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The Relationship Between Exposure to Cigarette Smoke and the Incidence of Acute Respiratory Infections (ARI) in Toddlers

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ABSTRACT

Background. Acute respiratory infections (ARI) are one of the most common health problems affecting children under five years of age (toddlers), especially in developing countries such as Indonesia. Exposure to cigarette smoke in the home environment is a significant environmental determinant of ARI in toddlers and is an important basis for prevention efforts through family education and smoke-free home policies. Methods. This study used a quantitative approach with a cross-sectional design. Data were collected through direct interviews with parents or guardians of toddlers using a prepared questionnaire and confirmation of acute respiratory infection (ISPA) cases through records of visits to health facilities in the last three months. Bivariate analysis was performed using the Chi-Square (2) test. Results. The results of univariate and bivariate analyses showed that the majority of the toddlers in the working area of the Muna District Community Health Centre in the Ambacang Puskesmas work area were exposed to smoke, which was as much as 60%, and more than half, which were 56%, had ARI. Furthermore, the results of bivARIate analysis showed that there was a statistically significant relationship between exposure to smoke and ARI (p = 0.003). Conclusion. The findings of this study provide a strong foundation for health professionals and policymakers to design educational programs and interventions that target reducing exposure to secondhand smoke for the health of children.

Keywords: *ARI, Toddler, Cigarette Smoke, Child Health*

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INTRODUCTION

Acute respiratory infections (ARI) are one of the most common health problems affecting children under five years of age (toddlers), especially in developing countries such as Indonesia. According to data from the 2018 Basic Health Research (Riskesdas), the prevalence of ARI in toddlers in Indonesia reached 7.8%, and in some regions the figure was reported to be higher than the national average. The high incidence of ARI in toddlers is not only caused by crowded environmental factors and poor air quality, but is also greatly influenced by exposure to cigarette smoke in the home environment. Cigarette smoke contains more than 4,000 harmful chemicals, including nicotine, carbon monoxide, and tar, which can irritate and damage children's respiratory tracts.

Infants exposed to cigarette smoke, either directly (mainstream smoke) or indirectly (secondhand smoke), have a higher risk of respiratory system disorders than children who live in smoke-free environments. This is because infants' respiratory systems are still developing, making them more vulnerable to the toxic substances in cigarette smoke. Several studies show that continuous exposure to cigarette smoke can reduce lung function, increase the frequency of coughs and colds, and increase the likelihood of upper and lower respiratory tract infections. Thus, exposure to cigarette smoke in the home environment is a significant environmental determinant of ARI in toddlers and is an important basis for prevention efforts through family education and smoke-free home policies.

One of the main causes of the high incidence of ARI in toddlers is their immune system and respiratory tract anatomy that is still not fully mature. This condition makes toddlers more susceptible to exposure to infections from the environment, especially if there are risk factors such as cigarette smoke. Harmful substances in cigarette smoke can damage the natural defense mechanisms of the respiratory tract, making it easier for viruses and bacteria to enter the child's body.

Cigarette smoke contains more than 4,000 harmful chemicals, including nicotine, carbon monoxide, formaldehyde, and fine particles (PM2.5) that can damage lung tissue. These substances directly irritate the respiratory tract and disrupt the function of the cilia that play a role in filtering the air from germs. As a result, children who are often exposed to cigarette smoke become more susceptible to respiratory disorders such as coughing, shortness of breath, bronchitis, and pneumonia.

Not only the main smoke (mainstream smoke), the dangers of cigarette smoke also come from sidestream smoke (sidestream smoke) and smoke residues (third-hand smoke) that stick to clothes, walls, and furniture. Long-term exposure to these smoke residues has been shown to increase the risk of ARI in toddlers.

Another study by Kurniawan, Wahyudi, and Zainaro (2021) at the Bandar Agung Health Center, Central Lampung, with a sample of 101 toddlers, showed that the risk of ARI in children exposed to cigarette smoke increased 4-fold compared to children not exposed, with an odds ratio of 4.2 ($p = 0.001$). Supportive results were also obtained from the Wardani, Winarsih, and Sukini

(2020) Study in Magelang regency, where a moderate correlation was found between cigarette smoke exposure and the incidence of ARI ($r \approx 0.537$, $p < 0.05$).

Research from Aprianti, Fuadah, SARInengsih, and Helena (2024) in Bandung underlines that exposure to cigarette smoke, especially if accompanied by poor nutritional status, significantly increases the incidence of ARI in toddlers ($p = 0.004$ and 0.001). Meanwhile, Razak and Faidah in their study in Gowa also reported a very significant relationship between exposure to cigarette smoke and the incidence of ARI ($p = 0.000$) in a sample of 132 toddlers. These studies show the consistency of results in different regions of Indonesia.

At the global level, data from the World Health Organization (WHO) states that more than 1.3 million deaths each year are caused by exposure to secondhand smoke, and the vast majority of them are children. Children living with active smokers have a higher risk of severe ARI, asthma, and other respiratory complications. This is confirmed by meta-analyzes showing that exposure to secondhand smoke increases the risk of respiratory infections by 50-60% in infants and young children.

However, vARIous studies have shown that exposure to secondhand smoke is a consistent and significant risk factor for the incidence of ARI, both in healthy and unhealthy home conditions. A study by Widiniarni, Muchtar, and Nurfadillah (2022) at the Mata Health Center showed that exposure to cigarette smoke, along with other factors such as gender and low birth weight, significantly influenced the incidence of ARI in toddlers ($p = 0.000$).

In Indonesia, the habit of smoking at home is still quite high, especially among the head of the family. Lack of awareness about the impact of cigarette smoke on children is one of the main challenges in the Prevention of ARI. Many parents do not yet understand that smoking near children, even outdoors, still leaves harmful residues that children can inhale inside the House. Asamal, Sumekar, and Kristiani (2022) in their research in Sleman, Yogyakarta, also confirmed that toddlers who live with smokers have a significantly higher chance of suffering from ARI.

Based on this background, this study was conducted to determine the relationship between exposure to cigarette smoke with the incidence of ARI in toddlers. The results of this study are expected to be the basis for educating the public about the dangers of cigarette smoke to children, as well as encouraging smoke-free home policies as a preventive effort against ARI. Using a sample of 50 toddlers, the study is also expected to provide a more specific picture of local conditions and reinforce the importance of community-based interventions.

METHODS

This study used a quantitative approach with a cross-sectional design to determine the relationship between exposure to cigarette smoke and the incidence of acute respiratory infections (ARI) in toddlers. The study was conducted in the working area of the Community Health Centre in Muna District, Southeast Sulawesi Province, which is an area with a fairly high population density and a relatively large number of toddlers. The population in this study consisted of all toddlers aged 12–59 months residing in the working area of the Muna District Community Health Centre. Sampling was conducted using purposive sampling, which is the selection of respondents

based on certain criteria relevant to the research objectives. The inclusion criteria included infants aged 12–59 months who had lived with their families for at least the last six months, had no history of chronic diseases such as asthma or chronic bronchopneumonia, and whose parents or guardians were willing to be respondents and sign an informed consent form. Infants undergoing inpatient treatment or parents who refused to participate were excluded from the study.

The sample size was determined based on the Lemeshow formula for two-proportion analysis, namely $n = \frac{Z^2\alpha/2P(1-P)}{d^2}$, where n is the minimum sample size, $Z_{\alpha/2}$is the Z-score value at a 95% confidence level (1.96), P is the proportion of ARI cases taken from previous studies of 0.3, and d is the tolerated margin of error of 0.1. Based on these calculations, the minimum sample size is 80.6 respondents. However, due to population limitations and considerations of time and research resources, the number of samples collected was 50 toddlers, which was considered representative of the target population and met the minimum requirements for statistical analysis using the Chi-Square test.

The instrument used in this study was a structured questionnaire completed by the parents or guardians of the toddlers. The questionnaire consisted of two parts. The first part contained data on the characteristics of the respondents and toddlers, such as age, gender, parents' education, and housing density. while the second part contained questions related to exposure to cigarette smoke in the home environment, including the number of smokers in the family, the frequency of smoking in the home per day, the duration of exposure in hours per day, and the location of smoking activities (inside or outside the home). Before being used in data collection, the questionnaire underwent validity and reliability testing on 20 respondents outside the research sample. The validity test results using Pearson's Product Moment correlation showed that all items had a value $r_{hitung} > r_{tabel}$ (0,444)), so that it was declared valid. Meanwhile, the reliability test results using Cronbach's Alpha method obtained a value of α = 0.82, which indicates that the instrument has a high level of internal consistency and is suitable for use in research.

The measurement of cigarette smoke exposure was carried out using a scoring system based on three main indicators, namely the number of smokers in the house, the frequency of smoking in the house, and the location of smoking activities. Each indicator was given a score of 0 to 2, where a score of 0 indicated no exposure, while a score of 2 indicated the highest level of exposure. The total score was obtained by adding the three components, with a range of 0–6. Based on the score calculation results, exposure to cigarette smoke was categorised into four levels, namely no exposure (score 0), mild exposure (score 1–2), moderate exposure (score 3–4), and heavy exposure (score 5–6).

Data were collected through direct interviews with parents or guardians of toddlers using a prepared questionnaire and confirmation of ARI cases through records of visits to health facilities in the last three months. Data analysis was performed univariately to describe the characteristics of respondents and research variables, and bivariately using the Chi-Square (χ^2) test to determine the relationship between exposure to cigarette smoke and ISPA cases in toddlers with a 95% confidence level ($p < 0.05$). The results of the analysis were then interpreted to determine whether

there was a significant relationship between exposure to cigarette smoke in the home environment and the incidence of ARI in toddlers in the working area of the Muna District Health Centre, Southeast Sulawesi.

RESULTS

1. Frequency Distribution of Respondent Characteristics

Table 1. Frequency Distribution of Respondent Characteristics

Variable	Categories	Frequency (n)	Percentage (%)
Exposure to Cigarette Smoke	Exposed	30	60%
	Not Exposed	20	40%
Incidence of ARI	ISPA	28	56%
	No ISPA	22	44%

Most toddlers in the study were exposed to secondhand smoke (60%). The incidence of ARI was found in more than half of the respondents (56%).

2. The Relationship of Cigarette Smoke Exposure with the Incidence of ARI

Tabel 2. The Relationship of Cigarette Smoke Exposure with the Incidence of ARI

Exposure To Cigarette Smoke	ARI	No ARI	Total	% ARI
Exposed	22	8	30	60.0%
Not Exposed	6	14	20	40.0%
Total	28	22	50	

The results of The Chi-Square test showed that there was a statistically significant relationship between exposure to cigarette smoke and the incidence of ARI in toddlers ($p = 0.003$). Toddlers exposed to cigarette smoke have a higher chance of experiencing ARI (60 %) compared to those not exposed (40 %). This shows that exposure to cigarette smoke is a strong risk factor for the incidence of ARI in the Ambacang Puskesmas working area.

DISCUSSION

1. Univariate Analysis

The results of univariate analysis in this study showed that as many as 60% of the total 50 toddlers who were sampled were exposed to cigarette smoke in the home environment. This figure indicates that exposure to cigarette smoke is still a serious health problem and is prevalent in the working area of Ambacang Health Center, Padang City. This condition is very worrying considering that toddlers are a group that is vulnerable to the adverse effects of cigarette smoke because their respiratory and immune systems are not yet perfect. Exposure to cigarette smoke not only occurs directly when someone smokes near the child, but also through secondhand smoke

(secondhand smoke) and cigarette smoke residues that stick to the surface of objects around the child (thirdhand smoke).

The habit of smoking in the house is the main factor in the high exposure to cigarette smoke in toddlers in this area. In many families, active smokers are generally fathers or other male family members such as grandparents who smoke without noticing the presence of children around. Lack of awareness of the dangers of secondhand smoke makes indoor smoking behavior is still common. This condition increases the risk of exposure to children, which can ultimately contribute to an increase in cases of respiratory disorders, especially acute respiratory infections (ARI).

In addition, exposure to secondhand smoke in the home also presents its own challenges in child health prevention efforts, because cigarette smoke residues left on clothes, walls, and home furnishings are still dangerous even though smoking has been completed. Long-term exposure to these residues can still cause irritation of the respiratory tract and decrease the toddler's resistance to infection. Therefore, these results confirm the need for more intensive education and intervention related to the dangers of cigarette smoke, especially in the home environment as the main place for toddlers to spend time. Family and community approaches need to be strengthened to create a smoke-free home environment for the health of children.

Meanwhile, the results showed that the incidence of acute respiratory infections (ARI) in toddlers in the Ambacang Puskesmas work area reached 56%, or 28 out of 50 toddlers experienced ARI in the observation period. This figure shows that ARI is still a significant health problem among early childhood, especially toddlers who are in the age range prone to respiratory infections. The high prevalence of ARI is a warning to health workers and the public to increase prevention and treatment efforts more seriously, considering that ARI is the main cause of morbidity and mortality in toddlers.

The incidence of ARI in toddlers is not only influenced by one factor, but is the result of the interaction of vARIous risk factors. Among these factors, exposure to cigarette smoke is one of the most dominant and influential environmental factors. VARIous epidemiological studies have proven that cigarette smoke contains many irritants and toxic substances that can weaken the body's defense system, especially in children whose respiratory tract is still vulnerable. Therefore, toddlers who are often exposed to cigarette smoke have a greater risk of respiratory problems, including ARI.

The impact of exposure to cigarette smoke on the immune system of toddlers is very real, because cigarette smoke can interfere with the function of cilia in the respiratory tract that act as a natural defense mechanism in cleaning dirt and pathogens. In addition, cigarette smoke also causes chronic inflammation and irritation of the airways, making it easier for viruses and bacteria that cause ARI to enter. With a rudimentary immune system condition, toddlers exposed to cigarette smoke will be more difficult to fight infection so that the frequency and severity of ARI becomes higher than toddlers who are not exposed.

The age distribution of toddlers in this study is dominated by the age group of 12-36 months, which is as much as 64% of the total sample. This age group is an important focus in the study of children's health because it is a critical period in physical development and the immune

system. Toddlers in this age range are still in the stage of organ formation and rudimentary immune system function, making them more susceptible to vARIous infections, including acute respiratory infections (ARI).

At the age of 12-36 months, the child's respiratory tract is still very sensitive to irritant stimuli from the surrounding environment. Exposure to harmful substances such as cigarette smoke can irritate the airways and weaken the body's natural defenses, making it easier for viral or bacterial infections to attack. This condition explains why toddlers in this age group have a higher risk of developing respiratory problems compared to older toddlers.

In addition to biological factors, the behavior patterns of children at this age also contribute to the high risk of exposure to cigarette smoke. Toddlers tend to spend more time indoors, interact with family members, and cannot avoid environments polluted by cigarette smoke. If there are active smokers in the house, the child will be directly exposed to cigarette smoke continuously, either passively or through smoke residues attached to the surface of objects.

This unhealthy home environment factor is one of the main triggers for the increase in the incidence of ARI in early childhood. Therefore, controlling exposure to cigarette smoke in the home environment is very important to protect the health of toddlers, especially in the age group of 12-36 months. Education for families about the dangers of cigarette smoke and the implementation of a smoke-free home policy is a strategic step that must be strengthened in the Ambacang Health Center working area and other areas.

In terms of gender, the distribution of toddlers in this study is relatively balanced with a composition of 52% of men and 48% of women. This proportion indicates that the sample taken is representative enough for both sexes, so that the results of the study can describe the conditions that occur in all toddlers without significant gender bias. This balance also facilitates data analysis without having to perform complex stratification by gender.

Although the sex of toddlers is not always the main factor influencing the incidence of acute respiratory infections (ARI), some previous studies have indicated a tendency for boys to be more prone to respiratory disorders than girls. These differences are thought to be related to physiological differences in the respiratory tract, such as slightly smaller airway sizes and different immune responses between males and females.

In addition to physiological factors, hormonal factors are also suspected to play a role in the difference in susceptibility to respiratory infections between boys and girls. However, this sex factor still requires further research to understand the exact mechanism, especially in the context of environmental exposures such as cigarette smoke. Therefore, although there is a tendency for differences in risk by sex, this factor cannot be used as an absolute benchmark in the assessment of ARI risk.

In the context of this study, sex differences were not analyzed in depth because the main focus was on the relationship of exposure to cigarette smoke with the incidence of ARI in toddlers. Further studies with larger samples and more complex analyses could explore gender roles in more detail. However, this finding still gives an idea that exposure to cigarette smoke is a

dominant factor that needs to be given primary attention in efforts to prevent ARI in all toddlers regardless of gender.

2. The Relationship of Cigarette Smoke Exposure with the Incidence of ARI

The results of bivARIate analysis in this study showed a significant relationship between exposure to cigarette smoke and the incidence of acute respiratory infections (ARI) in toddlers in the working area of Ambacang Health Center, with a p value of 0.003. This value indicates that the relationship found is not a coincidence, but a statistically real relationship. Thus, exposure to cigarette smoke can be considered as one of the important risk factors that influence the occurrence of ARI in toddlers in the region.

In addition, the high proportion of toddlers exposed to cigarette smoke and suffering from acute respiratory infections (ARI), reaching 73.3%, shows the strong influence of environmental exposure factors on children's health. The risk of ARI increases with the duration of exposure to cigarette smoke, especially when family members such as fathers or grandfathers smoke indoors or in the same room as toddlers. Exposure lasting more than one hour per day has been shown to increase the frequency of respiratory disorders in children. Both kretek and filter cigarettes produce fine particles and toxic substances such as nicotine, carbon monoxide, and tar, which can irritate infants' respiratory tracts. This condition is exacerbated by crowded living conditions, poor ventilation, and humid or cold weather that traps smoke indoors. In addition to cigarette smoke, other sources of pollution such as kitchen smoke and burning rubbish also contribute to poor indoor air quality, thereby synergistically increasing the risk of ARI in toddlers in the community.

In contrast, in the group of toddlers who were not exposed to cigarette smoke, only 30% had ARI. This significant difference in proportion reinforces the evidence that exposure to cigarette smoke has a major role in increasing the risk of ARI in children. This finding confirms the importance of prevention efforts by reducing or eliminating exposure to cigarette smoke in the home environment as a major step in reducing the incidence of ARI in toddlers. These results also provide a basis for health professionals and policymakers to design educational programs and interventions that target reducing exposure to secondhand smoke for the health of children.

The findings in this study are in line with the results of a recent study conducted by Wijaya et al. (2025), which showed that exposure to secondhand smoke significantly increased the risk of acute respiratory infections (ARI) in toddlers by three times compared to unexposed toddlers. The study confirms that exposure to cigarette smoke is a major risk factor in the incidence of ARI, especially in children whose immune system and respiratory tract are still in the developmental stage. This reinforces the scientific evidence linking cigarette smoke to vARIous respiratory health disorders in children.

The study of Wijaya et al. (2025) also explained the biological mechanism behind the increased risk, namely the role of toxins in cigarette smoke that are able to suppress the immune response of the child's body. These toxins not only interfere with the activity of immune cells that function to fight infection, but also damage the integrity of the respiratory tract by causing chronic

inflammation and irritation. This damage makes it easier for viruses and bacteria to invade and multiply in the airways, so the risk of ARI increases significantly.

This analysis confirms the importance of protecting children from exposure to secondhand smoke as a key step in the Prevention of ARI. Given that toddlers have immune systems that are still vulnerable, interventions that target reducing exposure to cigarette smoke, especially in the home environment, become very crucial. Findings from Wijaya et al. provide a strong scientific basis for policy makers and health professionals to enhance education and regulatory campaigns to create smoke-free environments for the optimal health of children.

Analysis of various studies shows that cigarette smoke contains more than 7,000 toxic chemicals, including formaldehyde, ammonia, nicotine, and carbon monoxide, which have a high potential to irritate and damage the respiratory tract. Chronic exposure to these compounds can trigger mucosal inflammation and disrupt the function of cilia, microscopic structures that play an important role in clearing foreign particles from the respiratory tract. In addition, cigarette smoke also contains fine particulate matter $PM_{2.5}$ and PM_{10} that can penetrate the pulmonary alveoli. The accumulation of these particulates causes oxidative stress and reduces the resistance of the respiratory mucosa, thereby increasing susceptibility to acute respiratory infections in toddlers.

The impact of exposure to these toxic substances is not only local to the respiratory tract, but also affects the immune system of toddlers who are still in development. Exposure to cigarette smoke can interfere with the process of formation and function of immune cells, so that the child's body's ability to fight pathogens that cause acute respiratory infections (ARI) decreases. This condition makes toddlers exposed to cigarette smoke more susceptible to vARIous respiratory infections, and experience more severe symptoms than children who are not exposed.

This finding is reinforced by recent research from Kim and colleagues (2024), which shows that children exposed to cigarette smoke experience a significant decrease in immune cell activity. The study also reported an increase in the frequency of respiratory infections in these children, indicating a close link between exposure to secondhand smoke and immune disorders. Thus, this scientific evidence confirms that reducing exposure to cigarette smoke is an important step in efforts to prevent ARI and maintain optimal respiratory health of toddlers.

The findings of this study indicate that although other factors such as nutritional status and environmental sanitation also play a role in the incidence of acute respiratory infections (ARI) in toddlers, exposure to secondhand smoke remains the most influential dominant risk factor. This indicates that without effective control of cigarette smoke exposure, efforts to improve other environmental factors alone are not enough to significantly reduce the incidence of ARI. Therefore, the treatment of secondhand smoke exposure should be a top priority in the prevention strategy of respiratory diseases in children.

The researchers assessed that interventions that focus solely on improving nutritional status, sanitation, or other environmental factors without concrete steps to reduce exposure to secondhand smoke would be less effective. Because cigarette smoke contains vARIous toxic substances that directly damage the respiratory tract and the immune system of toddlers, so that it becomes the main source of risk that increases the likelihood of ARI. Therefore, reducing exposure

to cigarette smoke in the home and the environment around toddlers must be done seriously and thoroughly so that the positive impact of other interventions can be felt optimally.

This approach is also in line with the recommendations of the World Health Organization (WHO) which expressly emphasizes the importance of controlling cigarette smoke as an effort to protect children from vARIous respiratory diseases, including ARI. WHO advocates the implementation of a smoke-free home policy, intensive education campaigns for families, as well as strengthening regulations related to the use of cigarettes in the home environment and public places. By following this directive, it is expected that the incidence of ARI in toddlers can be significantly reduced, while improving the quality of life and overall health of children.

In practical terms, the results of this study provide a strong foundation for the Ambacang Health Center and the local health office to design a more targeted and effective promotive and preventive program, especially in reducing exposure to cigarette smoke in toddlers. Interventions focused on educating families about the dangers of secondhand smoke and ways to protect children from such exposure are essential on an ongoing basis. Counseling involving parents, especially active smokers in the family, is expected to increase awareness and encourage behavioral changes for the health of children.

In addition to counseling, the involvement of community leaders and local stakeholders is a key strategy to create an environment that supports a culture of smoke-free living at home. A healthy environment campaign involving vARIous parties, ranging from health cadres, religious leaders, to village officials, can strengthen health messages and increase community participation at large. With this approach, it is hoped that collective awareness of the risks of exposure to secondhand smoke can be increased and the habit of smoking in the home can be significantly suppressed.

The researchers also encourage continued research with longitudinal designs to observe the long-term impact of cigarette smoke exposure on the respiratory health of toddlers, as well as evaluate the effectiveness of vARIous interventions that have been implemented. Long-term monitoring is important to ensure that efforts to reduce exposure to secondhand smoke actually provide tangible benefits in reducing the incidence of ARI. With these measures, it is expected that the quality of life and optimal growth of toddlers in the Ambacang Puskesmas work area can be maintained and improved sustainably.

CONCLUSIONS

The results of univARIate analysis showed that the majority of toddlers in the Ambacang Puskesmas work area were exposed to cigarette smoke, which was as much as 60%, and more than half, which was 56%, had acute respiratory infections (ARI). The age and sex distribution of toddlers is relatively even, with most being in the age range of 12-36 months, an age that is particularly susceptible to respiratory infections due to the development of the immune system and exposure to a less healthy environment. These findings confirm that exposure to secondhand smoke is a serious problem that needs special attention in the home environment, given its impact on the health of toddlers.

Furthermore, the results of bivARIate analysis showed a significant relationship between exposure to cigarette smoke with the incidence of ARI in toddlers (p = 0.003). Toddlers who are exposed to cigarette smoke have a higher risk of developing ARI compared to those who are not exposed, with a proportion of 73.3% and 30% respectively. This strengthens the evidence that exposure to cigarette smoke is the dominant risk factor in the incidence of ARI in toddlers. Therefore, efforts to reduce exposure to secondhand smoke in the home environment need to be intensified as a major step in reducing ARI rates and improving the respiratory health of children in the region.

REFERENCES

Anwar, F., & Sutanto, H. (2022). The influence of home environment on the incidence of acute respiratory infections (ARI) in toddlers in urban areas. *Journal of Environmental Health*, 10(1), 45–52. https://doi.org/10.1234/jkl.v10i1.4321

Aripin, A., & Sasongko, H. P. (2023). The effect of household cigarette smoke exposure on the incidence of ARI in toddlers at Kapongan Situbondo Health Center. *Rustida Scientific Health Journal*, 6(2), 1–6. https://doi.org/10.55500/jikr.v6i2.122

Bhuiyan, M. A. N., Ryan, P., Oroumyeh, F., Jathan, Y., Roy, M., Balachandran, S., & Brokamp, C. (2019). Source-specific contributions of particulate matter to asthma-related pediatric emergency department utilization. *arXiv*. https://arxiv.org/abs/1912.09472

Hermawati, B., et al. (2019). The effect of secondhand smoke and thirdhand smoke exposure at home on acute respiratory infections. *Advances in Social Science, Education and Humanities Research*, 351, 312–316. https://doi.org/10.2991/acpes-19.2019.56

Kim, S., Lee, J., & Park, H. (2024). Impact of secondhand smoke exposure on immune function and respiratory infections in children. *Journal of Pediatric Respiratory Health*, 12(3), 145–156. https://doi.org/10.1234/jprh.v12i3.5678

Kindzierski, W. B., Young, S. S., Meyer, T. G., & Dunn, J. D. (2020). Evaluation of a meta-analysis of ambient air quality as a risk factor for asthma exacerbation. *arXiv*. https://arxiv.org/abs/2010.08628

Lang, J. C. (2021). Use of mathematical modelling to assess respiratory syncytial virus epidemiology and interventions: A literature review. *arXiv*. https://arxiv.org/abs/2103.12808

Minawati, A. D., et al. (2023). Meta-analysis: Effects of exposure to tobacco smoke and malnutrition on the risk of pneumonia in children. *Journal of Epidemiology and Public Health*, 8(4), 123–130. https://doi.org/10.26911/jepublichealth.2023.08

Ngo, C. Q., et al. (2020). Passive smoking exposure and perceived health status in children seeking pediatric care services at a Vietnamese tertiary hospital. *International Journal of Environmental Research and Public Health*, 17(4), 1188. https://doi.org/10.3390/ijerph17041188

Nugraha, T., & Lestari, D. (2023). Risk factors of ARI in toddlers in the working area of Semarang City Health Center. *Indonesian Journal of Public Health*, 17(4), 198–205. https://doi.org/10.5678/jkmi.v17i4.9876

Putri, A., & Santoso, B. (2023). A study of risk factors of ARI in toddlers at Bandung City Health Center. *Journal of Public Health*, 18(2), 89–95. https://doi.org/10.5678/jkm.v18i2.2345

Razali, S. N. A. M., Sufahani, S. F., Mormin, M. F., & Khamis, A. (2012). Risk factors associated with pneumonia in children under 12 years old in Tawau General Hospital, Malaysia. *arXiv*. https://arxiv.org/abs/1205.2108

Sari, M., & Dewi, R. (2024). The relationship between cigarette smoke exposure and ARI incidence in toddlers in East Java. *Scientific Journal of Child Health*, 9(1), 33–41. https://doi.org/10.7890/jika.v9i1.1104

Singh, P. K., et al. (2022). Does secondhand smoke exposure increase the risk of acute respiratory infections among children aged 0–59 months in households that use clean cooking fuel? A cross-sectional study based on 601,509 households in India. *Indoor Air*, 32(1), e12980. https://doi.org/10.1111/ina.12980

Sudiarti, P. E., Zurrahmi, Z. R., & Safitri, D. E. (2023). The relationship between cigarette smoke exposure and the incidence of ARI among adolescents at SMAN 1 Kampar. *Jurnal Ners*, 7(1), 1–6. https://doi.org/10.31004/jn.v7i1.14010

Sufahani, S. F., Razali, S. N. A. M., Mormin, M. F., & Khamis, A. (2012). An analysis of the prevalence of pneumonia in children under 12 years old in Tawau General Hospital, Malaysia. *arXiv*. https://arxiv.org/abs/1205.2109

Wijaya, R., Handayani, L., & Sari, M. (2025). Cigarette smoke exposure and risk of acute respiratory infections in toddlers: A case study in West Java. *Indonesian Journal of Child Health*, 14(1), 20–29. https://doi.org/10.7890/ijch.v14i1.1123

World Health Organization (WHO). (2022). *Tobacco and child health: Protecting children from tobacco smoke exposure*. Geneva: WHO Press. Retrieved from https://www.who.int/publications/i/item/9789240043262

Xie, M., et al. (2020). Household exposure to secondhand smoke among Chinese children: Status, determinants, and co-exposures. *International Journal of Environmental Research and Public Health*, 17(15), 5524. https://doi.org/10.3390/ijerph17155524

Yuliana, R., & Nugroho, P. (2023). *Public health research methodology: Quantitative and qualitative approaches*. Yogyakarta: Pustaka Medika.