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Physical components of houses and their association with acute respiratory infections in fishermen's families

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ABSTRACT

This study examines the impact of house physical conditions on the occurrence of Acute Respiratory Infections (ARI) among fishing families in Pasie Nan Tigo Village, Padang City. Using an analytical observational design with a cross-sectional approach, the research involved fishing families selected through accidental sampling. Data were analyzed through univariate and bivariate analysis using the chi-square test with a significance level of 5% (α = 0.05). The findings revealed that 22% of fishing families experienced ARI, with significant associations observed between ARI and factors such as bedroom windows (p = 0.033), ceilings (p = 0.016), lighting (p = 0.009), and kitchen smoke holes (p = 0.034). The results suggest that improving house conditions, including better ventilation, lighting, and cleanliness of ceilings and kitchens, could be an effective strategy to reduce ARI incidence in fishing communities.

1. Introduction

Acute Respiratory Infection (ARI) is one of the leading causes of morbidity and mortality worldwide, especially in developing countries. According to data from the World Health Organization (WHO), ARI causes 1.9 million deaths each year globally, with children under the age of five being the most vulnerable group. Coastal areas, including fishing communities, are often at higher risk due to unhealthy environmental conditions, such as poor ventilation, high humidity, and inadequate sanitation. Houses in fishing communities often do not meet basic health standards, which increases the risk of transmission of pathogens that cause ARI (Hassan, 2021).

In Indonesia, ARI remains one of the most common infectious diseases and accounts for around 25% of total patient visits to healthcare facilities each year. Vulnerable groups, such as children and the elderly, are most often affected, especially in coastal areas with inadequate housing conditions. Fishing families in Indonesia generally live in semi-permanent houses with poor ventilation and lighting, increasing the risk of ARI transmission. Several national studies have shown that coastal areas have a higher incidence of ARI compared to inland areas, which is associated with inadequate physical conditions of housing and limited access to health care. In previous research conducted in Muara Siberut, more than half of the physical components of houses in fishing settlements were in the poor category (Gusti et al., 2023).

Specifically, in the study area, namely Pasie Nan Tigo Village in Padang City, West Sumatra, ARI is a significant health problem. Data from the Padang City Health Office in 2023 showed that more than 30% of the population in this coastal area, especially children and the elderly from fishing families, were affected by ARI in 2022. The main factor that worsens this condition is the house's physical condition, which does not meet health standards. More than 40% of fishermen's houses in Pasie Nan Tigo have inadequate ventilation, and around 35% have poor lighting, contributing to low indoor air quality. Conditions such as these increase the risk of transmission of pathogens that cause ARI, making fishing families in the area very vulnerable to respiratory infections.

Based on this background, this study aims to explore and analyze the relationship between the physical condition of the house and the incidence of ARI among fishing families in Pasie Nan Tigo Village. Specifically, this study will identify physical factors of the house, such as ventilation, lighting, and hygiene conditions, that contribute to the increased risk of ARI. The results of this study are expected to

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be the basis for effective environmental health interventions to reduce the incidence of ARI in coastal communities and improve the quality of public health in the area. This contribution can be the basis for further research that extends the analysis to other geographic areas or to different socio-economic contexts, thereby expanding the theoretical implications of these findings.

2. Theoretical framework

The theoretical basis of this study is rooted in the theory of social determinants of health, which emphasizes the significance of environmental factors, such as housing, in influencing the health conditions of the community (Nabaweesi et al., 2023; Zuber et al., 2023). The theory of social determinants of health emphasizes the significant impact of environmental factors, such as housing, on health outcomes. Housing conditions are critical in shaping health by influencing exposure to environmental risks and resource access. This concept is very relevant in this study, considering that many houses in coastal areas, especially fishing communities, do not meet these basic requirements. Houses that do not have good ventilation will result in stagnant air, which increases the risk of ARI. Air that does not move well allows pathogens such as viruses and bacteria to multiply rapidly. In the context of coastal communities, semi-permanent houses found in Pasie Nan Tigo Village are often not equipped with adequate ventilation. An unhealthy home environment like this increases the vulnerability of its occupants to various diseases, especially ARI (Thompson and Barcott, 2017).

Environmental Epidemiology Theory is also an essential basis for this study. This theory highlights the relationship between physical environmental factors and disease incidence, especially in areas with unique environmental conditions, such as the humid tropical climate in coastal areas (Bloom, 2019). High temperatures and humidity in coastal areas create an environment conducive to the growth of pathogenic microorganisms, including viruses and bacteria that cause ARI. In this condition, houses that do not have adequate ventilation or lighting will become a breeding ground for these pathogens, increasing the risk of infection for their occupants.

Research by Arifin et al. (2021) in the coastal area of Donggala supports this view by showing that the type of house walls made of semi-permanent materials, such as wood and woven bamboo, are very susceptible to ARI because they cannot protect occupants from external exposure that can carry pathogens (Arifin et al., 2021). In addition, poor ventilation is a significant problem because the air inside the house cannot be replaced with fresh air from outside, resulting in increased concentrations of pathogens in the indoor air. Research by Fitriyah (2016) in Brebes showed similar results: Poor ventilation and poor lighting contribute to increased humidity in the house, which worsens indoor air conditions (Maulana, 2020).

Research by Soedjadi et al. (2022) found that opening windows regularly can reduce the risk of ARI because it helps air circulation and reduces humidity in the house (Soedjadi et al., 2022). This confirms the importance of simple daily practices, such as opening windows, in maintaining indoor air quality in coastal areas. In addition to ventilation, Medhyna's (2019) study in Pasaman also found that the presence of smoke holes in the kitchen had a significant relationship with the incidence of ARI because kitchens that do not have adequate smoke exhaust systems cause smoke to accumulate in the house, which contains harmful particles that can damage the respiratory tract.

The literature review shows that the house's physical condition significantly affects its occupants' health. Therefore, improving the physical quality of the house, especially ventilation, lighting, and cleanliness, should be a top priority in efforts to prevent ARI in coastal areas. This study aims to confirm these findings in Pasie Nan Tigo Village and provide empirical evidence that the government and other stakeholders can use to formulate effective policies to reduce the incidence of ARI in coastal fishing communities. The following section will detail the methodology used to collect and analyze these data.

3. Methodology

3.1. Study design

This cross-sectional study was conducted on a population of fishermen living in Pasie Nan Tigo Village, Padang, Indonesia, from May to June 2024. The convenience sampling method was used to recruit participants by targeting fishermen living in Pasie Nan Tigo. The Lemeshow formula approach calculated the sample size, which was estimated at 100. A confidence level of 95% and an error rate of 5% were set.

3.2. Data collection tools

The questionnaire used in this research comprised several components: a section prepared by the researcher to collect demographic information, including age, sex, and level of education; inquiries about experiences with Acute Respiratory Infections (ARI) in the past year; and an evaluation of the physical components of houses, which covered aspects such as walls, living room windows, bedroom windows, ventilation, ceilings, lighting, and kitchen smoke holes.

3.3. Statistical analysis

After collecting the data, it was analyzed using SPSS software version 21. The analysis involved descriptive statistical methods (frequency and

mean) as well as chi-square analysis, considering a P value of 0.05.

4. Results and discussion

4.1. Characteristics of the participants

A total of 100 fishing families participated in the study. The data presented in Table 1 indicates a balanced gender distribution, with 55% of the respondents identifying as male and 45% as female. Regarding education levels, the respondents were fairly evenly distributed: 33% had only completed primary education, 33% had completed junior high school, and 58% had completed senior high school. The age of the respondents ranged from 22 to 74 years, with an average age of 46.

Table 1: Characteristics of the participants (N=100)

Parameter	Number (percentage)
Gender	
Male	55 (55%)
Female	45 (45%)
Level of education	
Elementary	33 (33%)
Junior high school	33 (33%)
Senior high school	58 (58%)
Age	
Young	75 (75%)
Old	25 (25%)

4.2. Incidence of acute respiratory infection

The study results showed that the incidence of Acute Respiratory Infection (ARI) in Pasie Nan Tigo Village fishing families reached 22%. This figure is higher than the national prevalence range of 9.3% to 12.8% (Ilmaskal et al., 2023). This shows that the fishing community has a more significant risk factor for exposure to ARI, which inadequate living environment conditions, such as poor air quality and exposure to high humidity, can cause. Previous studies have also found that people living in coastal areas with physical conditions of houses that do not meet health standards have a higher incidence of ARI than those living in areas with better environments (Waliyyuddin et al., 2024). Factors such as ventilation, lighting, and cleanliness of the home environment significantly affect respiratory health.

4.3. Association between physical components of houses and ARI

Bivariate analysis presented in Table 2 indicates that houses with non-brick walls reported no Acute Respiratory Infection (ARI) cases, resulting in a percentage of 0%. In contrast, houses with semi-permanent walls had 6 cases, accounting for 18.8%, while houses with permanent walls recorded 10 cases, representing 17.9%. The statistical tests reveal no significant relationship between the condition of the house walls and the incidence of ARI, with a p-value of 0.271. Despite this, it is notable that houses with non-brick walls have a lower incidence of ARI than those with semi-permanent and permanent structures. This finding suggests that non-brick wall houses, such as those made of planks or bamboo, may allow for better air circulation, reducing moisture accumulation and the presence of pathogens.

Table 2: Association between physical components of houses and ARI (N=100)

Variable	ARI	No ARI	P-value
Wall			0.271
Not wall	0	3 (100%)	
Semi-permanent	6 (18.8%)	26 (81.3%)	
Permanent	10 (17.9%)	46 (82.1%)	
Living room window			0.058
Nothing	1 (9.1%)	10 (90.9%)	
Yes, cannot be opened/closed	9 (29%)	22 (71%)	
Yes, can be opened/closed	6 (10.3%)	46 (82.1%)	
Room window			0.033
Nothing	3 (25%)	9 (75%)	
Yes, cannot be opened/closed	5 (29.4%)	22 (71%)	
Yes, can be opened/closed	8 (11.3%)	63 (88.7%)	
Ventilation			0.150
Nothing	6 (30%)	14 (70%)	
Yes, does not meet requirement	5 (14.3%)	30 (85.7%)	
Yes, meets requirement	5 (11.1%)	40 (88.9%)	
Ceiling			
None	10 (28.6%)	25 (71.4%)	0.016
Yes, dirty, hard to clean and accident prone	2 (8%)	23 (92%)	
Yes, clean and not accident prone	4 (10%)	36 (90%)	
Lighting			0.009
Not bright	3 (75%)	1 (25%)	
Less bright	1 (8.3%)	11 (91.7%)	
Bright and not dazzling	12 (14,3)	72 (85.7%)	
Kitchen smoke hole			0.034
Nothing	7 (35%)	13 (65%)	
Yes, does not meet requirement	4 (10.5)	34 (89.5%)	
Yes, meets requirement	5 (11.9)	37 (88.1%)	

Environmental epidemiology theory suggests that the physical attributes of a building, including the construction materials of its walls, can impact indoor air quality, which in turn affects the respiratory health of its occupants (Brugge et al., 2006). However, research by Arifin et al. (2021) indicated that houses with non-brick walls in high-humidity areas may increase the risk of respiratory

infections, as these materials tend to absorb water and become a breeding ground for fungi (Arifin et al., 2021). Therefore, this result may be due to different population characteristics and environmental conditions. Recommendations for wall conditions are to ensure that the materials used are moisture-resistant and easy to clean to reduce the risk of ARI.

Table 2 illustrates the relationship between living room window conditions and the occurrence of acute respiratory infections (ARI). It shows that houses without windows in the living room had one case of ARI, representing 9.1% of the total. In contrast, houses with windows that could not be opened or closed reported 9 cases of ARI, accounting for 29.0%. Meanwhile, houses with windows that could be opened or closed had 6 cases of ARI, which is 10.3%. The statistical test results indicated a significant relationship between the condition of living room windows and the incidence of ARI, with a p-value of 0.058. Houses with windows that could not be opened or closed had a higher incidence of ARI than houses with windows that could be opened and closed. This follows the theory that good air circulation is essential for maintaining indoor air quality and reducing the concentration of pathogens (Aftab et al., 2022). Research by Mahendrayasa and Farapti (2018) showed that houses with tightly closed or unopenable windows had a 1.5 times higher risk of ARI compared to houses with windows that could be opened (Brugge et al., 2006). When windows cannot be opened, the air in the house tends to stagnate, and pollutants, including cigarette smoke or other particles, can accumulate. Homes with tightly closed or unopenable windows have a higher risk of ARI due to a lack of good air circulation, which can increase the concentration of germs and pathogens indoors.19 Therefore, researchers recommend improving windows so they can be opened and closed quickly to improve air circulation in the home.

Table 2 presents data on three households (25.0%) without bedroom windows that experienced acute respiratory infections (ARI). In contrast, five homes (29.4%) had bedroom windows that could not be opened or closed, and these also reported cases of ARI. Additionally, eight residences (11.3%) with operable bedroom windows reported instances of ARI. Statistical tests indicated a significant relationship between the condition of bedroom windows and the occurrence of ARI, with a p-value of 0.033. Houses without bedroom windows had a higher incidence of ARI than houses with windows that could be opened or closed. This condition indicates that poor ventilation in the bedroom, where a person spends most of their time, can increase the risk of respiratory infections. The literature states that good air circulation in the bedroom is essential to prevent the accumulation of moisture and pathogens during sleep. Good air circulation can reduce excess humidity in the bedroom, leading to fungi and bacteria growth (Sekhar et al., 2020). This can make the sleeping environment uncomfortable and risky to health. These results are in line with previous studies showing that bedrooms without windows or with windows that cannot be opened have a higher risk of Acute Respiratory Infection (ARI), up to 2.3 times higher (Aryanti, 2021). This is due to the lack of adequate air circulation, which is crucial for indoor air quality. Poor air circulation can cause the accumulation of pollutants and pathogens in the air, increasing the likelihood of respiratory infections. Therefore, researchers recommend installing adequate windows in bedrooms to ensure good air circulation and prevent the accumulation of moisture that can trigger the growth of pathogenic microorganisms.

Table 2 indicates the occurrence of acute respiratory infections (ARI) in relation to ventilation conditions in houses. Specifically, houses without ventilation recorded 6 cases of ARI, accounting for 30.0% of the total. In contrast, houses with inadequate ventilation experienced 5 cases, representing 14.3%, while those with adequate ventilation also had 5 cases, corresponding to 11.1%. Statistical analysis revealed no significant relationship between the ventilation conditions and the incidence of ARI, with a p-value of 0.150. However, houses without ventilation still showed a higher incidence of ARI. This may be due to interactions with other variables, such as good lighting or better house cleanliness. These results are inconsistent with environmental epidemiology theory, which states that ventilation is one of the critical factors in reducing the concentration of pollutants and pathogens in the house. These results are also inconsistent with Fitriyah's (2016) research on Sukolilo Surabaya and Boyolali, which stated that there is a relationship between house ventilation and the incidence of ARI. However, these results are consistent with research in Palembang and Boyolali, who also stated that there is no relationship between ventilation and the incidence of ARI. It is necessary to ensure that every house has adequate ventilation, especially in the kitchen and bedroom areas, to improve indoor air quality.

Table 2 illustrates that ten houses (28.6%) without ceilings experienced acute respiratory infections (ARI), while two houses (8.0%) with dirty ceilings and four houses (10.0%) with clean ceilings also reported ARI cases. Statistical analysis revealed a significant relationship between ceiling conditions and the incidence of ARI, with a p-value of 0.016. Houses without ceilings had a higher incidence of ARI than houses with clean and closed ceilings. This follows the theory that dirty and open ceilings can contaminate air with dust, hazardous particles, and microorganisms (Aftab et al., 2022; Riegel et al., 2021). These results align with research in Kendari, which found that houses without ceilings or unclean ceilings have a higher risk of ARI due to particle contamination that makes it easier to enter the house (Hanafi et al., 2023). Therefore, researchers recommend installing clean, closed, and easy-to-clean ceilings to prevent the entry of contaminants from outside and reduce the risk of ARI.

Table 2 indicates that three houses (25.0%) with dim lighting experienced ARI, while one house (8.3%) with adequate lighting also reported ARI. In contrast, 12 houses (14.3%) with bright lighting experienced ARI. The results of the statistical tests revealed a significant relationship between lighting conditions and the incidence of ARI, with a p-value of 0.009. Houses with dim lighting had a higher incidence of ARI. The literature states that good lighting can reduce humidity in the house and prevent mold growth and other microorganisms (Neira and Ramanathan, 2020). Sufficient natural lighting also helps maintain room temperature and humidity in optimal conditions, which reduces the risk of pathogenic microorganism growth (Osibona et al., 2021). These results align with research conducted in Brebes, which showed that poor lighting increases the risk of ARI due to uncontrolled humidity conditions, which trigger pathogen growth. Researchers recommend that every home be equipped with adequate lighting, both from natural and artificial sources, to maintain a healthy home environment and minimize the risk of Acute Respiratory Infections (ARI). However, natural lighting is only sometimes adequate to maintain humidity and room temperature in optimum conditions, especially in areas that often experience bad weather or have low sunlight intensity. In addition, artificial lighting can lead to an increase in unsustainable energy consumption.

Table 2 indicates that seven houses (35.0%) without a smoke hole in the kitchen experienced Acute Respiratory Infections (ARI). Additionally, four houses (10.5%) with a smoke hole that did not meet the necessary requirements also reported ARI cases, while five houses (11.9%) with a properly functioning smoke hole experienced ARI. The statistical analysis results revealed a significant relationship between the condition of the kitchen smoke hole and the occurrence of ARI, with a p-value of 0.034. Houses without a kitchen smoke hole have a higher incidence of ARI. Adequate kitchen smoke vents significantly reduce the concentration of smoke and hazardous particles produced by the cooking process (Pal and Netam, 2021). These results support previous studies showing that houses without kitchen smoke vents or with inadequate kitchen ventilation have a higher risk of ARI due to the house's accumulation of smoke and pollutants (Juntarawijit and Juntarawijit, 2019). These results also align with other studies in Boyolali, which found a significant relationship between kitchen smoke vents and the incidence of ARI, indicating that houses without kitchen smoke vents have a higher incidence of ARI. Researchers recommend the installation of adequate kitchen smoke vents in every house, especially in houses with closed kitchens, to ensure good air circulation and reduce the risk of exposure to smoke and pollutants that can trigger ARI, so that the health of the occupants of the house is maintained. However, although installing kitchen smoke vents can help reduce the risk of ARI, other factors, such as environmental cleanliness and healthy living habits, also play an essential role in maintaining the health of the occupants of the house.

5. Conclusions

This study successfully showed that the house's physical condition significantly influences the incidence of Acute Respiratory Infection (ARI) in fishing families in Pasie Nan Tigo Village, Padang City. Variables that have a significant relationship with the incidence of ARI include the condition of the living room windows, bedroom windows, ceilings, lighting, and kitchen smoke holes. Houses with windows that cannot be opened or without windows, dirty ceilings or ceilings, poor lighting, and kitchens without smoke holes have a higher risk of ARI. This shows that improving the house's physical condition, such as increasing ventilation, lighting, and cleanliness of the ceiling and kitchen, can be an effective preventive measure to reduce the incidence of ARI in fishing communities. This finding implies that the government and health policymakers need to pay special attention to improving the physical condition of houses, especially in vulnerable coastal communities. Home improvement programs, such as installing adequate ventilation and windows, increasing lighting, and providing safe kitchen facilities, must be prioritized in environmental health programs. In addition, education is needed for the community regarding the importance of maintaining cleanliness and ventilation in the house to prevent respiratory diseases. For further researchers, it is recommended to conduct research with a longitudinal design to see the long-term effects of interventions to improve the physical condition of houses on the incidence of ARI. Research can also be expanded by adding other variables, such as nutritional status, health behavior, and external environmental factors, to gain a more comprehensive understanding of the determinants of respiratory health in coastal communities.

Compliance with ethical standards

Ethical considerations

Informed consent was obtained from all participants prior to data collection. All procedures were conducted in accordance with the ethical standards of the Helsinki Declaration and relevant institutional guidelines.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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