



# Physical Home Sanitation as a Risk Factor for Acute Respiratory Infection in Children under 5 at Labuan Regency, Central Sulawesi

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## Abstract

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**BACKGROUND:** Acute respiratory infections (ARIs) are a primary cause of morbidity and mortality in children under the age of 5. Environmental factors have a very large influence on the incidence of ARI, excessive dust content, air ventilation, lighting, and humidity believed to be the cause of ARI.

**AIM:** The purpose of this study was to determine the risk of physical home sanitation against ARI in children under five in Labuan Regency, Central Sulawesi.

**METHODS:** This study was done in Labuan District, Donggala Regency, from July 31, 2021, to October 28, 2021, as an observational study with a case-control study technique. All children under the age of 5 who have ARI in the Labuan Health Center Work Area, Labuan District, Donggala Regency, are included in the study. The research was approved by the Makassar Ministry of Health Poltekkes Ethics Committee Number 1068/KEPK-PTKMK/IX/2020 on the basis of its ethical feasibility.

**RESULTS:** The physical sanitation condition of the house that does not meet the requirements for dust content is 52.9% and home ventilation 58.6%. The lighting conditions are 47.1% and the humidity of the house is 35.7%. Bivariate analysis showed that there was a relationship between dust levels and the incidence of ARI ( $p = 0.000$ ), ventilation conditions with the incidence of ARI ( $p = 0.000$ ), lighting with the incidence of ARI ( $p = 0.001$ ), and humidity with the incidence of ARI ( $p = 0.005$ ) in children in Labuan District, Donggala Regency. The incidence of ARI is more common in children aged 0–2 years, and the incidence of ARI has no difference between male and female sexes. Multivariate analysis showed that dust content ( $p = 0.000$  confidence interval [CI] 95% odds ratio [OR] = 9.56) and ventilation ( $p = 0.001$  CI 95% OR = 6.08) were the main variables that caused ARI in children in Labuan District, Donggala Regency.

**CONCLUSION:** The main variables causing ARI in children in Labuan District, Donggala Regency, are dust content (OR = 9.56) and ventilation (OR = 6.08).

## Introduction

Acute respiratory infections (ARIs) are a primary cause of morbidity and mortality in children under the age of 5 around the world [1]. Respiratory disorders are the world's greatest cause of mortality and disability [2]. ARI claimed the lives of 878.829 children under the age of 5 worldwide in 2016. Between 2000 and 2016, the number of children under the age of 5 who died as a result of an ARI in Indonesia averaged 17% (15%–19%) [3]. Because we are constantly exposed to particles, chemicals, and infectious organisms in the surrounding air, the lungs are the internal organs that are most vulnerable to infections and dangers from the surrounding environment. An estimated 2 billion people worldwide are exposed to toxic fumes produced by biomass fuels, which are burned inefficiently in fireplaces or indoor stoves that are poorly ventilated. One billion people breathe secondhand smoke and another billion people breathe contaminated outdoor air. Environmental exposure, overcrowding, poverty,

and generally poor living conditions increase our sensitivity to this wide range of diseases. It causes disability and death worldwide and affects all social and economic classes. Respiratory disorders are a major cause of death and illness around the world. Five of these conditions are among the leading causes of serious illness [2]. Lower respiratory tract infection is estimated to cause about 4 million fatalities yearly and is the largest cause of mortality among children under the age of 5, notwithstanding the difficulty in quantifying the burden. In addition, acute lower respiratory tract infections in children are linked to the development of chronic respiratory disorders later in life. It is estimated that >10% of all disability-adjusted life years are caused by ARI [2].

ARI ranks second after cardiovascular disorders in terms of prevalence. Respiratory syncytial virus or RSV is the most common cause of ARI in children, accounting for nearly 34 million cases reported annually. RSV respiratory infection causes more than 90% of children's fatalities in low- and middle-income nations [4]. ARI is the most common disease

in Donggala Regency with 23,366 cases and other diseases such as tuberculosis, dengue fever, sexually transmitted infections, malaria, diarrhea, and HIV/AIDS with 329 cases [5].

The disease that still dominates in children under 5 years (toddlers) is ARI and was reported in 2013 to cause the death of around 4 million children under five per year. Based on Riskesdas 2013, the prevalence of ARI in children aged 1-4 years reached 25.8%. Environmental factors have a very large influence on the incidence of ARI, excessive dust content [6], [7], [8], [9], [10], air ventilation [11], [12], [13], [14], [15], lighting [16], and humidity [17], [18], [19], [20], [21] believed to be the cause of ARI, including ventilation which functions as an inlet and outlet of the air in the room. Natural or artificial lighting can directly or indirectly illuminate the entire room with an intensity of at least 60 Lux provided it creates glare. The regulation from the Minister of Health of the Republic of Indonesia in 2011 stipulates that air health in the form of indoor humidity for healthy homes is 40%-60%. Humidity that is too high or too low can cause the growth of microorganisms, including ARI microorganisms.

Based on data from the Labuan Health Center that the number of ARI cases in the past 2 years has increased, where in 2019, there were 658 ARI cases and, in 2020, it increased to 756 under five, even ARI ranks 3<sup>rd</sup> out of 10 main diseases in puskesmas. This shows that the incidence of ARI is still quite high for the working area of the Labuan Health Center, Labuan District, Donggala Regency. The absence of publications related to risk factors for the incidence of ARI in children under five in Labuan District, Donggala Regency, underlies this research.

The purpose of this study was to determine the risk of physical home sanitation against ARI in children under five in Labuan Regency, Central Sulawesi.

## Methods

This research is an observational study with a case-control study approach, namely, an observational epidemiological study design that studies the relationship between disease effects and certain risk factors. This research was conducted from July 31, 2021, to October 28, 2021, in Labuan District, Donggala Regency. The case population is all children under five who suffer from ARI in the Labuan Health Center Work Area, Labuan District, Donggala Regency. The sample is 140 toddlers. The independent variables in this study were dust content, ventilation, humidity, and lighting. The dependent variable in this study was the incidence of ARI in children under five.

Dust content is the amount of dust content measured at home with ARI patients. Measurement method: Direct measurement. Measuring instrument: Personal dust sampler. Measuring scale: Nominal. Measurement result: Qualified if dust content is  $<10 \text{ mg/m}^3$ . Not eligible if dust content is  $10 \text{ mg/m}^3$ .

Ventilation in this study is a vent for the process of changing fresh air into and removing dirty air from a closed room naturally or artificially. Measuring method: Direct measurement. Measuring instrument: Meter measuring scale: Nominal, measurement result: Said to be qualified if the ventilation area is at least 10% of the floor area. Said to be not eligible if the ventilation area is  $<10\%$  of the floor area.

Lighting is the amount of sunlight that illuminates the bedroom or room in the patient's home. Measuring method: Direct measurement, measuring instrument: Lux meter, measuring scale: Nominal, measurement result: It is said to meet the requirements, if the lighting is  $>60 \text{ lux}$ , it is said to be ineligible if it is less than 60 Lux.

Humidity is the amount of water vapor that can be affected by air circulation in the house. Measuring method: Direct measurement, measuring instrument: Hygrometer, measuring scale: Nominal, measurement result: Said to meet the requirements, if the humidity ranges from 40% to 70%. Said to be ineligible, if  $<40\%$  or  $>70\%$ .

Data collection: The type of data in this study is quantitative data which includes dust levels, ventilation, humidity, and lighting. Primary data are obtained through observation and/or measurement of dust, ventilation, lighting, and humidity levels in the house. Secondary data were obtained from health agencies such as the District Health Office, Donggala, Puskesmas and Labuan Health Center.

The instruments used in this research are tools and measurements. Measurement of dust content; the tool used is a personal dust sampler. How it works: Put filter paper on the head of the dust catcher, connect the hose connecting the pump head to the suction pump. Place the suction head close to the breathing source and the suction pump on the belt, turn on the tool by sliding the button to the front, adjust the air flow speed by setting the black ball exactly at number 2. Set the time of use using the timer. When finished, turn off the suction pump, then remove the filter with tweezers, put it in the sample storage box. Clean the tool, put it in a storage bag.

Ventilation measurement; the tool used for measuring ventilation is a rollmeter. The measurement method is: The room ventilation area is measured. The floor area of the room is measured. The ventilation area is compared to the floor area of the room. Exposure measurement; the tool used for measuring lighting is a lux meter, namely, by measuring in each part of the room to be measured through 5 points in the room being

measured and the results are averaged. How to use it: Slide the "Off/On" button toward On. Select the range of the range to be measured (2000 lux, 20,000 lux, or 50,000 lux) on the range button. Point the light sensor by hand at the surface. The area to be measured is the intensity of the illumination. View the measurement results on the panel display.

Air humidity measurement; the instrument used for measuring air humidity is a hygrometer, namely, by rotating the tool and around the room to be measured, and it is carried out 3 times and the results are averaged. How to use it, namely: Determined the humidity measurement point. The hygrometer is placed in a predetermined place. During the measurement, the instrument was allowed to stand for 3 min. The measurement results are read after the hygrometer needle is stable or constant.

Data processing includes editing, coding, entry, and tabulating data. Data analysis includes: Univariate analysis (percentage analysis) was conducted to describe the frequency distribution of the independent variable (independent) and the dependent variable (dependent). Bivariate analysis was performed using SPSS (Statistical Package for the Social Sciences) 16.0. The ethical feasibility of the research was obtained from the Makassar Ministry of Health Poltekkes Ethics Committee Number 1068/KEPK-PTKMKS/IX/2020.

## Results

Research respondents aged 0–2 years as many as 92 people (65.7%) and male sex as many as 72 people (51.4%). Respondents came from eight areas of Labuan and most were from Labuan Toposo as many as 50 people (35.7%) (Table 1).

**Table 1: Characteristics of research respondents in Labuan District, Donggala Regency**

Characteristics	n (%)
Age (years)	
0–2	92 (65.7)
3–5	48 (34.3)
Sex	
Male	72 (51.4)
Female	68 (48.6)
Region	
Labuan Induk	22 (15.7)
Labuan Kungguma	8 (5.7)
Labuan Lelea	24 (17.1)
Labuan Lumbu Baka	6 (4.3)
Labuan Panimba	14 (10.0)
Labuan Salumbone	16 (11.4)
Labuan Toposo	50 (35.7)
Labuan Induk	22 (15.7)
Total	140 (100)

Table 2 shows the physical sanitation conditions of the houses measured; it can be seen that the dust content does not meet the requirements (>10) as many as 74 houses (52.9%). The respondent's house ventilation did not meet the requirements as many as 58 houses (58.6%). The lighting conditions in

the house did not meet the requirements as many as 66 houses (47.1%); the humidity of the house did not meet the requirements, namely, 35.7%.

**Table 2: Physical sanitation of respondents' houses in Labuan District, Donggala Regency**

Variable	n (%)
Dust level	
Ineligible	74 (52.9)
Qualified	66 (47.1)
Ventilation	
Ineligible	58 (58.6)
Qualified	82 (41.4)
Lighting	
Ineligible	66 (47.1)
Qualified	74 (52.9)
Humidity	
Ineligible	50 (35.7)
Qualified	90 (64.3)
Total	140 (100)

In Table 3, the bivariate analysis shows that there is a relationship between dust levels and the incidence of ARI ( $p = 0.000$ ), ventilation conditions with the incidence of ARI ( $p = 0.000$ ), lighting with the incidence of ARI ( $p = 0.001$ ), and humidity with the incidence of ARI ( $p = 0.005$ ) in children in Labuan District, Donggala Regency.

**Table 3: Bivariate analysis of acute respiratory infection incidence with physical sanitation conditions of respondents' houses in Labuan District, Donggala Regency**

Home physical sanitation	ARIs		p
	Yes, n (%)	No, n (%)	
Dust level			
Ineligible	15 (22.7)	51 (77.3)	0.000*
Qualified	55 (74.3)	19 (25.7)	
Ventilation			
Ineligible	15 (25.9)	43 (74.1)	0.000*
Qualified	55 (67.1)	27 (32.9)	
Lighting			
Ineligible	27 (36.5)	47 (63.5)	0.001*
Qualified	43 (65.2)	23 (34.8)	
Humidity			
Ineligible	37 (41.1)	53 (58.9)	0.005*
Qualified	33 (66.0)	17 (34.0)	
Total	70 (50)	70 (50)	

ARIs: Acute respiratory infections. \* $p < 0.05$

Table 4 shows that the incidence of ARI is more common in children aged 0–2 years, and the incidence of ARI has no difference between male and female sexes. Table 5 multivariate analysis shows that dust content ( $p = 0.000$  confidence interval [CI] 95% odds ratio [OR] = 9.56) and ventilation ( $p = 0.001$  CI 95% OR = 6.08) are the main variables that cause ARI in children in Labuan District, Donggala Regency.

**Table 4: Bivariate analysis of acute respiratory infection incidence with characteristics of respondents in Labuan District, Donggala Regency**

Home physical sanitation	ARIs		p
	Yes, n (%)	No, n (%)	
Age (years)			
0–2	54 (58.7)	38 (41.3)	0.004*
3–5	16 (33.3)	32 (66.7)	
Sex			
Male	36 (50.0)	36 (50.0)	1.000
Female	34 (50.0)	34 (50.0)	
Total	70 (50)	70 (50)	

ARIs: Acute respiratory infections. \* $p < 0.05$

After multivariate analysis, dust and ventilation levels were the main proxies for the incidence of ARI related to the Physical Sanitation Condition of Houses in Labuan District, Donggala Regency. Dust levels that do not meet the requirements are a 9.5 times risk factor

**Table 5: Multivariate analysis of acute respiratory infection incidence with physical sanitation conditions of respondents' houses in Labuan District, Donggala Regency**

Variable	B	SE	Wald	df	Significant	Exp (B)
Dust level	2.258	0.441	26.242	1	0.000	9.567
Ventilation	1.806	0.543	11.081	1	0.001	6.087
Lighting	0.350	0.522	0.449	1	0.503	1.419
Humidity	-0.653	0.573	1.300	1	0.254	0.521
Constant	70	50	70	50		

SE: Standard error

for ARI in children under five and under five in Labuan District, Donggala Regency. Likewise, air ventilation that does not meet the requirements is a risk factor 6 times the cause of ARI in infants and toddlers in Labuan District, Donggala Regency.

## Discussion

Environmental factors have a significant impact on the occurrence of ARI. Dust level, air ventilation, lighting, and humidity are four variables that comprise physical home sanitation and are thought to be the cause of ARI. In this study, the physical sanitation conditions of the house that did not meet the requirements above 50% were the dust content and ventilation of the house, while the lighting and humidity conditions of the house were still below 50%. Multivariate analysis showed that dust content ( $p = 0.000$  CI 95% OR = 9.56) and ventilation ( $p = 0.001$  CI 95% OR = 6.08) were the main variables that caused ARI in children in Labuan District, Donggala Regency.

This study recommends that efforts be made to reduce dust exposure, although household dust appears to be a fine layer of dirt, it is actually a mixture of organic components such as sloughed-off skin cells, hair, germs, dust mites, bits of dead bugs, soil particles, and pollen. Toxic substances such as lead, mercury, flame retardants, and asbestos can be found in household dust [22].

Because they frequently play on the ground and put their hands and other objects into their mouths, young children are prone to ingest substantial amounts of dirt and dust. Those objects may be covered in dust or filth.

Risk; the health hazard of children from exposure to house dust can be 100 times higher than that of adults. Children are exposed to more dust and are estimated to be up to 10 times more susceptible to dust exposure. House dust is a major source of Gram-negative bacteria, pesticides, chromium, arsenic, cadmium, phenol, and other Endocrine-disrupting compounds (EDCs), is a mutagen and carcinogen for newborns, as well as a source of allergic exposure. Children who are exposed to contaminants early in life are more likely to develop chronic illnesses such as asthma, lose intellect, and develop cancer. Improved

home cleaning and hand washing can help protect the potential of children who live in locations where soil is contaminated by vehicle and industrial pollution [23]. Deep dust accumulates on the carpet during normal vacuuming, where it might be brought to the surface and become airborne as a result of activities on the carpet. The family can use the 3-point test to monitor deep dust with the vacuum with dirt finder, which helps reinforce good cleaning practices [23].

Cleaning hard surfaces are one of the basic guidelines for educational recommendations to reduce dust exposure in children. It is recommended that once a week, we clean the floor using soapy water, we can use a sponge or paper towel to clean the tin layer; use separate buckets for washing and rinsing water before sweeping wet floors, coat or seal wood floors for smooth and easy cleaning, scrub window sills once a week with soapy water. When children play on the floor, we put a mat or blanket on the floor. Always keep children and their belongings away from windows. Get used to opening windows that are double hung from the top [24].

To clean the surface of the carpet can be done using a vacuum or a vacuum cleaner; we can line the vacuum bag by vacuuming the cornstarch first, do the vacuuming for a long time; when cleaning the carpet can use steam, use a cleaning solution when vacuuming; and if possible old carpets that are heavily contaminated with lead dust can be disposed of with care [24].

The next step in an effort to reduce exposure to dust in the house is to reduce exposure to paint, such as immediately cleaning up loose paint with a damp cloth or disposable cloth; use furniture that is waterproof and easy to clean; cover chipped paint using contact paper; when the kids are playing on the porch, wash it down or put a blanket or rug down; tiny amounts of chipping paint to seal or enclose regions; it is recommended not to use hazardous paint removal procedures by mechanical sanding methods, burning the material with an open flame or possibly removing the chemical methylene chloride. If reduction is really needed, it is recommended to use a safer method to remove paint such as wet sanding or wet scraping [24].

Limiting soil exposure; cover bare dirt with grass, plants, gravel, or wood chips; do not let kids play near the house or garage walls or on bare soil. Allow kids to play in a covered grassy area or sandbox. After playing outside or with pets, children should wash their hands; shoes should be removed before entering the home; and a doormat should be used to prevent dust and filth from tracking into the house [24].

Hands, toys, bottles, and pacifiers should all be washed often, and children should not be allowed to consume food off the floor. For working parents, it is recommended to change into work clothes before returning home or taking a shower at work. In the

practice of washing clothes, work clothes should be washed separately from other clothes; for vehicles, cover the inside of the car with sheets or blankets [24].

In Labuan and Donggala, homes with poor ventilation and indoor air quality are particularly widespread. The previous research has found that the indoor air in these homes can include high levels of CO<sub>2</sub>, cigarette smoke from the outside, and high relative humidity, all of which can lead to mold problems. These situations can lead to a variety of health issues, including tenants' respiratory health being impaired, especially in children with growing respiratory systems [25].

Research in Romania linked summer classrooms with increased risk of allergy and flu-like symptoms, noisy classrooms with increased risk of asthma-like symptoms, and improved outdoor air quality with protective effects against allergens [26]. This also often happens in Labuan and Donggala regencies which have tropical characteristics and are quite hot throughout the year.

The results of this study indicate that it turns out that the level of dust and house ventilation that does not meet the requirements causes children to suffer from ARI in Labuan Donggala which is an interesting finding for further research. The practice of reducing dust levels and improving home ventilation is the efforts needed to overcome the problem of ARI in Donggala Labuan.

## Conclusion

The physical sanitation condition of the house that does not meet the requirements for dust content is 52.9% and home ventilation 58.6%. The lighting conditions are 47.1% and the humidity of the house is 35.7%. Bivariate analysis showed that there was a relationship between dust levels and the incidence of ARI ( $p = 0.000$ ), ventilation conditions with the incidence of ARI ( $p = 0.000$ ), lighting with the incidence of ARI ( $p = 0.001$ ), and humidity with the incidence of ARI ( $p = 0.005$ ) in children in Labuan District, Donggala Regency. The incidence of ARI is more common in children aged 0–2 years, and the incidence of ARI has no difference between male and female sexes. Multivariate analysis showed that dust content ( $p = 0.000$  CI 95% OR=9.56) and ventilation ( $p = 0.001$  CI 95% OR = 6.08) were the main variables that caused ARI in children in Labuan District, Donggala Regency.

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