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Relationship Between Housing Physical Conditions and the Incidence of Acute Respiratory Infections (ARI) Among Toddlers in Andalas Padang

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ABSTRACT

Acute Respiratory Infection (ARI) remains a major health problem among children under five in Indonesia, including in Padang City. Poor housing physical conditions such as inadequate ventilation, insufficient natural lighting, high residential density, and improper humidity levels may increase the risk of ARI among toddlers. This study aimed to determine the relationship between housing physical conditions and the incidence of ARI among toddlers in Andalas Padang 2026. This study used an analytic observational design with a cross sectional approach. The study population consisted of mothers with toddlers aged 12–59 months in the Andalas, Padang City. A total of 80 respondents were selected using proportional random sampling technique. Data were collected through interviews, direct observation of housing conditions, and measurement of temperature, humidity, and lighting using environmental measuring instruments. Data were analyzed using univariate and bivariate analysis with the Chi-Square test at a 95% confidence level (α = 0.05). The results showed significant relationships between house ventilation (p-value = 0.004), natural lighting (p-value = 0.018), residential density (p-value = 0.001), and house humidity (p-value = 0.015) with the incidence of ARI among toddlers. Residential density was the variable most strongly associated with ARI incidence. In conclusion, housing physical conditions are associated with the incidence of ARI among toddlers. Therefore, efforts to improve healthy housing quality are needed to reduce ARI incidence among children under five.

Keywords: *ARI, Toddlers, Housing Physical Conditions, Environmental Health*

INTRODUCTION

Acute Respiratory Infection (ARI) is one of the major public health problems in developing countries, including Indonesia. ARI is a leading cause of morbidity and mortality among children under five due to their immature immune systems. Environmental factors, nutritional status, family behavior,

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and housing physical conditions are important determinants of ARI incidence among toddlers. Recent international studies have shown that poor housing physical conditions contribute significantly to respiratory infections among children under five. (Simkovich, 2019) reported that inadequate ventilation and household air pollution increased the risk of respiratory diseases among children in developing countries. (Wimalasena, Chang-Richards, Wang, & Dirks, 2021)also stated that overcrowded housing, poor air circulation, and unhealthy indoor environmental conditions were important risk factors for respiratory diseases. In addition, (Holden, Lee, Hawcutt, & Sinha, 2023) explained that poor indoor air quality and damp housing conditions were associated with respiratory health problems among children.

In Indonesia, ARI is the leading cause of infant mortality and morbidity among children under five. In addition, this disease is consistently included among the ten most common illnesses treated at healthcare facilities, particularly community health centers (Puskesmas) (Febrianti, 2020). The prevalence of ARI in Indonesia reached 85.4%, with the highest prevalence reported in DKI Jakarta at 99.8%, followed by Bali at 97.0%, West Sumatra at 96.5%, East Nusa Tenggara at 96.2%, and Central Sulawesi at 93.0% (Indonesia, 2021).

Mortality among children under five due to ARI in Indonesia increased by 20.6% from 2019 to 2020, rising from 18.2% to 38.8% (Rahmat, 2021)ARI is also the most common disease among children in Indonesia. Episodes of cough and cold among toddlers are estimated to occur 3–6 times per year, meaning that each toddler experiences respiratory infections approximately 3–6 times annually. ARI is also one of the main causes of healthcare visits, accounting for 40%–60% of visits to community health centers and 15%–30% of outpatient and inpatient hospital visits (Indonesia, Profil Kesehatan Indonesia , 2019).

West Sumatra, with an ARI prevalence of 96.5%, is one of the provinces with the highest ARI incidence in Indonesia. One of its cities, Padang, has a toddler population of 939,112, with an ARI prevalence among children aged ≥5 years reaching 457.9‰ based on accumulated data from all community health centers in Padang City. Data from the Padang City Health Office showed that ARI cases reached 88,920 in 2019, decreased to 82,320 in 2020, and increased again to 99,000 cases in 2021 (Padang City Health Office, 2020).

The high incidence of ARI among toddlers is influenced by several risk factors, one of which is poor housing physical conditions. Houses with inadequate ventilation, insufficient natural lighting, high humidity, unsuitable indoor temperatures, overcrowding, and unhealthy flooring conditions may increase the risk of ARI transmission. Poor housing environments reduce indoor air quality and facilitate respiratory disorders among toddlers. According to the Decree of the Minister of Health of the Republic of Indonesia Number 829/Menkes/SK/VII/1999 concerning Housing Health Requirements, a healthy house must meet environmental health standards, including ventilation area of at least 10% of floor area, adequate natural lighting, humidity levels between 40%–60%, room temperatures between 18°C–30°C, and appropriate residential density. These regulations are reinforced through Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023.

The novelty of this study lies in the simultaneous assessment of several housing physical condition indicators, including ventilation, natural lighting, residential density, humidity, and indoor temperature in relation to ARI incidence among toddlers in an urban area of Padang City. This study provides a more comprehensive environmental health analysis compared to previous studies that generally focused on only one or two environmental factors.

Several previous studies have shown significant relationships between housing physical conditions and ARI incidence among toddlers. Research conducted by (Hidayanti & Darwel, 2020) in

Padang reported that house ventilation and residential density were significantly associated with ARI incidence among toddlers. Another study by (Wardani & Astuti, 2021)also stated that lighting, house humidity, and environmental sanitation were risk factors affecting ARI incidence among children under five. Based on the high incidence of ARI among toddlers in Padang City and the continued presence of unhealthy housing conditions, it is necessary to conduct research on the relationship between housing physical conditions and ARI incidence among toddlers in Padang City. This study is expected to serve as a basis for developing environmental health policies and interventions to reduce ARI incidence among children under five.

METHODS

This study employed a quantitative research method with an analytic observational design using a cross sectional approach. This approach was used to determine the relationship between housing physical conditions and the incidence of Acute Respiratory Infection (ARI) among toddlers through simultaneous measurement of independent and dependent variables. The cross sectional design was selected because it can describe the current condition of the home environment and ARI incidence among toddlers in the community. The study was conducted in Andalas, Padang from January to March 2026. The study location was selected based on the high incidence of ARI among toddlers and the presence of housing environmental conditions that potentially contribute to environmental-based diseases.

The population of this study consisted of all mothers with toddlers aged 12–59 months living in Andalas, Padang City. A total of 80 respondents were selected using proportional random sampling technique, ensuring that each member of the population had an equal opportunity to be selected according to the proportion of toddlers in each area. The sample size was considered adequate for observational research using a cross sectional design and Chi-Square statistical analysis. The independent variables in this study included house ventilation, natural lighting, residential density, house humidity, indoor and temperature. The dependent variable was the incidence of ARI among toddlers. Assessment of housing physical conditions referred to environmental health standards based on Government Regulation Number 66 of 2014 and Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023.

Data collection was carried out through direct interviews using structured questionnaires to obtain information regarding family characteristics and the history of ARI incidence among toddlers. In addition, direct observation of respondents' housing conditions was conducted. Temperature and humidity were measured using a thermohygrometer, while natural lighting intensity was measured using a lux meter. All measurements were conducted in the main room most frequently used by toddlers for daily activities.

The collected data were processed and analyzed using statistical computer software. Data analysis was conducted in two stages: univariate and bivariate analysis. Univariate analysis was used to describe the frequency distribution of each study variable in the form of tables and percentages. Furthermore, bivariate analysis was performed using the Chi-Square test with a 95% confidence level ($\alpha = 0.05$) to determine the relationship between housing physical conditions and ARI incidence among toddlers. A p-value of less than 0.05 indicated a statistically significant relationship between the independent variables and ARI incidence among toddlers.

RESULTS

1. Univariate Analysis

Univariate analysis was conducted to describe the frequency distribution of each research variable, including both independent and dependent variables. The independent variables in this study consisted of housing physical conditions, including ventilation, natural lighting, residential density, house humidity and indoor temperature. Meanwhile, the dependent variable was the incidence of Acute Respiratory Infection (ARI) among toddlers in Andalas 2026. The results of the univariate analysis are presented in the following tables.

a) Distribution of Respondents' Housing Physical Conditions

Table 1. Distribution of Respondents' Housing Physical Conditions in Andalas Padang City 2026

Variables	Category	n	%
Ventilation	Does not meet the standard	45	56.3
	Meets the standard	35	43.7
Natural Lighting	Does not meet the standard	47	58.8
	Meets the standard	33	41.2
Residential Density	Overcrowded	49	61.2
	Not overcrowded	31	38.8
Humidity	Does not meet the standard	46	57.5
	Meets the standard	34	42.5
Indoor Temperature	Does not meet the standard	42	52.5
	Meets the standard	38	47.5

Based on Table 1, it was found that most respondents' houses had ventilation that did not meet health standards, accounting for 45 houses (56.3%). Inadequate natural lighting conditions were found in 47 houses (58.8%). Overcrowded residential density was identified in 49 houses (61.2%), while 46 houses (57.5%) had humidity levels that did not meet health standards. In addition, 42 houses (52.5%) had indoor temperatures that did not meet the required standards.

b) Distribution of ARI Incidence Among Toddlers

Table 2. Distribution of ARI Incidence Among Toddlers in Andalas Padang City 2026

ARI Incidence	n	%
ARI	48	60.0
Non-ARI	32	40.0
Total	**80**	**100**

Based on Table 2, it was found that among the 80 toddlers who participated as respondents in this study, 48 toddlers (60.0%) experienced Acute Respiratory Infection (ARI), while 32 toddlers (40.0%) did not experience ARI.

2. Bivariate Analysis

Equations should be placed at the center of the line and provided consecutively with equation numbers in parentheses flushed to the right margin, as in (1). The use of Microsoft Equation Editor or MathType is preferred.

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Table 3. Relationship Between Housing Physical Conditions and ARI Incidence Among Toddlers in Andalas Padang City 2026

Variables	ARI n (%)	Non-ARI n (%)	p-value
Ventilation			
Does not meet the standard	33 (73.3)	12 (26.7)	0.004
Meets the standard	15 (42.9)	20 (57.1)	
Natural Lighting			
Does not meet the standard	32 (68.1)	15 (31.9)	0.018
Meets the standard	16 (48.5)	17 (51.5)	
Residential Density			
Overcrowded	37 (75.5)	12 (24.5)	0.001
Not overcrowded	11 (35.5)	20 (64.5)	
Humidity			
Does not meet the standard	31 (67.4)	15 (32.6)	0.015
Meets the standard	17 (50.0)	17 (50.0)	
Total	**100**	**100**	

Based on the results of the bivariate analysis presented in Table 3, there were significant relationships between house ventilation (p-value = 0.004), natural lighting (p-value = 0.018), residential density (p-value = 0.001), and house humidity (p-value = 0.015) with the incidence of ARI among toddlers in Andalas 2026. The findings indicate that toddlers living in houses with physical conditions that did not meet health standards had a higher risk of experiencing ARI compared to toddlers living in houses with adequate physical conditions.

DISCUSSION

1. Relationship Between House Ventilation and ARI Incidence Among Toddlers

The results of this study showed a significant relationship between house ventilation and the incidence of Acute Respiratory Infection (ARI) among toddlers in Andalas in 2026, with a p-value of 0.004. Most toddlers who experienced ARI lived in houses with ventilation that did not meet health standards. House ventilation plays an important role in maintaining indoor air quality. Inadequate ventilation causes poor air circulation, leading to the accumulation of dirty air, dust, microorganisms, and indoor pollutants. These conditions may increase the risk of respiratory disorders among toddlers whose immune systems are still developing. In addition, poor ventilation may increase indoor humidity, creating favorable conditions for the growth of bacteria and viruses that cause ARI.

The findings of this study are consistent with the research conducted by (Hidayanti & Darwel, 2020), which reported a significant relationship between house ventilation and ARI incidence among toddlers in Padang. (Handayani, 2016)also found that inadequate ventilation had a strong association with ARI incidence among toddlers, with an odds ratio (OR) of 2.60. Furthermore, research conducted by (Cheni, 2024)regarding indoor PM10 concentration and ARI incidence among toddlers in Padang City revealed that ventilation was one of the environmental factors influencing the increase in ARI cases. The study indicated that poor indoor air quality and inadequate ventilation increased toddlers' exposure to PM10 particles, thereby elevating the risk of respiratory disorders. According to Government Regulation Number 66 of 2014 and Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023, house ventilation must ensure adequate air circulation to create a healthy and safe living environment. This finding is consistent with the study conducted by (Simkovich, 2019), which reported

that inadequate household ventilation and poor indoor air quality significantly increased respiratory infection risks among children.

2. Relationship Between Natural Lighting and ARI Incidence Among Toddlers

The study results showed a significant relationship between natural lighting and ARI incidence among toddlers, with a p-value of 0.018. Toddlers living in houses with inadequate natural lighting had a higher proportion of ARI incidence compared to those living in houses with adequate lighting. Natural lighting from sunlight has an important role in maintaining a healthy home environment. Sunlight can reduce indoor humidity and inhibit the growth of pathogenic microorganisms such as bacteria, fungi, and viruses. Houses with limited natural lighting tend to be damp and dark, creating conditions favorable for the development of respiratory disease agents. This finding is in line with the study conducted by (Wardani & Astuti, 2021), which stated that house lighting was associated with ARI incidence among toddlers. Another study by (Yulia, Awalia, & Suharno, 2024)also found that inadequate natural lighting increased the risk of ARI among children under five. Research conducted by (Kristina, 2011) from the Faculty of Public Health, Universitas Indonesia also stated that inadequate house lighting could increase the risk of ARI because it affects indoor humidity and air quality. Adequate natural lighting can be achieved through sufficient windows, ventilation, and house openings that allow sunlight to enter the room. Therefore, the community should pay greater attention to healthy house design to reduce the risk of environment-based diseases. (Holden e. a., 2023) stated that inadequate natural lighting and poor indoor environmental quality contribute to respiratory health problems among children under five.

3. Relationship Between Residential Density and ARI Incidence Among Toddlers

The results of this study indicated a significant relationship between residential density and ARI incidence among toddlers, with a p-value of 0.001. Toddlers living in overcrowded houses experienced ARI more frequently than those living in non-overcrowded houses. High residential density increases the frequency of contact among family members, making the transmission of respiratory infections through droplets or air more likely to occur. In addition, overcrowded houses generally have poorer air quality due to limited living space and inadequate ventilation. This finding is consistent with the study by Irma et al. (2024), which identified residential density as one of the main risk factors for ARI among toddlers. Bambang Irianto (2006) also reported a significant relationship between overcrowded housing and ARI incidence among toddlers. Furthermore, (Handayani, 2016) found that residential density was an important risk factor for ARI incidence among toddlers, with an OR value of 2.14. According to environmental health housing standards, inappropriate residential density can affect the comfort and health of house occupants. The more crowded a house is, the greater the risk of spreading infectious diseases, including ARI among toddlers. This result is also supported by (Wimalasena, Chang-Richards, Wang, & Dirks, 2021), who identified overcrowded housing as one of the major environmental determinants of respiratory diseases among children.

4. Relationship Between House Humidity and ARI Incidence Among Toddlers

The study results demonstrated a significant relationship between house humidity and ARI incidence among toddlers, with a p-value of 0.015. Toddlers living in houses with humidity levels that did not meet health standards experienced ARI more frequently than those living in houses with normal humidity levels. Excessive humidity can increase the growth of microorganisms such as fungi, bacteria, and viruses indoors. In addition, damp housing conditions may reduce indoor air quality and trigger

respiratory health problems, especially among toddlers who are more vulnerable due to their weaker immune systems. This finding is consistent with the study conducted by (Haryani et al, 2021), which found a significant relationship between house humidity and ARI incidence among toddlers. Research by (Cheni, 2024) also reported that house humidity acted as a controlling variable influencing the relationship between indoor PM10 concentration and ARI incidence among toddlers in Padang City. The study emphasized that houses with high humidity tend to have poorer indoor air quality, thereby increasing the risk of respiratory diseases among toddlers. In addition, (Afandi, 2012) reported that poor housing physical conditions were associated with increased ARI incidence among toddlers. House humidity is influenced by air circulation, natural lighting, and building conditions. Therefore, maintaining proper ventilation and adequate lighting is an important step in creating a healthy home environment and preventing ARI among toddlers.

(Fakunle et al, 2021) explained that excessive indoor humidity and microbial aerosols were associated with respiratory symptoms among children under five.

5. Study Limitations

This study has several limitations. First, the cross-sectional design used in this study cannot determine causal relationships between housing physical conditions and ARI incidence among toddlers. Second, ARI history data were partly obtained through respondents' recall, which may cause recall bias. Third, this study did not assess several other potential confounding variables such as nutritional status, parental smoking behavior, socioeconomic status, and immunization history. Future studies are recommended to use longitudinal designs and include broader environmental and behavioral variables to obtain more comprehensive findings regarding ARI risk factors among toddlers.

CONCLUSIONS

Based on the results of the study conducted in Andalas Padang 2026, it can be concluded that there were significant relationships between housing physical conditions and the incidence of Acute Respiratory Infection (ARI) among toddlers. Variables associated with ARI incidence included house ventilation (p-value = 0.004), natural lighting (p-value = 0.018), residential density (p-value = 0.001), and house humidity (p-value = 0.015). Toddlers living in houses with physical conditions that did not meet health standards had a higher risk of experiencing ARI compared to those living in houses with adequate physical conditions. Residential density was identified as the variable most strongly associated with ARI incidence among toddlers in the study area.

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