomes showed a higher risk among exposed children, with an increased risk of 66% in cross-

sectional studies (aOR=1.66; 95% CI: 1.38–2.01) and more than two-fold increased risk in case-control studies (aOR=2.15; 95% CI: 1.25–3.68) (Riestiyowati et al., 2020). More recent systematic reviews further confirm that this association remains consistent across different study designs and geographical regions and may also be associated with increased disease severity, including hospitalization, intensive care requirements, and longer hospital stays (Syarli et al., 2025; Khujaefah & Prayogo, 2025).

Nevertheless, the magnitude of this association is not always consistent across studies. A systematic review conducted in Indonesia reported that most studies identified a significant relationship between household cigarette smoke exposure and pneumonia among children under five; however, effect estimates varied between studies, with some reporting odds ratios ranging from approximately 2 to 4, while a smaller proportion found no statistically significant association (Widiastuti et al., 2024). These variations may reflect differences in population characteristics, exposure definitions, family smoking behaviors, other environmental confounding factors, and healthcare system contexts (M & Vaithilingan, 2024; Syarli et al., 2025; Khujaefah & Prayogo, 2025).

In Indonesia, the need for local evidence remains important because childhood pneumonia continues to represent a substantial health burden, and its determinants are strongly influenced by household conditions and local environmental factors (Widiastuti et al., 2024; M & Vaithilingan, 2024). However, evidence specifically examining the relationship between household cigarette smoke exposure and bronchopneumonia among hospitalized children under five years in West Sumatra remains limited. Therefore, investigating this association in a local clinical setting is essential to provide context-specific evidence and support targeted preventive strategies, including the promotion of smoke-free homes among families with young children (M & Vaithilingan, 2024; Syarli et al., 2025; Khujaefah & Prayogo, 2025).

RSU Bunda Padang has reported a considerable number of pediatric bronchopneumonia cases requiring hospitalization. Preliminary observations indicated that several hospitalized children lived in households where family members smoked, suggesting potential exposure to cigarette smoke as an environmental risk factor. Therefore, further investigation is needed to understand the relationship between household cigarette smoke exposure and bronchopneumonia among children under five in this setting. This study aimed to determine the association between household cigarette smoke exposure and bronchopneumonia among children under five hospitalized at RSU Bunda Padang, Indonesia.

2. Research Method

2.1. Study Design and Setting

This study used a hospital-based cross-sectional design to investigate the association between household cigarette smoke exposure and bronchopneumonia among children under five years of age. The study was conducted in the pediatric inpatient ward of RSU Bunda Padang, West Sumatra, Indonesia. Data collection was performed from February to March 2026.

2.2. Population and Sample

The study population consisted of children under five years who were hospitalized at RSU Bunda Padang during the study period. Participants were selected using consecutive sampling. A total of 56 children who met the eligibility criteria were included in the study.

The inclusion criteria were children aged 0–59 months who were hospitalized during the study period, had complete medical records, and whose parents or guardians provided informed consent. Children with congenital respiratory disorders, chronic pulmonary diseases, or incomplete data were excluded.

2.3. Data Collection and Measurement

Household cigarette smoke exposure was assessed through structured interviews with parents or guardians using a questionnaire adapted from WHO recommendations on tobacco smoke exposure among children. The questionnaire assessed household smoking status, smoking frequency, smoking location, and children's exposure patterns. Exposure levels were categorized as low, moderate, and high based on the obtained scores. Bronchopneumonia status was determined based on physician diagnosis documented in medical records.

2.4. Statistical Analysis

Descriptive statistics were used to present participant characteristics and distribution of study variables. The association between household cigarette smoke exposure and bronchopneumonia was analyzed using the Chi-square test. Odds ratios with 95% confidence intervals were calculated to estimate the strength of association. Statistical significance was determined at $p < 0.05$.

2.5. Ethical Consideration

Ethical approval was obtained from the relevant institutional ethics committee. Written informed consent was obtained from parents or guardians before participation. All participant information was kept confidential.

3. Results

Table 1. Frequency Distribution of Parents' Educational Characteristics in the Inpatient Ward of RSU Bunda Padang

Educational level	Frequency (f)	Percentage (%)
Senior high school	44	78.6
Diploma III	8	14.3
Bachelor's degree	4	7.1
Total	**56**	**100**

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Table 1 shows that most parents of children under five had completed senior high school education, accounting for 78.6% of respondents. A total of 14.3% had completed a Diploma III program, while 7.1% held a bachelor's degree.

Table 2. Frequency Distribution of Parents' Age Characteristics in the Inpatient Ward of RSU Bunda Padang

Age	Frequency (f)	Percentage (%)
30–40 years	40	71.4
41–50 years	16	28.6
Total	**56**	**100**

Table 2 shows that most parents of the respondents, accounting for 71.4%, were between 30 and 40 years of age, while 28.6% were between 41 and 50 years of age.

Table 3. **F**requency Distribution of Children Under Five by Sex in the Inpatient Ward of RSU Bunda Padang

Sex	Frequency (f)	Percentage (%)
Male	23	41.1
Female	33	58.9
Total	**56**	**100**

Table 3 shows that most of the children under five were female, accounting for 58.9% of respondents, while 41.1% were male.

Table 4. Frequency Distribution of Bronchopneumonia Among Children Under Five in the Inpatient Ward of RSU Bunda Padang

Bronchopneumonia	Frequency (f)	Percentage (%)
No	19	33.9
Yes	37	66.1
Total	**56**	**100**

Table 4 shows that most respondents, accounting for 66.1%, were diagnosed with bronchopneumonia, while 33.9% were not diagnosed with bronchopneumonia.

Table 5. Frequency Distribution of Cigarette Smoke Exposure Among Children Under Five in the Inpatient Ward of RSU Bunda Padang

Cigarette smoke exposure	Frequency (f)	Percentage (%)
Low	14	25.0
Moderate	18	32.1

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Cigarette smoke exposure	Frequency (f)	Percentage (%)
High	24	42.9
Total	**56**	**100**

Table 5 shows that 42.9% of respondents experienced high cigarette smoke exposure, 32.1% experienced moderate cigarette smoke exposure, and 25.0% experienced low cigarette smoke exposure.

Table 6. Association Between Cigarette Smoke Exposure and the Incidence of Bronchopneumonia Among Children Under Five in the Inpatient Ward of RSU Bunda Padang

Bronchopneumonia	Low f	Low %	Moderate f	Moderate %	High f	High %	Total n	Total %	p-value
No	10	52.6	7	36.8	2	10.5	19	100	
Yes	4	10.8	11	29.7	22	59.5	37	100	
Total	**14**	**25.0**	**18**	**32.1**	**24**	**42.9**	**56**	**100**	**0.000**

Table 6 shows that bronchopneumonia was more common among respondents with high cigarette smoke exposure, accounting for 59.5%, compared with 10.5% among respondents without bronchopneumonia. The statistical analysis produced a p-value of less than 0.001. Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected. This finding indicates that there was a statistically significant association between cigarette smoke exposure and the incidence of bronchopneumonia among children under five in the inpatient ward of RSU Bunda Padang.

4. Discussion

This study found a significant association between household cigarette smoke exposure and bronchopneumonia among children under five years hospitalized at RSU Bunda Padang. A higher proportion of bronchopneumonia cases was observed among children exposed to high levels of household cigarette smoke compared with those with lower exposure. These findings indicate that household tobacco smoke exposure may represent an important environmental factor associated with respiratory illness among young children.

The results are consistent with previous epidemiological studies demonstrating that secondhand smoke exposure increases the risk of respiratory infections, including pneumonia, among children under five. Exposure to tobacco smoke has been associated with impaired respiratory health through several biological pathways. Toxic substances in cigarette smoke, including nicotine, carbon monoxide, particulate matter, and reactive compounds, may disrupt airway defense mechanisms, reduce mucociliary clearance, and

impair local immune responses, thereby increasing susceptibility to lower respiratory tract infections.

The relationship between household smoking exposure and childhood bronchopneumonia may also be influenced by exposure intensity and household smoking behavior. Children who spend more time near smokers or live in environments where smoking occurs indoors may receive higher cumulative exposure. Therefore, reducing smoking inside the home represents an important preventive approach to decrease respiratory disease risk among young children.

From a public health perspective, these findings support the implementation of family-centered interventions, including smoking cessation support for caregivers and education regarding smoke-free household environments. Healthcare providers, particularly pediatric and nursing professionals, have an important role in identifying household tobacco exposure and providing preventive counseling.

This study has several limitations. The cross-sectional design prevents causal interpretation between household cigarette smoke exposure and bronchopneumonia. In addition, exposure assessment relied on parental reports, which may introduce recall and reporting bias. The study was conducted in a single hospital with a limited sample size, which may restrict the generalizability of the findings. Furthermore, potential confounding factors, including nutritional status, immunization status, and other environmental exposures, were not fully controlled. Future multicenter studies using objective exposure measurements and multivariable analysis are recommended to further clarify the relationship between household cigarette smoke exposure and bronchopneumonia among children under five.

5. Conclusion

This study demonstrated a significant association between household cigarette smoke exposure and bronchopneumonia among children under five years hospitalized at RSU Bunda Padang, Indonesia. Children exposed to higher levels of household cigarette smoke showed a greater proportion of bronchopneumonia compared with those with lower exposure levels. These findings suggest that household tobacco smoke exposure may represent an important modifiable environmental factor associated with respiratory illness among young children. Strengthening smoke-free home practices, increasing parental awareness, and integrating tobacco exposure assessment into pediatric healthcare services may contribute to reducing the burden of bronchopneumonia among children under five years. Further multicenter studies with larger samples and adjustment for potential confounding factors are recommended to confirm these findings.

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