



THE EFFECT OF CIGARETTE SMOKE EXPOSURE ON THE INCIDENCE OF ACUTE RESPIRATORY INFECTIONS IN TODDLERS

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ABSTRACT

ARI remains one of the leading causes of death among infants, and the incidence of ARI is still quite high in the working area of the Simpang Timbangan Community Health Center. This study aims to determine the relationship between exposure to cigarette smoke and the incidence of ARI among infants in the working area of the Simpang Timbangan Community Health Center. This study used a cross-sectional approach involving 90 households with infants (infants, mothers, and family members who smoke) selected through purposive sampling to assess the relationship between the presence or absence of family members who smoke, CO levels, smoking locations, and the number of cigarettes smoked per day. Statistical analyses used included the Mann-Whitney test, Fisher's exact test, and chi-square test. Results: There were 35.6% of toddlers who experienced ARI. Furthermore, toddlers who lived with family members who smoked were significantly 1.64 times more at risk of experiencing ARI, and among toddlers who lived with smokers, they were 4.55 times more at risk of experiencing ARI if the smokers smoked inside or outside the house. The number of cigarettes smoked per day was also significantly associated with ARI, but CO levels were not significantly associated with ARI. Thus, the presence or absence of smokers, the location of smoking, and the number of cigarettes smoked per day were significantly associated with ARI, although CO levels were not significantly associated.

Keywords: carbon monoxide; cigarette smoke; ISPA; toddlers

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INTRODUCTION

Acute respiratory infections (ARI) are one of the most common health problems in toddlers. These infections attack the upper and lower respiratory organs, including bronchitis and pneumonia. In Indonesia, based on the 2023 Indonesian Health Survey (SKI 2023), a total of 4.8% of toddlers experienced ARI, with 4.4% of children under 12 months diagnosed with ARI by a doctor and the prevalence increasing in older children, namely 4.9% among children aged 1- 4 years (Ministry of Health, 2024). In terms of symptoms, the Ministry of Health (2024) states that ARI is characterized by a history of fever, coughing for <2 weeks, runny nose/stuffy nose, and/or sore throat. Based on a doctor's diagnosis or experiencing these symptoms, 26.6% of children under 12 months of age were categorized as having ARI, while the prevalence in the 1- 4 year old age group was 35.7%. In South Sumatra, based on SKI 2023, 25.4% of toddlers experienced ARI based on a doctor's diagnosis or based on the symptoms they experienced. This is very crucial because ARI can also cause children to experience shortness of breath and even death, where Fathmawati et al. (2021) revealed that 22.3% of toddler deaths in Indonesia were caused by ARI.

ARI in toddlers is associated with various risk factors. According to Fathmawati et al. (2021), working mothers increase the risk of toddlers experiencing ARI by up to 1.46 times, while drinking water from wells prevents ARI by up to 0.46 times. Furthermore, Islam et al. (2024) revealed that infants who live in overcrowded houses, cook with unsafe fuel, are exposed to cigarette smoke

indoors, and do not have access to proper sanitation are at high risk of developing ARI. In this study, a history of preterm birth and low birth weight increased the risk of ARI, while a history of exclusive breastfeeding prevented children from developing ARI. Al-Taj et al. (2025) added that children living in rented houses, especially those frequently exposed to cigarette smoke indoors, were at greater risk of developing ARI.

Upon further investigation, exposure to cigarette smoke in toddlers, especially those exposed indoors/in enclosed spaces, tends to increase the risk of toddlers developing ARI. Toddlers who are passive smokers in enclosed spaces often inhale smoke containing various harmful substances, including carbon monoxide (CO). This can damage the natural defense mechanisms in the infant's respiratory tract, making the child more susceptible to ARI (Islam et al., 2024). Not only that, CO exposure is also associated with neurocognitive and behavioral disorders in infants. This shows that CO exposure can affect a child's brain development, which is related to the child's cognitive level into adulthood. CO toxicity begins when it is inhaled during inspiration and binds to hemoglobin in the blood to form carboxyhemoglobin. This condition interferes with oxygen binding and hemoglobin dissociation, causing disruption of oxygen supply and distribution in the blood and leading to tissue hypoxia (Palmeri & Gupta, 2025).

Unfortunately, smoking remains an unresolved risk factor for various diseases in Indonesia. Indonesia has the highest number of active smokers aged 15 years and above globally, after China and India in 2023 (The Tobacco Atlas, 2023). This is because the implementation of Government Regulation No. 109 of 2011, which regulates smoking in smoke-free areas (KTR), has not been effective. One of the reasons for this is that there are no penalties that deter violators, so they continue to smoke in areas that are supposed to be smoke-free (Putra, 2020). In fact, in the working area of the Lompoe Community Health Center in Pare-Pare city, it was recorded that 73.3% of smokers tend to smoke 5-11 cigarettes a day, and 10% smoke more than 15 cigarettes a day (Jamal et al., 2022). In fact, the study also found that exposure to cigarette smoke is associated with the incidence of ARI in toddlers. In another area, the working area of the Sukaraya Community Health Center, Ogan Komering Ulu, one of the risk factors for ARI in toddlers is also exposure to cigarette smoke from family members (Setiawati et al., 2021).

Based on these various studies, a significant relationship between exposure to cigarette smoke and the incidence of ARI has been found in various regions, but none have discussed comprehensively the various aspects of exposure to cigarette smoke on the incidence of ARI in the Ogan Ilir region. In fact, based on preliminary studies, there were 235 toddlers who experienced ARI in the Simpang Timbangan Community Health Center area in 2025, and this number increased significantly compared to 2024, which only had 9 toddlers with ARI. Therefore, this study was conducted to determine the relationship between exposure to cigarette smoke and the incidence of ARI in toddlers in the working area of the Simpang Timbangan Community Health Center, Ogan Ilir Regency. This is expected to provide a comprehensive picture of the effect of exposure to cigarette smoke on the incidence of ARI in infants, as a basis for decision making.

METHOD

This cross-sectional study involved 90 respondents selected through purposive sampling. The respondents were spouses of infants aged 0-59 months, mothers, and family members who were smokers, selected through purposive sampling in four villages within the working area of the Simpang Timbangan Community Health Center. The dependent variable in this study was the incidence of ARI in toddlers, while the independent variables were the presence or absence of family members who smoke, CO levels, smoking location, and number of cigarettes per day. ARI was defined as fever followed by cough and runny nose more than twice in the last 3 months. The presence of smokers was defined as whether there were family members in the household who smoked. The average number of cigarettes per day was calculated from the average number of

cigarettes smoked by all family members who smoked in one day, while CO levels were passive smoker CO levels calculated using a smokelyzer on mothers. Furthermore, the statistical analysis performed was the Mann-Whitney test to see the relationship between CO levels and the average number of cigarettes per day with the incidence of ARI, while the variables of the presence or absence of smokers and the incidence of ARI in toddlers were tested with the Fisher exact test, and the location of smoking with the incidence of ARI was analyzed using the chi-square test. This study has been approved by the Ethics Committee of the Faculty of Public Health, Sriwijaya University, with number 789/UN9.FKM/TU.KKE/2025.

RESULT

Based on the research results, the characteristics of the respondents are presented in Table 1 below.

Table 1.
Characteristics of Respondents (n=90)

Respondent Characteristics	f	%
Child's Gender		
Female	43	47.8
Male	47	52.2
Child's age (mean, SD)	29.33 (14.8)	
Number of smokers		
None	8	8.9
Yes, 1 smoker	73	81.1
Yes, >1 smoker	9	10
Family Members Who Smoke		
Father	71	86.6
Others (Grandmother, Grandfather, Other Siblings)	11	13.4

Based on the table above, 52.2% of children are male and the average age of children is 28.33 months. Furthermore, 81.1% of households have one smoker in the home and 10% have more than one smoker. Among these smokers, 86.6% are fathers of toddlers. The prevalence of ARI in toddlers is presented in Table 2 below.

Table 2.
Prevalence of ISPA in Infants (n=90)

Respondent Characteristics	f	%
ARI		
No	58	64.4
Yes	32	35.6

From the table 2, it was found that 35.6% of toddler respondents experienced ARI. Furthermore, the relationship between the presence or absence of family members who smoke and the incidence of ARI is presented in Table 3 below.

Table 3.
Relationship between the Presence or Absence of Family Members Who Smoke and the Incidence of ARI in Toddlers (n=90)

Respondent Characteristics	No ARI		A		p-value	OR	95% CI
	f	%	f	%			
Presence of Family Members Who Smoke					0.047		
No	8	100	0	0		Ref.	
Yes	50	61.0	32	39.0		1.64	1.38 – 1.95

Based on the table, 39% of toddlers living with smokers experienced ARI. Statistically, a significant relationship was found between the presence or absence of family members who smoke and the incidence of ARI in toddlers (p-value <0.05). Furthermore, toddlers living with family members who smoke are 1.64 times more likely to experience ARI than those who do not live with smokers (OR=1.64; 95%CI=1.38 – 1.95). Furthermore, the relationship between CO levels and the incidence

of ARI in toddlers is presented in Table 4 below.

Table 4.

Relationship between CO Levels and ISPA Incidence in Infants (n=90)

Karakteristik Responden	No ARI			ARI			p-value
	n	mean	SD	n	Mean	SD	
Kadar CO	58	1,29	0,62	32	2,13	3,75	0,399

Table 4 shows that there is no significant relationship between CO levels and the incidence of ARI in toddlers (p-value >0.05). However, it can be seen that the average CO level in toddlers with ARI is higher than in toddlers without ARI. Furthermore, the relationship between smoking location and the incidence of ARI in toddlers is presented in Table 5. In this case, respondents included in the analysis of the relationship between smoking location and the number of cigarettes smoked per day with the incidence of ARI in toddlers were only toddlers who lived with family members who smoked.

Table 5.

Relationship between Smoking Location and ISPA Incidence in Toddlers (n=82)

Respondent Characteristics	No ARI		ARI		p-value	OR	95% CI
	n	%	n	%			
Location of Smoking					0.005		
Outside the Home	28	80.0	7	20.0		Ref.	
Inside and Outside the Home	22	46.8	25	53.2		4.55	1.66 – 12.44

Based on the table, 53.2% of toddlers whose family members smoke indoors and outdoors experience ARI. Statistically, a significant relationship was found between the location of smoking and the incidence of ARI, where toddlers whose family members smoke indoors and outdoors are 4.55 times more likely to experience ARI than those who only smoke outdoors. Furthermore, the relationship between the number of cigarettes smoked per day and the incidence of ARI is presented in Table 6 below.

Table 6.

Relationship between the Number of Cigarettes Consumed per Day and the Incidence of ARI in Infants (n=82)

Respondent Characteristics	No ARI			ARI			p-value
	n	mean	SD	n	Mean	SD	
Number of Cigarettes Per Day	50	7.34	5.71	32	9.56	4.89	0.020

Table 6 reveals that family members living with ISPA toddlers tend to have a higher average number of cigarettes smoked per day (9-10 cigarettes) compared to family members of non-ISPA toddlers (7-8 cigarettes). Statistically, a significant relationship was found between the number of cigarettes smoked per day and the incidence of ISPA in toddlers (p-value < 0.05).

DISCUSSION

In this study, 35.6% of toddlers in the Simpang Timbangan Community Health Center working area were found to have ARI. This prevalence is still quite high compared to the overall prevalence of ARI in South Sumatra based on the 2023 SKI results, which is 25.4% (Ministry of Health, 2024). This requires attention, considering that ARI is one of the leading causes of death in toddlers. Furthermore, the presence of family members who smoke is also significantly associated with the incidence of ARI in toddlers. This is in line with research conducted by Islam et al. (2024), which found that toddlers who have family members who smoke are at greater risk of developing ARI. (Santri et al., 2023) also found that fathers who smoke are significantly associated with the incidence of ARI in toddlers.

This is associated with exposure to cigarette smoke experienced by infants as passive smokers, where infants who live with active smokers tend to be exposed to cigarette smoke more often and become passive smokers. Daily exposure to cigarette smoke as a passive smoker can reduce children's lung function, especially in terms of forced expiratory volume (FEV) (Pavić et al., 2024). In addition, exposure to cigarette smoke also erodes the respiratory tract of toddlers, making it

easier for bacteria and viruses to infect the respiratory tract of toddlers and cause ARI (Qamarya & Zahratul Hayati, 2022). In fact, in 2019, passive smoking among toddlers was estimated to be the cause of 6.94% of toddler deaths worldwide due to lower respiratory tract infections (Xiang et al., 2023).

This exposure is also associated with the location of smoking and the number of cigarettes smoked per day. In this study, toddlers whose family members smoke indoors or outdoors are more likely to experience ARI. In terms of cigarette consumption, smokers who smoke 9 or more cigarettes per day increase their toddlers' risk of developing ARI. This is associated with the intensity of cigarette smoke exposure inhaled by children in enclosed spaces, such as inside the home. Cigarette smoke, as a pollutant, has high toxicity and increases the risk of ARI in toddlers by 1.19 times (Desye et al., 2025). An increase in the number of cigarettes smoked also increases the intensity of exposure to smoke inside the home, especially if ventilation is poor, making it difficult for the smoke to escape. Infants who are exposed to cigarette smoke indoors for longer periods of time are at higher risk of developing ARI (Riyanto & Kusumawati, 2016).

This study has several strengths and weaknesses. This study has a fairly large research location, namely 4 villages which are the working areas of the Simpang Timbangan Community Health Center, so that it can better represent the actual conditions in the working area of the Simpang Timbangan Community Health Center. Furthermore, this study comprehensively describes several variables related to cigarette smoke exposure, but it has a limitation in that CO levels were not measured directly in toddlers, but rather in their mothers, who are the caregivers who spend the most time with the toddlers and are able to blow properly for CO level testing using a smokelyzer.

CONCLUSION

The incidence of ARI among toddlers in the working area of the Simpang Timbangan Community Health Center is still quite high. This is related to the exposure to cigarette smoke experienced by toddlers at home. This study also found a significant relationship between the presence or absence of family members who smoke, the location of smoking, and the number of cigarettes smoked per day. In this case, infants who live with families who smoke indoors or outdoors, with an average of 9 to 10 cigarettes per day, are at greater risk of developing ARI.

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