Tropical Health and Medical Research
Vol. 7, No. 2, August 2025, pp. 99-110
ISSN (Online): 2684-740X
Journal homepage: https://tropicalhealthandmedicalresearch.com

Family Socioeconomic Factors as a Risk Factor for ARI Incidence in Toddlers in Pekauman Dalam Village, Banjar Regency, Indonesia

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Abstract: Acute Respiratory Tract Infections (ARI) remain a leading cause of infant mortality worldwide, including in Indonesia. Banjar Regency, South Kalimantan, has the highest infant pneumonia mortality rate in the province, despite its lower prevalence. This situation necessitates a study of the risk factors contributing to the incidence of ARI, particularly from a family's socioeconomic perspective. This study aims to determine the relationship between the incidence of ARI in toddlers and family socioeconomic risk factors in Pekauman Dalam Village, Banjar Regency. This study used an analytical study design with a cross-sectional approach. A sample of 28 toddlers was selected using total sampling. Data were collected through structured questionnaires completed by the toddlers' mothers/caregivers. Data analysis was performed bivariately using simple binary logistic regression, with further analysis using the Chi-Square test and Fisher's Exact Test on significant variables. The results of the study showed that among the 28 toddlers examined, six toddlers (21.4%) exhibited symptoms of acute respiratory infections (ARI). Statistical analysis revealed that, among all variables tested, only the toddler's age had a significant association with ARI incidence (p = 0.001; Fisher's Exact Test = 0.011). Toddlers aged ≤1 year had a higher proportion of ARI cases than toddlers aged >1 year. Other variables such as family income, home ownership, residential density, cooking fuel, and maternal education did not show statistically significant relationships, although some had p-values approaching the significance threshold. Toddler age was the main risk factor influencing ARI cases in this study. Although most other socioeconomic factors were not statistically significant, these aspects are still important to consider in ARI prevention efforts. This study can form the basis for more targeted preventive interventions in areas with high socioeconomic vulnerability.
Keywords: Age; acute respiratory tract infections; Banjar regency; risk factors; socioeconomic; toddlers.

INTRODUCTION

Acute Respiratory Tract Infection (ARI) is one of the leading causes of infant mortality worldwide. The World Health Organization (WHO) recorded that 740,180 infants died from pneumonia, a severe form of ARI, in 2019[1]. In 2015, the WHO also reported that the number of infant deaths due to pneumonia reached 920,136 cases, the majority of which occurred in developing countries such as South Asia and Africa[2]. In Indonesia, the results of the 2018 Basic Health Research showed that the national prevalence of pneumonia in infants reached 2.1%, with variations between provinces. South

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Kalimantan Province recorded a prevalence rate of 1.2%, while Banjar Regency reported 0.9% cases of pneumonia in infants[3]. Although lower than the provincial average, Banjar Regency is the region with the highest infant mortality rate due to pneumonia[4].

Various studies have identified several factors that influence the incidence of ARI in toddlers. Individual characteristics, such as age, indicate that children aged 1–2 years have a higher risk of ARI than children under one year of age[5-9]. In addition to age, toddler health factors such as nutritional status, breastfeeding, and immunization have also been shown to be important determinants in preventing ARI. Research by Shibata et al. (2014) showed that breastfeeding protects against respiratory tract infections (10). Other studies by Lutpiatina L et al. (2022) and Tazinya A et al. (2018) explain that vitamin A administration and basic immunization play a role in increasing the body's resistance to infection[9,11].

Environmental factors and household behaviors also contribute to the incidence of ARI in toddlers. Overcrowding, poor home ventilation, the use of environmentally unfriendly cooking fuels such as wood, and inadequate sanitation are factors proven to increase the risk of ARI12-15. Most of these studies were conducted in urban or highland areas with better access to health facilities and more stable socioeconomic characteristics. Although various studies have been conducted, to date, there are still few studies that specifically examine the relationship between family socioeconomic factors and the incidence of ARI in toddlers in rural areas with a high caseload, such as Banjar Regency, South Kalimantan. Banjar Regency itself is an area with the largest number of toddlers in the province, low vitamin A coverage (80.1%), prevalence of malnutrition at 14.5%, and the highest rate of wasting toddlers at 10.9% (4). These conditions indicate vulnerability at the household level that needs to be explored further, especially from a socioeconomic perspective such as income, home ownership, housing facilities, and access to basic family needs.

This study aims to determine the relationship between the incidence of acute respiratory infections (ARI) in toddlers and family socioeconomic risk factors. This research is expected to contribute to the formulation of more contextual preventive interventions, particularly in areas with high levels of socioeconomic vulnerability.

MATERIALS AND METHODS

This study used an analytical study design with a cross-sectional approach to determine the relationship between various risk factors and the incidence of acute respiratory infections (ARI) in toddlers. The study was conducted in Banjar Regency in 2025. The target population consisted of all toddlers living in Pekauman Dalam Village who responded to the examination invitation. A total sampling method was applied, and all 28 toddlers who were present and met the inclusion criteria were included in the study. Although the sample size was relatively small (n = 28), it represented the entire accessible population during the study period, which justifies its use in this exploratory analysis. The researchers conducted the study in accordance with ethical research principles, including obtaining informed consent and maintaining the confidentiality of all documents and personal data.

Researchers collected data using a structured questionnaire completed by mothers or caregivers of toddlers. The questionnaire included information on individual characteristics of the toddlers (age, gender, birth order, breastfeeding status,

immunization status, and history of comorbidities), maternal characteristics (age, education, occupation), and physical and socioeconomic environmental data (residential density, home ownership, electronics ownership, electricity capacity, communication devices, cooking fuel, kitchen ventilation, distance from the main road, water source, and sanitation facilities). The questionnaire was developed based on a previously validated instrument and had been reviewed for its content and quality by subject matter experts. It was subsequently used in this study without modification.

Researchers classified ARI incidence based on the presence or absence of symptoms reported by parents or caregivers, specifically by asking whether the toddler had experienced cough and runny nose in the past two weeks. All independent variables were categorized dichotomously. Toddler characteristics included age (≤1 year or >1 year), gender (male or female), birth order (1st–2nd or 3rd–4th), breastfeeding status (breast milk–dominant or formula–dominant), immunization status (complete or incomplete), and comorbidities (present or absent). Maternal characteristics included age (≤30 or >30 years), education (elementary–middle school or high school–academic), and occupation (working or not working).

Socioeconomic and environmental variables were also grouped into binary categories: residential density (eligible or not eligible)[16], family income (above or below the District Minimum Wage/UMK), home ownership (owned or not), electronic goods (TV/radio or refrigerator/washing machine), electricity capacity (450 or 900 watts), and communication devices (basic cellphone or cellphone with WiFi). Environmental exposure factors included type of cooking fuel (LPG or wood), indoor smoking (yes or no), use of mosquito repellent (yes or no), kitchen type (separate or not), distance from the main road (>100 meters or ≤100 meters), water source (piped or non-piped supply), and toilet facilities (private or shared). History of contact with ARI sufferers was also classified as present or absent.

Researchers analyzed the data bivariately to determine the relationship between each independent variable and the incidence of ARI. Researchers used a simple binary logistic regression test with a significance level of 0.05. Variables with a p-value <0.05 were considered to have a statistically significant relationship with the incidence of ARI. For variables showing an important relationship, researchers conducted further tests using the Chi-Square. If a cell with an expected value of less than five was found, researchers used an alternative test, Fisher's Exact Test, to ensure the accuracy of the results.

RESULTS AND DISCUSSION

The results showed that the majority of children were in the 25–36-month age group, totaling 10 children (35.7%). This was followed by two equally dominant age groups: 13–24 months and 37–48 months, each with six children (21.4%). Meanwhile, the 49–60-month age group consisted of four children (14.3%), and the smallest proportion was found in the 1–12-month age group, with only two children (7.1%). The complete age distribution is presented in Table 1.

In terms of gender, the majority of respondents were boys, accounting for 18 children (64.3%), while girls totaled 10 children (35.7%), as shown in Table 2. When categorized by birth order, more than half of the children were firstborn (15 children, 53.6%), followed by secondborn (9 children, 32.1%), thirdborn (3 children, 10.7%), and

fourthborn (1 child, 3.6%). Detailed data on birth order are shown in Table 3.

Table 1. Toddler Age Distribution

Toddler Age	Frequency (n)	Percentage (%)
1-12 months	2	7.1%
13-24 months	6	21.4%
25-36 months	10	35.7%
37-48 months	6	21.4%
49-60 months	4	14.3%
Total	28	100%

Table 2. Gender of Toddler Distribution

Gender	Frequency (n)	Percentage (%)
Male	18	64.3%
Female	10	35.7%
Total	28	100%

Table 3. Toddler Birth Order

Birth Order	Frequency (n)	Percentage (%)
1st	15	53.6%
2nd	9	32.1%
3rd	3	10.7%
4th	1	3.6%
Total	28	100%

In the past two weeks, 21.4% of children had experienced coughs and colds, while 78.6% had not. All children (100%) had received vitamin A supplementation. Most children (57.1%) were primarily breastfed, while 42.9% received formula milk. Regarding immunization, 64.3% had completed the schedule, while 35.7% had not. Only 3.6% of children had a history of other illnesses in the past one to four weeks, with the remaining 96.4% having no such history. Children's weights ranged from 7.3 to 22.6 kilograms.

Table 4. Toddler Health Conditions

Variables	Category	Amount	Percentage (%)
Cough and cold	Yes	6	21.4%
	No	22	78.6%
Body Weight	7,3-22,6 (Kg)		
Breastfeeding	Breast milk dominant	16	57.1%
	Formula Milk Dominance	12	42.9%
Giving Vitamin A	Yes	28	100%
	No	0	0%
Immunization	Complete	18	64.3%
	Incomplete	10	35.7%
Other diseases	Yes	1	3.6%
	No	27	96.4%

The majority of mothers or childcare providers were between 21 and 54 years old. In terms of occupation, 75% were housewives, while the remainder worked as teachers (10.7%), self-employed (10.7%), and laborers (3.6%). The mothers' education levels were 32.1% junior high school graduates, 28.6% high school graduates, 28.6% elementary school graduates, and 10.7% had some academic education.

Table 5. Characteristics of Mothers of Toddlers

Variables	Category	Amount	Percentage (%)
Age		21-54 Years	100%
Work	Teacher	3	10.7%
	Self-employed	3	10.7%
	Homemaker	21	75%
	Laborer	1	3.6%
Education	Elementary School	8	28.6%
	Middle School	9	32.1%
	high School	8	28.6%
	Academic	3	10.7%

In terms of housing density, 64.3% of families lived in substandard environments, with more than two people occupying a bedroom measuring less than or equal to 8 square meters. In comparison, 35.7% of families lived in adequate housing. Only 7.1% of children had a history of close contact with someone with an acute respiratory infection, and 3.6% of children had a family member with a history of respiratory diseases such as tuberculosis or asthma. The majority of children, 92.9% and 96.4%, respectively, did not have such contact.

Table 6. Risk Factors for Inter-Individual Contact

Contact Between Individuals	Category	Amount	Percentage (%)
Occupancy density (≤2 people/8m2 floor area bedroom)	Meet the Conditions	10	35.7%
	Not fulfilling conditions	18	64.3%
History of close contact with previous ARI sufferers	Yes	2	7.1%
	No	26	92.9%
Family history of respiratory tract disease respiratory (TB/Asthma)	Yes	1	3.6%
	No	27	96.4%

The majority of families, 60.7%, have incomes below the City/Regency Minimum Wage, while 39.3% of families have incomes above the UMK. Seventy-five percent of families live in their own homes, while the other 25% live in non-privately owned homes. In terms of electronic goods ownership, 75% of families own appliances such as refrigerators, washing machines, or air conditioners. In comparison, 25% only own a radio or television, or even no electronics at all. Household electricity capacity is evenly distributed, with 50% of families having 450 watts of electricity and 50% having 900 watts.

Ownership of communication devices also shows a similar pattern, with 50% of families owning only a telephone or cell phone, and the other 50% having a cell phone and Wi-Fi access.

Table 7. Risk Factors Related to Family Economic Level

Economic Level Family	Category	Amount	Percentage (%)
Family Income	Below the minimum wage	17	60.7%
	Above the minimum wage	11	39.3%
Home ownership status	Not property rights	7	25%
	Right of ownership	21	75%
Ownership of goods electronic	Radio/TV/don't have	5	18%
	Refrigerator/washing machine/air conditioner	23	82%
Home electrical capacity	450 watt	14	50%
	900 watt	14	50%
Ownership of tools communication	Phone/Mobile	14	50%
	Hp/Wifi	14	50%

Table 8 shows that the majority of homes, 92.9%, use LPG for cooking, while 7.1% still use wood fuel. The level of exposure to secondhand smoke in the home is considered high, as 78.6% of homes have family members who smoke inside. Additionally, 85.7% of homes use mosquito coils, which can increase indoor air pollution exposure. Only 3.6% of homes have kitchens that are not separated from other rooms, while 96.4% have separate kitchens. In terms of location, 53.6% of homes are located within or equal to 100 meters of a main road, while 46.4% are located more than 100 meters from a main road.

Table 8. Risk Factors Related to Indoor Air Pollution

Home Air Pollution	Category	Amount	Percentage (%)
Cooking fuel	Wood	2	7.1%
	LPG	26	92.9%
Family members smoking in the house	Yes	22	78.6%
	No	6	21.4%
Mosquito repellent	Yes	24	85.7%
	No	4	14.3%
Kitchen space	Not separated from other spaces	1	3.6%
	Separated from other spaces	27	96.4%
The distance between the house and the road	≤100 meter	15	53.6%
	>100 meter	13	46.4%

Table 9 shows that in terms of household facilities, the majority of respondents (86%) used non-PDAM clean water sources, while only 14% of respondents used PDAM water. The majority of homes (96%) had their own toilets, while 4% of homes still used shared toilets. These data indicate that, in general, basic household facilities such as

cooking fuel, clean water sources, and sanitation facilities are considered good. However, several aspects, such as exposure to cigarette smoke inside the home and the use of mosquito coils, still require more attention from an environmental health perspective.

Table 9. Risk Factors Related to Household Facilities

Home facilities	Category	Amount	Percentage (%)
Clean water source	Piped supply	4	14.3%
	Non-piped supply	24	85.7%
WC	Private	27	96.4%
	Shared	1	3.6%

Table 10. Relationship Between ARI and Risk Factors (Logistic Regression)

No	Variables	p-value
1	Toddler Age	0,001
2	Toddler gender	0,649
3	Toddler birth order	0,212
4	Breastfeeding	1,000
5	Immunization	0,649
6	Other diseases	0,078
7	Mother's age	0,334
8	Mother's occupation	0,801
9	Mother's education	0,118
10	Residential density	0,649
11	Contact history	0,397
12	Family income	0,823
13	House ownership	0,208
14	Ownership of electronic goods	0,776
15	Electricity capacity	0,663
16	Communication tools	0,663
17	Cooking fuel	0,078
18	Family members smoke	0,776
19	Mosquito coils	1,000
20	Kitchen space	0,078
21	Distance of house from main road	0,126
22	Water source	0,212
23	Toilet facilities	0,078

The results of the analysis of the relationship between the incidence of Acute Respiratory Tract Infections (ARI) in toddlers and various risk factors using the simple binary logistic regression test show that only a few variables have a significance value below 0.05. Toddler age is the only variable that shows a statistically significant relationship with the incidence of ARI, with a significance value of 0.001. Meanwhile, other variables such as toddler gender, birth order, breastfeeding status, immunization, maternal age, maternal occupation, maternal education level, residential density, contact history, family income, home ownership, electronic goods ownership, electricity capacity, communication tools, type of cooking fuel, family members who smoke, use of mosquito

repellent, kitchen space, distance of the house from the main road, water source, and toilet facilities do not show a statistically significant relationship with the incidence of ARI. However, several variables such as other diseases, cooking fuel, kitchen space, and toilet facilities have p-values approaching the significance threshold, which is 0.078.

Further analysis of the cross-relationship between toddler age and the incidence of ARIs corroborates previous findings. Of the 28 toddlers studied, 21 toddlers, or 75%, aged over one year, did not experience ARIs, while only four toddlers, or 14.3%, did. Conversely, in the group of toddlers aged one year or less, three toddlers, or 10.7%, experienced ARIs, and none did not experience ARIs. These findings indicate that the proportion of ARIs is higher in toddlers aged ≤1 year compared to the age group >1 year, so toddler age can be considered an important risk factor for ARIs.

To determine the strength of the relationship between toddler age and the incidence of ARI, researchers conducted Pearson's Chi-Square and Fisher's Exact Tests. The Pearson Chi-Square test showed a significance value of 0.001, indicating a highly statistically significant relationship between toddler age and the incidence of ARI. However, because there were two cells in the contingency table with expected frequencies below five, researchers used the alternative Fisher's Exact Test. The results of this test showed a significance value of 0.011, further strengthening the conclusion that there is a significant relationship between toddler age and the risk of experiencing ARI. Complete data regarding the relationship between the incidence of ARI and risk factors based on the simple binary logistic regression test can be seen in Table 10.

Table 11. Cross-relationship between ARI in Toddlers and Toddler Age

	Toddler Age		Total
	≤1 Year	>1 Year	
No ARI	0 (0%)	21 (75%)	21 (75%)
ARI	3 (10.7%)	4 (14.3%)	7 (25%)
Total	3 (10.7%)	25 (89.3%)	28 (100%)

Table 12. Relationship between ARI in Toddlers and Risk Factors Using the Chi Square Test

	Asymptotic Significance (2-sided)	Exact Sig, (2-sided)
Pearson Chi-Square	0,001	
Fisher's Exact Test		0,011

Because there are 2 data that have estimated numbers below 5, the Fisher Exact Test is used.

This study aims to determine the relationship between family socioeconomic risk factors and the incidence of Acute Respiratory Tract Infections (ARI) in toddlers. The results of the analysis showed that only toddler age had a statistically significant relationship with the incidence of ARI, with a p-value of 0.001. Further testing using Fisher's Exact Test showed a p-value of 0.011, which strengthened the relationship. Toddlers aged one year or less were more likely to experience ARI than older toddlers. This finding is in line with the results of research by Lutpiatina et al., which showed that

toddlers aged less than one year were less likely to experience ARI with an OR of 0.61 (0.45–0.82)[9]. Other studies also reported similar findings, such as Acharya P, Adesanya OA & Chiao C (OR 2.88), Akinyemi JO & Morakinyo OM (OR 2.36), and Rayhan Sk et al. (OR 1.31), which concluded that the highest risk of ARI occurs in children aged 12 to 23 months[5-8].

Although this study did not show a statistically significant relationship, family income remains an important factor in the context of child health. Low income can limit a family's ability to provide a healthy living environment, adequate nutrition, and access to health services. Research by Shibata T et al. stated that low income contributes to an increased risk of ARI in children. Cardoso AM et al. found that a household income below US$30.00 per month was associated with an increased risk of ARI with an OR of 2.77[17]. Research in Ethiopia by Abebaw B and Damtie D also showed that families with low monthly income had a higher risk of ARI[18].

In this study, residential density did not show a significant association with the incidence of ARI. However, previous research has identified dense housing as an important factor in the spread of respiratory diseases. Hidayanti R et al. showed that a density of more than two people per bedroom increased the risk of ARI with an OR of 21.99 and a p-value of 0.001[13]. Research by Sandar Tin Tin et al. also confirmed that residential density facilitates the transmission of infection between family members[12].

Maternal education did not show a significant association in the results of this study, but several previous studies have confirmed that maternal education influences the ability to maintain child health. Akinyemi JO & Morakinyo OM showed that mothers with low education had a higher risk of ARI in children, with an OR of 1.24 (7). Research by Rayhan Sk et al. and Lutpiatina L et al. also supported this finding with OR values of 1.14 and 1.36, respectively[8,9].

Maternal occupation, home ownership, electricity capacity, and ownership of electronic goods also did not show a significant relationship with the incidence of ARI. However, several studies have shown that maternal employment status and household asset ownership are associated with a family's ability to create a healthy environment and meet children's basic needs. Admasie A et al., Akinyemi JO & Morakinyo OM, and Lutpiatina L et al. reported that occupation and household assets can act as socioeconomic indicators related to susceptibility to ARI[7,9,19].

Home environmental factors such as cooking fuel, presence of smokers in the home, kitchen ventilation, and water source did not show a statistically significant relationship in this study. However, this finding differs from several previous studies that showed that the use of wood fuel increases the risk of ARI in children. Addisu A et al. reported that dirty fuel correlated with an increased risk of ARI with an OR of 4.35[14]. Research by Andualem Z et al. stated that houses located less than 100 meters from main roads with heavy traffic had a higher risk of ARI[20].

This study has several limitations that should be considered. The relatively small sample size limited the power of the statistical tests, resulting in some relationships that might have been practically meaningful not being detected. Data obtained through interviews are at risk of information bias, particularly regarding variables such as medical history and environmental habits in households. The cross-sectional study design does not allow for determining causal relationships between the variables studied. Several environmental factors, such as indoor smoking frequency and ventilation quality, were

not measured in detail, so the results may not reflect actual conditions. Furthermore, the unique geographic conditions of the study area, such as flooding vulnerability and peat soil structure, were not included in the analysis despite their potential to influence exposure to ARI causative agents.

Despite its limitations, this study has several strengths. First, it provides a focused analysis of ARI risk factors in a rural area with high socioeconomic vulnerability, a setting that has received limited attention in previous research. Second, the use of total sampling allowed for full coverage of the accessible population, ensuring representativeness for the local context. Third, the questionnaire used had undergone expert review for content and quality, enhancing the reliability of the data collected. Finally, the study contributes context-specific evidence that can inform local health authorities in developing targeted ARI prevention strategies, especially for vulnerable populations such as toddlers aged ≤1 year.

CONCLUSION

Of all the socioeconomic risk factors analyzed, only toddler age showed a statistically significant association with the incidence of ARI in toddlers. Although other socioeconomic variables were not statistically significant, existing literature suggests that these factors remain practically important and relevant in the prevention of ARI. Therefore, ARI prevention interventions should focus particularly on toddlers aged ≤1 year, who appear to be more vulnerable. This study provides an important initial overview of ARI risk in toddlers living in rural areas with high socioeconomic vulnerability. It can serve as a foundation for more targeted and context-specific preventive strategies. Given the limited sample size and the cross-sectional design, further research using a longitudinal approach with a larger and more representative sample is needed to strengthen and validate these findings.

CONFLICT OF INTEREST

In this study there is no conflict of interest

REFERENCES

1. World Health Organization (WHO). Pneumonia. Geneva: WHO; 2021. accessed in July 2025. https://www.who.int/news-room/fact-sheets/detail/pneumonia
2. World Health Organization (WHO). Pneumonia [Internet]. Geneva: WHO; 2016. accessed in July 2025. http://www.who.int
3. Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI. Laporan Nasional Riset Kesehatan Dasar (Riskesdas) 2018. Jakarta: Kemenkes RI; 2018.
4. Dinas Kesehatan Provinsi Kalimantan Selatan. Profil Kesehatan Provinsi Kalimantan Selatan Tahun 2020. Banjarbaru: Dinkes Kalsel; 2021.
5. Acharya P, Mishra SR, Berg-Beckhoff G. Solid fuel in kitchen and acute respiratory tract infection among under five children: evidence from Nepal demographic and health survey 2011. J Community Health. 2015;40(3):515–21.
6. Adesanya OA, Chiao C. Environmental risks associated with symptoms of acute respiratory infection among preschool children in North-Western and South-

Southern Nigeria Communities. Int J Environ Res Public Health. 2017;14(11):1396. doi:10.3390/ijerph14111396
7. Akinyemi JO, Morakinyo OM. Household environment and symptoms of childhood acute respiratory tract infections in Nigeria, 2003–2013: a decade of progress and stagnation. BMC Infect Dis. 2018;18:296. doi:10.1186/s12879-018-3207-5
8. Rayhan Sk, Rasooly MH, Barua S. Do fuel type and place of cooking matter for acute respiratory infection among Afghan children? J Biosoc Sci. 2019;1–14. doi:10.1017/S002193201900035X
9. Lutpiatina L, Sulistyorini L, Notobroto HB, Raya RP, Utama RD, Thuraidah A. Multilevel analysis of lifestyle and household environment for toddlers with symptoms of acute respiratory infection (ARI) in Indonesia in 2007, 2012 and 2017. Glob Pediatr Health. 2022;9:1–13.
10. Shibata T, Wilson JL, Watson LM, LeDuc A, Meng C, La Ane R, Maidin A. Childhood acute respiratory infections and household environment in an eastern Indonesian urban setting. Int J Environ Res Public Health. 2014;11(12):12190–203. doi:10.3390/ijerph111212190
11. Tazinya AA, Halle-Ekane GE, Mbuagbaw LT, Abanda M, Atashili J, Obama MT. Risk factors for acute respiratory infections in children under five years attending the Bamenda Regional Hospital in Cameroon. BMC Pulm Med. 2018;18:7. doi:10.1186/s12890-018-0579-7
12. Tin ST, et al. Internal living environment and respiratory disease in children: findings from the Growing Up in New Zealand longitudinal child cohort study. Environ Health. 2016;15(120):1–10.
13. Hidayanti R, Yetti H, Putra EA. Risk factors for acute respiratory infection in children under five in Padang, Indonesia. J Matern Child Health. 2019;4(2):62–9. doi:10.26911/thejmch.2019.04.02.01
14. Addisu A, Getahun T, Deti M, Negesse Y, Mekonnen B. Association of acute respiratory infections with indoor air pollution from biomass fuel exposure among under-five children in Jimma Town, Southwestern Ethiopia. J Environ Public Health. 2021;2021:7112548. doi:10.1155/2021/7112548
15. Mondal D, Paul P. Effects of indoor pollution on acute respiratory infections among under-five children in India: Evidence from a nationally representative population-based study. PLoS One. 2020;15(8):e0237611. doi:10.1371/journal.pone.0237611
16. Kementerian Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan Republik Indonesia Nomor 829/MENKES/SK/VII/1999 tentang persyaratan kesehatan perumahan [Internet]. Jakarta: Kemenkes RI; 1999. accessed in July 2025.https://dokumen.tips/documents/kepmenkes-ri-no-829-tahun-1999-persyaratan-kesehatan-perumahan.html
17. Cardoso AM, Coimbra CE Jr, Werneck GL. Risk factors for hospital admission due to acute lower respiratory tract infection in Guarani indigenous children in southern Brazil: a population-based case-control study. Trop Med Int Health. 2013;18(5):596–607.
18. Abebaw B, Damtie D. Pneumonia prevalence and associated risk factors among under-five children in Goncha Siso Enesie District, Northwest Ethiopia. Adv Public Health. 2022;2022:1–8. doi:10.1155/2022/6497895.

19. Admasie A, Kumie A, Worku A. Children under five from houses of unclean fuel sources and poorly ventilated houses have higher odds of suffering from acute respiratory infection in Wolaita-Sodo, Southern Ethiopia: a case-control study. J Environ Public Health. 2018;2018:1–9.
20. Andualem Z, Taddese AA, Azene ZN, Azanaw J, Dagne H. Respiratory symptoms and associated risk factors among under-five children in Northwest Ethiopia: community-based cross-sectional study. Multidiscip Respir Med. 2020;15:685. doi:10.4081/mrm.2020.685.