

## The Physical Condition of Household Environment and History of Acute Respiratory Infection (ARI) to the Stunting Cases in Ogan Ilir Regency

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### ABSTRACT

**Background:** The case of stunting in toddlers can be caused by infectious diseases such as acute respiratory infection as the direct factor and the physical conditions of the household environment as the indirect factor. This study aims to determine the relationship between the physical condition of the household environment and history of Acute Respiratory Infection (ARI) to the stunting cases in toddlers in 13 stunting locus villages in Ogan Ilir Regency 2024.

**Method:** This study used a case-control study focusing on stunted toddlers aged 24-59 months in 13 locus villages in Ogan Ilir Regency. A total of 129 samples of under-fives were obtained using the Lameshow formula, with a ratio of 1:2 found (43 cases and 86 controls). Inclusion criteria were stunted toddlers for cases and non-stunted toddlers in the neighborhood for controls. This study examined various factors including wall type, floor type, ceiling type, residential density, temperature, humidity, lighting, ventilation, and history of acute respiratory infections (ARI). Data analysis included univariate, bivariate (using chi-square test), and multivariate (using multiple logistic regression) methods.

**Result:** The bivariate analysis showed a significant association between residential density (p-value = 0,010), ventilation (p-value = 0,002), history of acute respiratory infection (ARI) (p-value = 0,000), moderate ARI severity (p-value = 0,000), and one-time ARI frequency (p-value = 0,001) with the stunting cases in Ogan Ilir Regency. Multivariate analysis identified history of ARI as the dominant factor influencing stunting in toddlers (OR = 13,458, 95% CI 3,618 – 50,063) and also found that wall type as the protective factor against the case of stunting (p value= 0,038, OR= 0,323, 95% CI 0,111 - 0,941).

**Conclusion:** This study conducted in 13 villages of Ogan Ilir regency found that factors such as residential density, ventilation, wall type, and a history of Acute Respiratory Infection (ARI) were significantly linked to stunting in children aged 24 to 59 months with the history of ARI was the dominant factor against stunting in toddlers.

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## INTRODUCTION

The nutritional problem that is still faced by many developing countries is stunting. Stunting is a form of growth failure, also known as growth faltering, that results from deficient nutrition in the first 1,000 days of a child's life. This condition leads to growth disorders, specifically shorter height compared to age standards (1). Stunting can

be caused by direct and indirect factor. Direct factors include poor maternal nutrition during pregnancy, inadequate infant and toddler nutrition, inadequate exclusive breastfeeding, and infectious diseases. Indirect factors include environmental factors, family income, education, parental knowledge, and parental occupation (2). WHO (3) states that 22.3% of toddlers worldwide are stunted, including within the Ogan Ilir Regency. Ogan Ilir has the second highest prevalence of stunting in the South Sumatra region, at 24.9%. Stunting must be a prioritized problem that needs to be addressed immediately because the development and progress of the country can deteriorate if the prevalence of stunting continues to increase (4).

Infectious diseases are a direct factor leading to the occurrence of stunting in young children. According to the research by Suarayasa, Miranti (5), children who had experienced an infectious disease had almost double the risk of becoming stunted (OR = 1.944). Infectious diseases can lead to decreased the nutrition levels, affecting infants and children's overall health and development. One type of infectious disease that directly contributes to stunting is Acute Respiratory Infection (ARI). In Indonesia, Acute Respiratory Infections (ARI) is among the top 10 diseases suffered by the community. Data from the Directorate of Communicable Disease Prevention and Control of the Ministry of Health showed that there were approximately 1.5 to 1.8 million cases of ARI nationally from January to September 2023 (6). In the South Sumatra region, the Central Bureau of Statistics reported that Acute Respiratory Infection (ARI) was the second most common disease, with 519,167 cases recorded in 2022 (7). According to data from the South Sumatra Provincial Health Office in 2022, the coverage of ARI case finding in Ogan Ilir Regency was 13% of the total 6,663 ARI cases in South Sumatra. It is important to know the association between the history of ARI and the case of stunting in Ogan Ilir Regency. The results of research conducted by Eldrian, Karinda (8) show that there is a relationship between a history of ARI disease and cases of stunting in toddlers. Toddlers with a history of ARI disease have a 3,4 times risk of stunting compared to toddlers with no history of ARI disease.

The physical condition of the household environment plays an essential role in being a source of infectious disease transmission, such as ARI, which also directly affects the incidence of stunting in toddlers. The physical condition of the household environment includes various indicators of a healthy home, such as lighting, temperature, humidity, air ventilation, the physical condition of the building, and the residential density. The poor physical condition of household environment can cause significant growth of germs and viruses, which can cause the child to be exposed to infectious diseases and affect the child's diet so that the child's growth is inhibited and results in a short or very short body condition (9). To ensure the health protection for all residents, it is essential to properly fulfill all healthy home requirements (10). Understanding how the physical conditions of household environment and ARI are associated with stunting is critical to developing specific interventions and policies that aim to address stunting and improve child health and well-being. By clarifying the relationship between the physical environment of the home, history of ARI, and stunting, it is hoped that this information can help create effective approaches to reduce child malnutrition and accelerate the reduction of stunting both in Indonesia and globally. This study aims to analyze the relationship between the physical conditions of the household environment and the history of acute respiratory infection (ARI) to stunting cases in toddlers in Ogan Ilir Regency.

## **METHOD**

This research was conducted as an observational study utilizing a case-control approach, focusing on stunted children aged 24-59 months in 13 locus villages, with data sourced from the Ogan Ilir Regency Health Office and local midwives. The size of the sample was calculated using the Lameshow formula, resulting in 43 cases of stunted children. The case-to-control ratio was 1:2, resulting in a sample size of 129 participants, consisting of 43 stunting toddlers as cases and 86 non-stunting as controls. The purposive sampling method was utilized to select the participants. Inclusion criteria for cases consisted stunted toddlers within the specified age range (24-59 months) in the selected villages, while the controls were non-stunted toddlers of the same age who lived in the neighbourhood around the case House. The dependent variables under this study were the incidence of stunting, with independent variables including wall type, floor type, ceiling type, residential density, temperature (assessed using a hygrometer), humidity (also measured with a hygrometer), lighting (measured using a lux meter), ventilation (measured with a roll meter), and a history of Acute Respiratory Infections (ARI). Scores for wall type, floor type, and ceiling type were categorized as watertight and non-watertight. Watertight wall type, floor type, and ceiling type scores indicate the use of materials that are permanent and can prevent water from entering the house. Scores for residential density were categorized as  $< 9\text{m}^2$  and  $\geq 9\text{m}^2$ , temperature were categorized as  $< 18\text{ }^\circ\text{C}$  or  $> 30\text{ }^\circ\text{C}$  and  $18 - 30\text{ }^\circ\text{C}$ , humidity were

categorized as < 40 or > 60 % Rh and 40 – 60 % Rh, lighting were categorized as < 60 lux and ≥ 60 lux, and ventilation were categorized as < 10% and ≥ 10%, which indicate that the residential density, temperature, humidity, lighting, and ventilation meets or does not meet the requirements based on (11) with the minimum limit of 9 m<sup>2</sup> for residential density, 18 – 30 °C for temperature, 40 – 60 % Rh for humidity, ≥ 60 lux for lighting, and ≥ 10% for ventilation. The history of ARI were categorized as Yes and No, while the severity level of ARI were categorized as severe, moderate, and No ARI based on their treatment history. A toddler with a history of ARI and being hospitalized means that the severity is severe. In comparison, a toddler with a history of ARI who was not hospitalized implies that the severity is moderate. Data analysis methods were univariate, bivariate, and multivariate. Univariate analysis is presented as frequencies, bivariate analysis using chi-square test with Odds Ratio (OR) with α = 5% and 95% confidence level, and multivariate analysis using multiple logistic regression.

### Ethical Approval

This research has been approved by the Health Research Ethics Commission of the Faculty of Public Health, Sriwijaya University with number 311/UN9.FKM/TU.KKE/2024 on September, 23rd 2024.

### RESULTS

This study was conducted in 13 stunting locus villages in Ogan Ilir Regency consisting of Palembang, Sukaraja Lama, Seri Banding, Tanjung Agung, Maju Jaya, Rantau Panjang Ilir, Rantau Alai, Senuro Barat, Lubuk Bandung, Ketiau, Seri Menanti, Skonjing and Pegayut.

**Table 1.** The Distribution of Respondent Status Based on Stunting Cases in Several Locus Areas in Ogan Ilir Regency

Status	Frequency	%
Case	43	33,3
Control	86	66,7

Source: Primary Data 2024

Based on Table 1, it is known that the number of stunting respondents from 13 stunting locus villages in Ogan Ilir Regency was 43 respondents (33,3%). At the same time, the number of respondents who were not stunted (control group) was 86 respondents (66,7%).

**Table 2.** The Relationship Between Physical Conditions of the Household Environment with Stunting in Toddlers in Several Locus Areas in Ogan Ilir Regency

Variabel	Case		Control		p-value	OR	95% Confidence Interval (CI)
	n	%	n	%			
<b>Wall Type</b>							
Non-watertight	12	27,9	37	43,0	0,140	0,531	0,232 – 1,131
Watertight	31	72,1	49	57,0			
<b>Ceiling Type</b>							
Non-watertight	36	83,7	64	74,4	0,332	1,768	0,688 – 4,541
Watertight	7	16,3	22	25,6			
<b>Floor Type</b>							
Non-watertight	23	53,5	44	51,2	0,950	1,098	0,527 – 2,286
Watertight	20	46,5	42	48,8			
<b>Lighting</b>							
< 60 lux	36	83,7	60	69,8	0,134	2,229	0,878 – 5,656
≥ 60 lux	7	16,3	26	30,2			
<b>Temperature</b>							
< 18 °C or > 30°C	36	83,7	72	83,7	1,000	1,000	0,371 – 2,695
18 – 30 °C	7	16,3	14	16,3			
<b>Humidity</b>							
< 40 or > 60 % Rh	29	67,4	51	59,3	0,480	1,422	0,659 – 3,068
40 – 60 % Rh	14	32,6	35	40,7			

<b>Residential Density</b>							
< 9 m <sup>2</sup>	17	39,5	16	18,6	0,019*	2,861	1,263 – 6,480
≥ 9 m <sup>2</sup>	26	60,5	70	81,4			
<b>Ventilation</b>							
< 10%	18	41,9	13	15,1	0,002*	4,043	1,736 – 9,419
≥ 10%	25	58,1	73	84,9			

\*Significant at a 5% significance level

Source: Primary Data 2024

In Table 2, the findings from the bivariate analysis related to the physical conditions of the household environment are presented. Data in Table 2 show that the proportion of residential density categories between stunted and non-stunted children differs significantly ( $p < 0,05$ ). Similarly, the average score of home ventilation with stunted children is significantly different with non-stunted children ( $P < 0,05$ ).

**Table 3.** The Relationship between History of ARI with Stunting in Toddlers in Several Locus Areas in Ogan Ilir Regency

Variabel	Case		Control		p-value	OR	95% Confidence Interval (CI)
	n	%	n	%			
<b>History of ARI</b>							
Yes	17	39,5	4	4,7	0,000*	13,404	4,139 – 43, 409
No	26	60,5	82	95,3			
<b>Severity Level of ARI</b>							
Severe	11	25,6%	3	3,5%	0,696	0,611	0,052 – 7,240
Moderate	6	14,0%	1	1,2%	0,000*	11,564	2,996 – 44,637
No ARI	26	60,5%	82	95,3%	reference	reference	reference
<b>Frequency of ARI</b>							
More than once	12	27,9%	1	1,2%	0,121	7,200	0,596 – 87,020
One time	5	11,6%	3	3,5%	0,001*	37,846	4,694–305,111
Never	26	60,5%	82	95,3%	reference	reference	reference

\*Significant at a 5% significance level

Source: Primary Data 2024

Data in Table 3 show that the proportion of history of ARI categories between stunted and non-stunted children differs significantly ( $p < 0,05$ ). This also occurred in the categories of severity level of ARI and frequency of ARI. Stunted toddlers who had moderate severity and one time ARI frequency were significantly different from non-stunted toddlers ( $p < 0,05$ ).

**Table 4.** The Final Model Multivariate Analysis of Physical Household Environment and History of ARI with Stunting Cases in Toddlers

Variables	p-value	OR	95% CI	
			Lower	Upper
History of ARI	0,000	13,458	3,618	50,063
Ventilation	0,005	4,075	1,519	10,928
Ceiling Type	0,038	3,886	1,075	14,055
Residential Density	0,100	2,434	0,843	7,031
Lighting	0,254	1,939	0,622	6,040
Wall Type	0,038	0,323	0,111	0,941

Source: Primary Data 2024

Based on the multivariate results presented in Table 4, it can be concluded that history of ARI is the most dominant associated with the case of stunting in toddlers aged 24-59 months in the 13 stunting locus villages in Ogan Ilir Regency ( $p < 0,05$ ). The wall type is protective factor against the case of stunting. Toddlers aged 24-59 months

who's live in home with watertight wall type have a 0,323 times risk of being stunted compared to toddlers who live in home with non-watertight wall type.

## **DISCUSSION**

### **The Relationship Between Physical Conditions of Household Environment with Stunting in Toddlers**

Based on the results of the analysis, it is known that there are two variables of the physical household environment that have an association with the stunting cases: residential density and ventilation. The bivariate analysis showed that residential density has a p-value of 0,010 ( $p < 0,05$ ) and OR = 2,861, meaning that toddlers living in homes with poor residential density have a 2,86 times higher risk of being stunted. These findings align with studies carried out by Angraini, Firdaus (12) that residential density is a determinant of the stunting cases in toddlers with a p-value of 0,046 ( $p < 0,05$ ). The residential density health requirement has been regulated in Minister of Health Regulation Number 2 Year 2023, which is a minimum of 9 m<sup>2</sup>.

The results of bivariate analysis for the ventilation variable showed a p-value of 0,002 ( $p < 0,05$ ) and OR = 4,043 which means that toddlers who live in homes with poor ventilation have a 4 times higher risk of being stunted. These findings align with studies carried out by Yuniastuti, Hidayah (13) that home ventilation is one of the factors causing stunting in toddlers with a p-value of 0,000 ( $p < 0,05$ ). This study also states that toddlers who live in homes with unqualified ventilation have a 9,9 times chance of being stunted. The percentage of house ventilation area has been regulated in Minister of Health Regulation Number 2 Year 2023 which is 10% of the floor area.

Various infectious diseases can arise due to environmental conditions that do not meet health requirements, such as residential density, which exceeds capacity, and the air ventilation, which does not meet the health standards. Residential density that exceeds capacity can affect the speed of disease transmission in the house. The closer the physical contact, the easier and faster the disease transmission (14). Meanwhile, home ventilation is a medium for exchanging fresh air from outside to inside the house. If a house has a poor ventilation system and the residential density is too full, the health of the residents in it will be disturbed. Ventilation is needed to keep the airflow in the house fresh and maintain the O<sub>2</sub> balance. Airborne diseases can enter or settle in the room and last for some time, but they can eventually be transmitted to others in the room (15). The infection that arises and transmitted in rooms with poor ventilation and residential density can affect the health of toddlers and become a direct contributing factor to stunting.

From the results, it was found that the physical condition of the household environment, which included the wall type, ceiling type, floor type, lighting, temperature, and humidity, had a p-value  $> 0,05$ , which indicated that there was no relationship between the physical condition of the household environment and stunting cases. The results of this analysis are in line with several studies that have been conducted. A research conducted by Setiawati (16) showed that there was no relationship between the wall type (p-value = 0,239) and stunting cases. But the wall type acted as a protective factor against stunting. The likelihood of stunting in toddlers aged 24 to 59 months living in homes with watertight walls was 0,323 times higher compared to those living in homes with non-watertight walls. Research conducted by Widiyanto and Wati (17) showed that there was no relationship between the ceiling and the incidence of stunting. Research conducted by Nadhiroh, Riyanto (18) showed that there was no relationship between the floor type (p-value = 0,148) and the incidence of stunting. Research conducted by Angraini, Firdaus (19) showed that there is no association between the lighting (p-value = 0,072) with stunting cases in toddlers. Research conducted by Azizah, Razak (20) showed that there is no association between temperature (p-value = 0,299) and humidity (p-value = 0,454) with stunting cases. This is inversely proportional to research conducted by Setiawati (16) that there is an association between floor type (p-value = 0,027) and stunting cases. Research conducted by Yuniastuti, Hidayah (13) showed that there is a relationship between lighting (p-value = 0,000) and stunting cases. Then research by Rahma, Razak (21) showed that there is a relationship between temperature and stunting cases (p-value = 0,051). Research conducted by Angraini, Firdaus (12) showed that there is a relationship between humidity (p-value = 0,024) with stunting cases in toddlers.

Health standards concerning lighting, temperature, and humidity are outlined in Minister of Health Regulation Number 2 Year 2023. According to this regulation, the minimum requirement for indoor lighting is 60 lux, with temperature set between 18 - 30°C, and humidity at 40 - 60% Rh. The average lighting recorded was 49.15 lux, falling below the required 60 lux, the average temperature was 32.95°C, exceeding the upper limit of 30°C, and the average humidity level was 65.2% Rh, also surpassing the maximum of 60% Rh. Therefore, it can be concluded that the

respondents' homes do not adhere to the health requirements established in Minister of Health Regulation Number 2 Year 2023 regarding floor type, ceiling type, lighting, temperature, and humidity. The percentage proportion of floor type, ceiling type, lighting, temperature, and humidity of the respondent's house did not find a significant difference between the case and control groups and the results showed that there was no relationship between the type of floor, ceiling type, lighting, temperature, and humidity of the respondent's house with stunting cases in toddlers in 13 Stunting Locus Villages in Ogan Ilir Regency in 2024. To improve the household health, it is essential to raise the public awareness. The government and health office can provide a counselling on the importance of maintaining Healthy Homes for overall health and family well-being. Additionally, the Ogan Ilir government can collaborate with the Ministry of Public Works and Public Housing to expand the reach of programs such as the Program Bantuan Stimulan Perumahan Swadaya (Self-Help Housing Stimulant Assistance Program) and Bedah Rumah (Home Improvement). These programs focus on decreasing the number of unlivable homes and improving the living conditions for low-income family by offering safe, healthy, and adequate housing.

### **The Relationship Between History of ARI with Stunting in Toddlers**

Based on the results of the analysis, it is known that the history of ARI, moderate severity of ARI, and one-time ARI frequency have a relationship with the incidence of stunting in toddlers. The analysis of ARI history showed a p-value of 0,000 ( $p < 0,05$ ) and OR = 13,404, meaning toddlers with a history of ARI have a 13,4 times greater risk of being stunted. This aligns with research conducted by (22) which found that ARI contributes to the prevalence of stunting among toddlers. Meanwhile, moderate ARI and the one-time ARI frequency also have an association with stunting cases in children aged 24-59 months. Moderate ARI has a p-value of 0,000 and OR = 11,564 meaning that toddlers with moderate ARI have an 11,5 times higher risk of being stunted. It is because toddlers who fall into the category of moderate ARI are not doing treatment during illness, so it is feared that there will be more effects than toddlers with ARI who are doing treatment. Meanwhile, one-time ARI frequency has a p-value of 0,001 and OR = 37,846 which means that toddlers with a one-time ARI frequency have a 37,8 times higher risk of being stunted.

ARI or Acute Respiratory Infection, refers to an infection affecting either the upper or lower parts of the respiratory system that is transmitted through the air (airborne disease), causing a diverse spectrum of diseases consisting of asymptomatic diseases or mild infections to severe and deadly diseases (23). According to UNICEF (24) ARI is an infectious disease that is a direct contributing factor to the occurrence of ARI in toddlers. ARI has an effect on reducing the nutritional status of toddlers, which results in stunting. Inflammation that occurs due to ARI in children can cause metabolic disorders and impaired bone growth in their body (25).

### **The Most Dominant Variable Associated with The Case of Stunting**

The final multivariate analysis model using multiple logistic regression showed that the most dominant variable at risk of influencing stunting in toddlers was a history of acute respiratory infection (ARI). In the final multivariate analysis modelling, a history of ARI had the highest OR compared to the other variables, which was 13,458, meaning that toddlers with history of ARI had a 13 times greater risk of being stunting, in contrast to toddlers without a history of ARI. The history of ARI confidence interval (95% CI: 3,618 - 50,063) means that the respondents in 13 locus villages are 95% sure that toddlers are at risk of developing stunting ranging from 3,618 to 50,063 when compared to toddlers who do not have a history of ARI.

ARI (Acute Respiratory Infection) contributes to a decrease in children's nutritional status (26). ARI has the capability to significantly alter children's eating behaviors. Children with ARI tend to be fussy eaters and may show a lack of interest in food. Consequently, their nutritional intake from daily meals is often insufficient (27). In addition, ARI, which is an infectious disease, associated with the process of inflammation. During inflammation, the body produces high-sensitivity C-reactive protein (hs-CRP), which affects growth hormone resistance. The presence of inflammation hinders the function of Insulin Growth Factor 1 (IGF-1), a hormone that links the body and growth hormone (28). This condition leads to impaired growth and development in toddlers, resulting in noticeable stunting that affects their height and overall physical development.

### **Limitations and Cautions**

The limitation of this study is that it did not utilize the toddler's ARI data from health services. ARI information was gathered only through questionnaires and interviews with parents.

## **Recommendations for Future Research**

Researchers can use the complete toddler's health data from the health services around the research location and consider new research location to increase the number of respondents.

## **CONCLUSION**

Residential density, ventilation, wall type, history of acute respiratory infections (ARI), moderate ARI severity, and one-time ARI frequency were significantly associated with stunting cases in children aged 24 to 59 months in 13 villages identified as stunting locus in the Ogan Ilir regency. The history of ARI emerged as the most dominant factor contributing to stunting in toddlers. This study revealed that most of stunted toddlers had a history of ARI, which adversely affected their health status and reduced their appetite, leading to stunting. Therefore, from the results of this study, it is advisable for parents to act quickly when their child is unwell and seek health services to avoid more severe consequences, especially those related to infectious diseases such as Acute Respiratory Tract Infection (ARI). Furthermore, the government and healthcare professionals must engage with the community, providing essential guidance on maintaining proper home sanitation to ensure the health and well-being of families to prevent cases of stunting.

## **AUTHOR'S CONTRIBUTION STATEMENT**

N.A.P, R.R, and Y designed the study. N.A.P collected data, analyzed data, and wrote the paper with support from R.R, Y, I.T, and A.R. R.R and Y organized the substance of the article. I.T and A.R contributed to the systematics and finalization of the manuscript. All authors reviewed the results and approved the final version of the manuscript.

## **CONFLICTS OF INTEREST**

The authors declare that they have no conflict of interest related to this publication.

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