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Relationship Between Temperature, Rainfall, Humidity and Wind Speed to the Occurrence of ARI in Kisaran Timur District

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ABSTRACT

ISPA is a significant global health problem. The purpose of this study was to determine the relationship between temperature, rainfall, humidity and wind speed with the incidence of ISPA in East Kisaran City in 2024. This study is a quantitative study, with a case control approach. This study was conducted in the working area of the East Kisaran City Health Center. This study was conducted from August 2024 to January 2025. The population in this study was 175 people in East Kisaran City. The research sample was 60 consisting of 30 case samples and 30 control samples. Data collection using questionnaires, observations and direct interviews. The analysis used univariate analysis, in the form of descriptive, bivariate analysis using the chi square test via SPSS software. This study found a significant relationship between temperature and the incidence of ARI in the Kisaran Timur District, (p = 0.00, OR = 13.143), wind speed with the incidence of ARI in the Kisaran Timur District, (p = 0.000,), rainfall with the incidence of ARI in the Kisaran Timur District, (p = 0.016), humidity with the incidence of ARI in the Kisaran Timur District, (p = 0.000, OR = 16.249). In conclusion, in general, weather factors have a significant influence on the incidence of ARI. However, this influence is complex and influenced by various other factors. To prevent ARI, it is important to maintain environmental cleanliness, maintain immunity, and avoid exposure to risk factors such as air pollution.

Keywords: Temperature, Rainfall, Humidity, Wind Speed, ISPA, Kisaran Timur District.

INTRODUCTION

Acute Respiratory Infection (ARI) is a disease that affects the throat, nose, and lungs within a period of about 14 days. ARI can attack the respiratory tract above the larynx. However, most cases involve both parts of the upper and lower respiratory tract simultaneously or consecutively. Usually, viruses are the cause of upper respiratory tract infections, while factors that cause lower respiratory tract infections are such as bacteria, viruses, and mycoplasma. The lower respiratory tract infected by bacteria tends to have more severe clinical symptoms, and can cause many

problems in its handling or management (Khairiyati et al., 2020).

According to (WHO) World Health Organization explains that Acute respiratory tract infection is a significant cause of morbidity and mortality of the largest disease in the world. Nearly 4 million people die each year the largest disease mortality in the world. Nearly 4 million people die each year from acute respiratory tract infections of these deaths 98% are caused by lower respiratory tract infections. Even infant, child and elderly mortality is very high, especially in low and middle poor countries. Acute respiratory tract infection is one of the most common reasons for consultation or treatment in health care facilities, especially children's facilities (WHO, 2020).

ISPA disease is the main cause of morbidity and mortality of infectious diseases in the world and is the disease that causes the third largest death in the world, ten to fifty times in developing countries than in developed countries. ISPA is not pneumonia is one part of the disease that attacks the upper respiratory tract (from the nose to the pharynx). Climate is a supporting factor that influences the occurrence of ISPA.

Acute respiratory tract infection (ARI) is an acute respiratory tract infection that attacks the throat, nose and lungs which lasts approximately 14 days. ARI affects the structure of the tract above the larynx, but most of these diseases affect the upper and lower tracts simultaneously or sequentially. ARI disease occurs due to the interaction between the host agent components and the environment. Changes in a component disrupt the balance. The factors that cause ARI vary widely, the spread and impact of the disease are related to environmental factors, host factors, the availability and effectiveness of health services and infection prevention measures and pathogen characteristics. Based on the activities of toddlers who are more often involved in activities indoors, ARI in toddlers is caused by the environment in the home (Andi Ruhban, et al., 2023).

The data found that in 2021 less than 3000 cases of ISPA were reported, in 2022 it increased by 50,000-70,000 cases. While in 2023 we got the figure at the end of the year or early January reaching 200,000 sufferers, said the Head of the Bureau of Communication and Public Services of the Ministry of Health, Siti Nadia Tarmizi (2023).

Based on Medan City Health Service Data from 2013 to 2022, the highest ISPA cases in 2019 reached 330,088 cases and the lowest cases in 2021 were 185,621 cases. However, in 2022 ISPA cases increased and were the second highest cases at 286,635 cases (Medan City Health Service, 2022).

The incidence of ARI in Asahan Regency in 2023 continued to increase, at least 480 male babies

and 640 female babies came into contact with ARI, of which 184 cases occurred in Kedai Ledang Village, 160 cases in Sentang, 185 cases in Selawan, 175 cases in Mutiara, 177 cases in Siumbut Baru, and 177 cases in Siumbut Umbut (Profile of the Regional Technical Implementation Unit (UPTD), Mutiara Health Center, 2023).

As an environmental component that has a very large influence on health, air pollution in the house will trigger the presence of ISPA. The characteristics of the air in the house are influenced by the roof, air vents, density of housing, and humidity (DKPS, 2019).

According to Achmadi (2012), increasing temperatures can cause changes in the pattern of disease transmission and parasites, both transmitted by disease and through vectors. Increasing greenhouse gas concentrations can cause climate change that can affect the pattern of disease transmission and increase the risk of infection in vulnerable age groups, namely children and the elderly. The increase in the spread of infectious diseases is caused by disease pathogens (viruses, bacteria, or other parasites), as well as vectors (insects or rodents) that are sensitive to temperature, humidity, and environmental conditions. Climate change can have an impact on individual health by increasing the frequency of respiratory and cardiovascular diseases. This fact indicates a strong link between climate and disease, especially infectious diseases.

Based on these studies and the high cases of ARI in East Kisaran City and the climate change that has occurred, this underlies that climate change affects the incidence of ARI, so it is necessary to study the relationship between climate elements including temperature, humidity, and rainfall with the incidence of ARI in East Kisaran City. The results of this study will be a reference for agencies or local governments in creating programs related to climate in order to minimize the incidence of ARI.

METHOD

This type of research is quantitative research, with a case control approach. Case control is a study conducted by comparing two groups, namely the case group and the control group (Notoatmodjo, 2010). Case control studies are conducted by identifying the control group and the treatment group, while the control group is not given exposure. This study was conducted to determine "The relationship between temperature, rainfall, humidity and wind speed to the incidence of ARI in Kisaran Timur District".

In this study, data collection was conducted through interviews and observations. The data were

then processed using SPSS and analyzed with univariate analysis to describe the frequency of each variable that had been obtained, and bivariate analysis obtained with chi square test analysis to determine the relationship between independent and dependent variables.

RESULTS AND DISCUSSION

Temperature

Table 4.1 Results of Temperature Variable Analysis

Variables	Case		Control	
	N	%	N	%
Temperature				
1. Not eligible>18ºC or >30ºC	23	38.3	6	10.0
2. Qualify(18ºC-30ºC)	7	11.7	24	40.0
Total	**30**	**100**	**30**	**100**

Source: Primary Data 2024

Table 4.1 shows that as many as 23 (38.3%) of the temperatures in the houses of the case group did not meet the requirements, as many as 7 (11.7%) of the case group's temperatures in the houses met the requirements and as many as 24 (40.0%) of the temperatures in the houses of the control group met the requirements.

Wind velocity

Table 4.2 Results of Wind Speed Variable Analysis

Variables	Case		Control	
	N	%	N	%
Wind velocity				
1. Fast (>20 km/h)	3	5.0	8	13.3
2. Moderate (11-20 km/h)	22	36.7	6	10.0
3. Calm (0-10 km/h)	5	8.3	16	26.7

Total	**30**	**100**	**30**	**100**

Source: Primary Data 2024

In table 4.2, as many as 22 (36.7%) wind speeds in the case group are classified as Moderate, as many as 16 (26.7%) wind speeds in the control group are in the Calm category, and as many as 3 (5.0%) in the case group wind speeds are classified as Strong, and as many as 8 (13.3%) in the control group wind speeds are classified as Strong.

Rainfall

Table 4.3 Results of Rainfall Variable Analysis

Variables	Case		Control	
	N	%	N	%
Rainfall				
Low (<250 mm)	6	10.0	5	8.3
Medium (800 mm-1500 mm)	20	33.3	11	18.3
Height (>2000 mm-3000 mm)	4	6.7	14	23.3
Total	**30**	**100**	**30**	**100**

Source: Primary Data 2024

In table 4.3, it is known that 20 (33.3%) of the rainfall in the case group is in the Moderate category, 14 (23.3%) of the rainfall in the control group is High, and 6 (10.0%) of the rainfall in the case group is classified as Low.

Humidity

Table 4.4 Results of Humidity Variable Analysis

Variables	Case		Control	
	N	%	N	%
Humidity				
1 Not eligible if (<40% Rh or >60% Rh)	23	38.3	5	8.3
2 Eligible if (40% Rh- 60% Rh)	7	11.7	25	41.7

Total	**30**	**100**	**30**	**100**

Source: Primary Data 2024

In table 4.5, it is known that 23 (38.3%) case groups do not meet the requirements for humidity in the home area, 5 (8.3%) control groups do not meet the requirements for humidity in the home area, and 25 (41.7%) control groups for humidity in the home area meet the requirements.

Relationship between Temperature and the Incidence of ARI

Table 4.5 Relationship between Temperature and the Incidence of ARI

Temperature	Incident ISPA				Amount		OR (95% CI)	*p*Value
	ISPA		No ISPA					
	N	%	N	%	N	%		
Not eligible (>18ºC or >30ºC)	23	38.3	6	10.0	29	48.3	13,143 (3,837-45,023)	0,000
Qualify(18ºC-30ºC)	7	11.7	24	40.0	31	51.7		
Total	**30**	**50.0**	**30**	**50.0**	**60**	**100**		

Source: Primary Data 2024

It is known in table 4.6 the results of the Chi-Square test analysis that there is a significant relationship between Temperature and the Incidence of ARI with a P-Value of 0.000 (<0.05). A total of 23 (38.3%) people with ARI have a house temperature that does not meet the requirements, 24 people without ARI have a house temperature that meets the requirements, and 7 (11.7%) people without ARI have a house temperature that does not meet the requirements. Based on the OR value = 13.143 where the house temperature that does not meet the requirements has a risk of 13.143 times causing someone to get ARI.

Relationship between Wind Speed and ISPA Incidents

Table 4.6 Relationship between Wind Speed and ISPA Incidents

Wind velocity	Incident ISPA				Amount		*p*Value
	ISPA		No ISPA				
	N	%	N	%	N	%	
Fast (>20 km/h)	3	5.0	8	13.3	11	18.3	
Moderate (11-20 km/h)	22	36.7	6	10.0	28	46.7	0,000
Calm (0-10 km/h)	5	8.3	16	26.7	21	35.0	
Total	**30**	**50.0**	**30**	**50.0**	**60**	**100**	

Source: Primary Data 2024

The results of the analysis in Table 4.7 found a significant relationship between Wind Speed and the occurrence of ARI with a P-Value of 0.000 (<0.05), it was found that 22 (36.7%) people who experienced ARI felt the wind speed in the Moderate category (11-20 km/hour), while in people who did not experience ARI, 28 (46.7%) people felt the wind speed in the Moderate category, and 3 (5.0%) people who experienced ARI felt the wind speed in the Strong category (>20 km/hour).

Relationship between Rainfall and ISPA Incidence

Table 4.7 Relationship between Rainfall and ISPA Incidence

Rainfall	Incident ISPA				Amount		*p*Value
	ISPA		No ISPA				
	N	%	N	%	N	%	
Low (<250 mm)	6	10.0	5	8.3	11	18.3	
Medium (800 mm-1500 mm)	20	33.3	11	18.3	31	51.7	0.016
Height (>2000 mm-3000 mm)	4	6.7	14	23.3	18	30.0	

Total	**30**	**50.0**	**30**	**50.0**	**60**	**100**

Source: Primary Data 2024

The results of the analysis in table 4.8 showed a significant relationship between rainfall and the incidence of ARI with a P-Value of 0.016 (<0.05). It is known that 20 (33.3%) people who experienced ARI found rainfall in the Moderate category, 14 (23.3%) people who did not experience ARI found rainfall in the High category, and 6 (10.0%) people who experienced ARI found rainfall in the Low category.

4. Relationship between Humidity and the Occurrence of ARI

Table 4.8 Relationship between Humidity and the Incidence of ARI

Humidity	Incident ISPA				Amount		OR (95% CI)	*p*Value
	ISPA		No ISPA					
	N	%	N	%	N	%		
Not eligible (<40% Rh or >60% Rh)	23	38.3	5	8.3	28	46.7	16,429 (4,569-59,073)	0,000
Eligible (40% Rh- 60% Rh)	7	11.7	25	41.7	32	53.3		
Total	**30**	**50.0**	**30**	**50.0**	**60**	**100**		

Source: Primary Data 2024

It is known that the analysis results in table 4.9 show a significant relationship between Humidity and the Incidence of ARI with a P-Value of 0.000 (<0.05). It is known that as many as 23 (38.3%) people who experience ARI have Humidity at home that does not meet the requirements, as many as 25 (41.7%) people who do not experience ARI have Humidity at home that meets the requirements, as many as 7 (11.7%) people who experience ARI have Humidity at home that meets the requirements, and as many as 5 (8.3%) people who do not experience ARI have humidity at home that does not meet the requirements. Based on the OR value, humidity at home that does not meet the requirements has a risk of 16.429 times causing someone to experience ARI.

Discussion

Relationship between Temperature and the Incidence of ARI

In this study, a significant relationship was found between Temperature and the Incidence of ISPA in Kisaran Timur District with a P-Value of 0.000 (<0.05). Unqualified house temperatures have a risk of 13.143 times causing someone to get ISPA with an OR value of 1.143; Cl 95% = 3.837-45.023. In another study by(Ernawati et al., 2022)There is a relationship between the temperature of toddlers' bedrooms and the incidence of ISPA in toddlers in Cigedug District, Lebakwangi Health Center Work Area. This is not in line with research.(Mulyati et al., 2024)which states that there is no relationship with the occurrence of ISPA in residents around the airport. Based on the results of the research(Syahaya et al., 2021)stated that room temperature that does not meet the requirements has a risk of ARI 28.9 times greater than room temperature that meets the requirements with an OR value = 28.900; 95% CI = 5.987 – 139.497.

As many as 23 (38.3%) people who had ARI had a house temperature that did not meet the requirements, as many as 24 people who did not have ARI had a house temperature that met the requirements, and as many as 7 (11.7%) people who did not have ARI had a house temperature that did not meet the requirements. Theory in the study(Princess, 2021)The Staphylococcus type of bacteria that causes ARI grows well at a temperature of 37ºC. The temperature limits for its growth are 15ºC and 40ºC, while the optimum growth temperature is 35ºC.

According to the researcher's assumption, the indoor air temperature in Kisaran Timur District is quite hot because rainfall is relatively low. The hot air temperature is also influenced by the area of ventilation in the respondent's house which does not meet the requirements. If a house is equipped with ventilation that meets health requirements, the air circulation process will not be disturbed, so it does not increase the air temperature in the house.

Relationship between Rainfall and ISPA Incidence

In this study, a significant relationship was found between rainfall and the incidence of ARI in Kisaran Timur District with a P-Value of 0.016 (<0.05). In this study(Bonita, 2021)getting rainfall has a significant positive pattern of moderate correlation with the incidence of ISPA not pneumonia. In the study(Aini & Purwasari, 2020)There is no relationship between air temperature and ISPA in Muaro Jambi Regency.

It is known that 20 (33.3%) people who experienced ISPA found rainfall in the Moderate category, 14 (23.3%) people who did not experience ISPA found rainfall in the High category, and 6 (10.0%) people who experienced ISPA found rainfall in the Low category. According to the theory in the study(Apriliani & Mustafidah, 2021)The number of parasites that infect humans is on average in tropical and subtropical areas that have hot and humid temperatures, rainfall and wind can be determinants of the elimination of pollutants that cause 3 Acute respiratory tract infections.

Based on the results of observations, rainfall in the East Kisaran area tends to be in the Moderate category (800 mm-1500 mm) due to unstable weather and only a few times a month it rains. According to researchers, there is a relationship between rainfall and the occurrence of ARI, namely because when it rains, the air can carry dust particles and pollutants down to the surface. Based on the opinion in the study (Rudianto, 2021)which explains that in urban areas, rainwater can carry pollutants from the soil, vehicles, and factories back into the air when the rain stops. This pollution can trigger respiratory tract irritation and facilitate the occurrence of ARI infections.

Relationship between Humidity and the Occurrence of ARI

In this study, a significant relationship was found between Humidity and the Incidence of ARI in Kisaran Timur District with a P-Value of 0.000 (<0.05). Based on the OR value, house humidity that does not meet the requirements has a risk of 16.429 times causing someone to experience ARI compared to house humidity that meets the requirements. In line with the study(Ullya & Sari, 2021)who found a very significant relationship between humidity and ISPA in toddlers in Kebun Kenanga Village, Bengkulu City. And explained that humidity that does not meet the requirements has an 8.6 times greater risk of experiencing ISPA compared to humidity that meets the requirements.

It is known that 23 (38.3%) people who experienced ISPA had house humidity that did not meet the requirements, 25 (41.7%) people who did not experience ISPA had house humidity that met the requirements, 7 (11.7%) people who experienced ISPA had house humidity that met the requirements, and 5 (8.3%) people who did not experience ISPA had house humidity that did not meet the requirements. Based on the theory in the study(Najmi, 2021)Humidity influences the process of spreading airborne diseases because it can accelerate the growth of viruses, bacteria or fungi that cause respiratory tract infections.

According to researchers, there is a close relationship between indoor humidity and the incidence of Acute Respiratory Infections (ARI). One of the main contributing factors is the habit of people who rarely open windows or ventilate their homes, making it difficult for sunlight to enter the room. This condition creates a humid environment that is ideal for the growth of pathogenic microorganisms that can cause ARI.

Relationship between Wind Speed and ISPA Incidents

In this study, a significant relationship was found between Wind Speed and the occurrence of ISPA in Kisaran Timur District with a P-Value of 0.000 (<0.05). In this study(Khairiyati et al., 2020)There is no significant relationship between wind speed and the incidence of ARI in Banjarmasin City in 2012-2016. In the study(Ernyasih et al., 2021)found no significant relationship between air wind speed and ISPA cases in DKI Jakarta in 2011-2015.

The results of this study showed that 22 (36.7%) people who experienced ARI felt wind speeds in the Moderate category (11-20 km/hour), while in people who did not experience ARI, 28 (46.7%) people felt wind speeds in the Moderate category, and 3 (5.0%) people who experienced ARI felt wind speeds in the Strong category (>20 km/hour). This is in accordance with the theory in the study(Ernyasih et al., 2021)which states that the distribution of disease and the increase of organisms are influenced by physical factors such as wind as well as biotic factors such as vegetation and human intervention.

According to wind speed observations in the Kisaran Timur district, Seidang (11-20 km/hour) and Teinang (0-10 km/hour). Wind speeds in the moderate category are usually sufficient to help air circulation in open environments, which can bring a cooling effect during the day. Reispoindein's opinion states that recent weather conditions are not normal, sometimes hot, sometimes rainy. According to the researcher's assumption, the relationship between wind speed and the incidence of ARI is because natural ventilation that relies on wind flow is also less effective in calm wind conditions. Indoor air becomes stuffy and allows the accumulation of household pollutants, such as smoke from cooking, dust, and allergens, all of which can trigger or worsen ARI. In line with the theory in the study(Aini & Purwasari, 2020)which explains that in temperate climates, respiratory diseases are most common in the winter months.

CONCLUSION

Based on the results of research on the community in the East Kisaran District, the following conclusions were obtained:

1. There is a significant relationship between temperature and the incidence of ARI in the Kisaran Timur District, (p=0.00, OR=13.143)
2. There is a significant relationship between wind speed and the occurrence of ARI in the Kisaran Timur District, (p=0.000,)
3. There is a significant relationship between rainfall and the incidence of ARI in the Kisaran Timur District (p=0.016)
4. There is a significant relationship between humidity and the incidence of ARI in the Kisaran Timur District (p=0.000, OR=16.249)

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