

Risk Factors for Acute Respiratory Tract Infection (ARI) Incidence in the Coastal Community of Liwuto Village

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ABSTRACT

Background: Cases of Acute Respiratory Infection (ARI) in the service area of Liwuto Health Center continue to rise, from 318 cases (2021) to 472 cases during the period of January–October 2024, with children under five as the most vulnerable group. Research Objective: This study aims to identify risk factors associated with the incidence of ARI among coastal communities within the service area of Liwuto Health Center. Methods: This was an analytic observational quantitative study with a cross-sectional design. The population consisted of 203 children under five, with a sample of 67 respondents calculated using the Slovin formula and selected through accidental sampling. Data analysis used univariate and bivariate (chi-square) tests. Results: Variables significantly associated with ARI incidence were exposure to cigarette smoke ($p=0.000$), Clean and Healthy Living Behavior (PHBS) ($p=0.000$), house ventilation ($p=0.000$), residential density ($p=0.000$), and type of house wall ($p=0.024$). Conclusion: There is an association between exposure to cigarette smoke, PHBS, house ventilation, residential density, and type of wall and the incidence of ARI. Education from the Health Center regarding environmental hygiene and clean and healthy living behaviors is needed to prevent ARI transmission in coastal communities.

INTRODUCTION

Acute Respiratory Tract Infection (ARI) is the most common infection affecting the respiratory tract, from the nose, sinuses, pharynx, to larynx, and remains one of the leading causes of morbidity and mortality in both children and adults worldwide (School of Public Health, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya dkk., 2021). Its transmission is closely related to environmental conditions; poor sanitation, the habit of burning and indiscriminately disposing of waste, and the lack of awareness in maintaining environmental cleanliness are factors that facilitate the spread of this disease (Bupu dkk., 2024).

Globally, the World Health Organization (WHO) records ARI as one of the ten leading causes of death, with mortality from this infectious disease reaching millions of lives each year, and the largest proportion occurring in developing countries (Riris I. M. Sogara dkk., 2024). In Indonesia, ARI consistently ranks first among the ten most prevalent diseases, particularly among infants and young children, with determinants including environmental factors, family economic status, housing density, education level, smoking habits, and clean and healthy living behaviors (Fauziah & Fajariyah, 2023). A similar situation is seen in Southeast Sulawesi, particularly in the city of Baubau, where the number of ARI cases has risen sharply in recent years. The working area of Puskesmas Liwuto, located in the coastal area of Kokalukuna District, has recorded a significant increase in ARI cases: 318 cases in 2021, 364 cases in 2022, 429 cases in 2023, and rising to 472 cases in just the period from January to October 2024, with children under five being the most vulnerable group. Initial interviews with the environmental health program officer at Puskesmas Liwuto indicated that air pollution caused by waste burning, exposure to cigarette smoke, the habit of indiscriminate waste disposal, and substandard housing conditions are suspected to be contributing factors to the high incidence of ARI in the area.

The incidence of ARI is essentially the result of interactions between host, agent, and environmental components, so that changes in any of these components can disrupt the balance and increase the risk of disease transmission (Fauziah & Fajariyah, 2023).

As a coastal area characterized by densely populated settlements and diverse housing conditions, Liwuto Subdistrict has considerable potential for exposure to residential environmental risk factors; however, data on the relationship between housing physical conditions and community behavior with the incidence of ARI in this area remain limited.

Based on the above description, this study aims to identify risk factors associated with the incidence of Acute Respiratory Infection (ARI) in the coastal communities within the Liwuto Community Health Center's service area, including exposure to cigarette smoke, clean and healthy living behavior (PHBS), house ventilation, occupancy density, and type of house walls.

METHOD

This study is a quantitative research using an analytic observational method and a cross-sectional design, in which measurement of the independent and dependent variables is carried out at the same time. The research was conducted in Liwuto Village, the working area of Liwuto Public Health Center, Baubau City, in May - June 2025.

The study population consists of all families with children under five in the Liwuto Community Health Center working area, totaling 203 children under five. The sample size was calculated using the Slovin formula with a 10% margin of error, resulting in a sample of 67 respondents. The sampling technique used was accidental sampling. Inclusion criteria included heads of families who have resided for at least the past six months in the Liwuto Community Health Center working area and have infants/children under five, while exclusion criteria included respondents who do not have a permanent residence or whose homes are unoccupied during the study period.

The independent variables in this study are exposure to cigarette smoke, clean and healthy living behavior (PHBS), home ventilation, occupancy density, and type of house wall, while the dependent variable is the incidence of ARI in children under five. Primary data were collected through interviews using questionnaires as well as direct observation and measurement of the respondents' home conditions, while secondary data were obtained from reports by Puskesmas Liwuto and the relevant Health Department.

The collected data were processed through editing, coding, tabulation, and data presentation stages, then analyzed univariately to describe the frequency distribution of each variable, and bivariately using the chi-square test to determine the relationship between independent and dependent variables at a 95% confidence level ($\alpha=0.05$). The relationship is considered significant if the p-value ≤ 0.05 .

RESULTS AND DISCUSSION

The study involved 67 respondents in Liwuto Village, all of whom were female (mothers/caregivers of toddlers), with the largest age group being 31–40 years old (54.0%), the highest education level being high school/vocational school (47.8%), and the majority working as Housewives (79.1%). The distribution of toddlers by gender was dominated by males (59.7%), with the highest proportion of toddlers in the 1-year-old age group (35.8%).

The results of the univariate analysis showed that out of 67 children under five, 40 (59.7%) experienced ARI. The majority of respondents were exposed to cigarette smoke (65.7%), did not practice clean and healthy living behaviors (71.6%), and had home ventilation that did not meet the requirements (64.2%). Conversely, most respondents had housing density (62.7%) and wall types (79.1%) that met health standards. A summary of the distribution of research variables is presented in Table 1.

Table 1. Distribution of Research Variables in Liwuto Subdistrict

Variable	n	%
Incidence of ARI		
Not Suffering	27	40.3
Suffering	40	59.7
Exposure to Cigarette Smoke		
Not Exposed	23	34.3
Exposed	44	65.7
Clean and Healthy Lifestyle Behavior (PHBS)		
Unhealthy	48	71.6
Healthy	19	28.4

Variable	n	%
Home Ventilation		
Does Not Meet Requirements	43	64,2
Meets Requirements	24	35,8
Housing Density		
Does Not Meet Requirements	25	37,3
Meets Requirements	42	62,7
Wall Type		
Does Not Meet Requirements	14	20,9
Meets Requirements	53	79,1

The results of the chi-square test in Table 2 indicate that all variables examined are significantly associated with the incidence of ARI in children under five, namely exposure to cigarette smoke ($p=0.000$), clean and healthy living behavior ($p=0.000$), house ventilation ($p=0.000$), housing density ($p=0.000$), and type of house wall ($p=0.024$), as all p -values are below $\alpha=0.05$.

Table 2. Bivariate Analysis Results of Risk Factors with the Incidence of ARI

Variable	Category	Not Suffering		Suffering		Total	p-value
		n	%	n	%		
Exposure to Cigarette Smoke	Not Exposed	23	85,2	0	0,0	23	0,000
	Exposed	4	9,1	40	90,9	44	
PHBS	Unhealthy	12	25,0	36	75,0	48	0,000
	Healthy	15	78,9	4	21,1	19	
Home Ventilation	Does Not Meet	8	18,6	35	81,4	43	0,000
	Meets the Requirements	19	79,2	5	20,8	24	
Occupancy Density	Does Not Meet	2	8,0	23	92,0	25	0,000
	Meets Requirements	25	59,5	17	40,5	42	
Wall Type	Does Not Meet	2	14,3	12	85,7	14	0,024
	Meets Requirements	25	47,2	28	52,8	53	

The Relationship between Exposure to Cigarette Smoke and Incidence of ARI

Of the 67 respondents, all children under five who were not exposed to cigarette smoke (23 children) did not suffer from ARI (100%). Conversely, of the 44 children under five who were exposed to cigarette smoke, 40 children (90.9%) suffered from ARI and only 4 children (9.1%) did not suffer from ARI. The chi-square test produced a p -value of 0.000 (< 0.05), indicating a significant association between exposure to cigarette smoke and the incidence of ARI in the Liwuto Community Health Center work area.

Cigarette smoke contains various harmful chemicals, including nicotine and tar, that can damage the protective lining of the respiratory tract and decrease the immune system's ability to fight viruses and bacteria. Continuous exposure to cigarette smoke, especially from the habit of the head of the household smoking indoors, increases the likelihood that toddlers will become passive smokers and experience respiratory disorders. Toddlers exposed to cigarette smoke but not suffering from ARI (9.1%) are suspected to have irregular exposure or exposure that does not occur in a closed room, while toddlers who are not exposed to cigarette smoke but remain at risk of ARI may be due to exposure to other pollutants such as dust or vehicle emissions.

These findings are consistent with the research by (Wahyudi dkk., 2021) at the Bandar Agung Community Health Center, which found a significant association between exposure to cigarette smoke and the incidence of ARI in children under five ($p=0.001$; $OR=4.2$), indicating that children under five exposed to cigarette smoke are 4.2

times more likely to develop ARI. The study by Kumar and Kumar (2021) also reported a significant relationship between parental smoking behavior and the risk of ARI in children under five ($p=0.01$; $OR=4.364$). Residual cigarette smoke adhering to the smoker's clothing and body can persist for several hours, so the habit of smoking outside the home still carries a risk of exposing children under five (Ni Putu Ayu Juniantari dkk., 2023; Yusuf dkk., 2023). Given the magnitude of this risk, education on the dangers of cigarette smoke to children under five needs to be continuously promoted, particularly to heads of households who are active smokers within the family.

The Relationship between Clean and Healthy Living Behavior (PHBS) and the Incidence of ARI

Of the 48 respondents with unhealthy lifestyles, 36 children under five (75.0%) suffered from ARI, whereas among the 19 respondents who had properly implemented PHBS, the majority of their children under five (78.9%) did not suffer from ARI. The chi-square test yielded a p -value of 0.000 (< 0.05), indicating a significant relationship between PHBS and the incidence of ARI.

Inconsistent implementation of PHBS, such as forgetting to wash hands before breastfeeding or touching toddlers, increases the risk of transmission of pathogens causing ARI through physical contact. Some respondents who practiced unhealthy behaviors but whose toddlers did not suffer from ARI (25.0%) are thought to be affected by other relatively good home environmental factors, while respondents who already practiced healthy behaviors but whose toddlers still suffered from ARI (21.1%) indicate that environmental risk factors such as poor ventilation or wall type in the home can still pose risks even when individual behaviors are already good.

These findings are consistent with the study by Navy and Muhlisin (2025) in Sindon Village, which identified a significant relationship between PHBS and the incidence of ARI in children under five ($p=0.001$), attributed to habits such as forgetting to wash hands before breastfeeding and the presence of family members who still smoke indoors. The study by Pellondou dkk., t.t. (2025) further emphasized that parental knowledge of PHBS is closely associated with preventive behaviors against ARI, where good hand-washing practices can reduce the morbidity of infectious diseases by 2–3 times. These results underscore the importance of continuous PHBS education for families with young children in coastal areas.

Relationship between Home Ventilation and Incidence of ARI

Of the 43 houses with inadequate ventilation, 35 children under five (81.4%) suffered from ARI. Conversely, of the 24 houses with adequate ventilation, the majority of young children (79.2%) did not suffer from ARI. The chi-square test yielded a p -value of 0.000 (< 0.05), indicating a significant association between household ventilation and the incidence of ARI.

Ventilation that does not meet standards (less than 10% of the house's floor area, or present but rarely opened) impedes the exchange of air from outside to inside the house, making it difficult for bacteria and viruses causing ARI to exit, and increasing room humidity, thus creating ideal conditions for the growth of pathogenic microorganisms. Infants and toddlers were also found who had adequate ventilation but still suffered from ARI (20.8%), which is suspected to be caused by poor outdoor air quality due to pollution or vehicle emissions still entering through the ventilation.

These results are consistent with the study by Iswati dkk., (2025) in the Juntinyuat area, which found a significant association between household ventilation and the incidence of ARI in children under five ($p=0.004$), as well as the study by Sercy Servya et al. (2023), which obtained a p -value of 0.004 with a contingency coefficient $C=0.280$. Ardian S. Leky dkk., (2022) also reported that individuals living in homes with poor ventilation had a 2.590 times higher risk of experiencing ARI compared to those living in well-ventilated homes. Nevertheless, the study by Magfirah dkk., (2024) reported no significant association ($p=1.000$), which was explained by the fact that house doors were more often left open, thereby allowing for air circulation even when window ventilation was limited. These differences underscore that the effectiveness of ventilation is also influenced by residents' habits in utilizing available openings in the home.

Relationship between Occupancy Density and Incidence of ARI

Of the 25 houses with substandard occupancy density, 23 children under five (92.0%) suffered from ARI. Conversely, of the 42 houses with adequate occupancy density, most of the children under five (59.5%) did not suffer from ARI. The chi-square test yielded a p -value of 0.000 (< 0.05), indicating a significant relationship between occupancy density and the incidence of ARI.

Based on Indonesian Ministry of Health Decree No. 829 of 1999, housing density is considered to meet requirements if the floor area of the house provides at least 9 m² per person (equivalent to >36 m² for 4 people). High housing density accelerates the transmission of airborne infectious diseases, as the close proximity between individuals facilitates the transfer of microorganisms, especially if a family member is experiencing a respiratory tract infection. In this study, several houses were found to be occupied by 7–10 people, even by two to three families in a single house, with a floor area that does not correspond.

These findings are consistent with research by Zulfikar and Sukriadi (2021, t.t.) in Tingkem Bersatu Village, which found that non-compliant housing density increased the risk of ARI by 6.167 times ($p=0.008$), as

well as research by Salimah et al. (2020) at Mandomai Community Health Center, which obtained a p-value of 0.003. However, the study by Dani et al. (2022) at Ahmad Community Health Center reported no significant association ($p=0.12$), which was explained by the generally low housing density in that area. These differing results indicate that housing density can be a strong risk factor in regions with densely populated residential characteristics, such as the coastal area of Liwuto Subdistrict.

Relationship between Wall Type and Incidence of ARI

Of the 14 houses with non-compliant wall types, 12 children under five (85.7%) suffered from ARI. Meanwhile, among the 53 houses with compliant wall types, 28 children under five (52.8%) were still found to suffer from ARI. The chi-square test yielded a p-value of 0.024 (< 0.05), indicating a significant association between wall type and the incidence of ARI.

Walls that are not tight and not waterproof, such as plank or wooden walls with gaps, facilitate the direct entry of dust and night air into the house, and are difficult to clean, making them sites for dust accumulation and breeding grounds for bacteria. Interestingly, in the group of houses with walls that met the requirements but still had children under five suffering from ARI (52.8%), this was caused by dusty brick walls that were rarely cleaned, indicating that the suitability of wall materials alone is not sufficient without regular cleanliness.

These results are consistent with the study by Adolph (2020) in Pematang Raya, which found a significant association between wall type and incidence of ARI ($p=0.005$), with children under five living in houses with substandard walls being 3.5 times more likely to develop ARI. However, the study by Togelang et al. (2018) in Kalinaun Village reported no significant association ($p=0.528$), as most local residents already had permanent walls and routinely cleaned them. This comparison underscores that the wall type factor needs to be considered alongside household cleaning behaviors, not solely the type of material.

CONCLUSION

Based on the research results, it can be concluded that exposure to cigarette smoke, clean and healthy living behavior, home ventilation, housing density, and type of house walls each have a significant association with the incidence of Acute Respiratory Infections (ARI) among coastal communities in the working area of Puskesmas Liwuto. Children under five who live in homes with high exposure to cigarette smoke, inadequate implementation of clean and healthy living behavior, ventilation and housing density that do not meet standards, as well as poorly maintained house wall conditions, tend to have a higher risk of developing ARI. This condition underscores that household environmental factors and family behavior play an important role in determining the degree of respiratory health in children under five living in coastal areas, whose residential characteristics are typically dense and vulnerable to air pollutant exposure.

These findings imply that efforts to control ARI in coastal communities need to focus on improving the physical condition of homes as well as strengthening clean and healthy living behaviors within families, not solely on medical interventions. Cross-sectoral support among health service facilities, local government, and the community is needed to promote sustainable improvements in the coastal residential environment, so that the risk of ARI incidence in children under five can be reduced in the future.

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