



The Relationship of Acute Respiratory Infectional Diseases (ARI) With Climate (Rainfall, Air Quality, And Lighting) In Indonesia: Literature Review

Yahdi Fitrah Ridha¹, Ramadhan Tosepu², R. Azizah¹, Mhd. Izzan Naser¹

¹Department of Environmental Health, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

²Department of Environmental Health, Faculty of Public Health, Universitas Haluoleo, Kendari, Indonesia

Article Info	Abstract
<p>Article history:</p> <p>Received: Month XX, 20XX Revised: Month XX, 20XX Accepted: Month XX, 20XX (Garamond 9)</p> <hr/> <p>Keywords:</p> <p>Acute Respiratory Infection (ARI) Climate Factors Rainfall and Humidity Air Quality Indonesia Public Health</p>	<p>BACKGROUND: Acute Respiratory Infection Disease (ARI) is a leading cause of mortality among children and toddlers in underdeveloped nations. Acute respiratory infection (ARI) has the potential to be transmitted via various viral agents, including Rotavirus and Influenza virus, as well as bacterial pathogens such as Streptococcus pneumoniae and Staphylococcus aureus. The age cohorts that exhibit susceptibility to Acute Respiratory Infections (ARI) include infants aged 0-12 months and toddlers aged 12-59 months, who are particularly prone to pneumonia. AIM: The objective of this study is to perform a comprehensive literature review pertaining to the impact of rainfall, air quality, and lighting on the occurrence of Acute Respiratory Infections (ARI) in Indonesia. METHODS: This study employs a Scoping Review methodology by utilizing the Google Scholar database and Academia.edu platform. A total of 49 journals were initially identified and subsequently narrowed down to 11 journals with matching titles. These 11 journals were then further assessed for eligibility based on the predetermined criteria set by the author, resulting in the selection of 6 journals. RESULTS: Evaluation of the research literature shows that there is a clear correlation between high rainfall, humidity and lighting on the occurrence of Acute Respiratory Infections (ARI). CONCLUSION: The occurrence of intense precipitation has the potential to amplify the incidence of acute respiratory infections (ARI) due to the resultant cold, Insufficient illumination and damp conditions in the affected region, especially in Indonesia.</p>

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INTRODUCTION

Acute Respiratory Infections (ARI) primarily afflict children residing in both developing and developed nations that possess a relatively higher socioeconomic status. A significant proportion of these children necessitate hospitalization due to the severity of their illnesses. Respiratory tract disorders occurring throughout infancy and youth have the potential to result in long-term impairments that persist into adulthood (1).

Acute Respiratory Infections (ARI) represent a prevalent cause of mortality among children residing in underdeveloped nations. Roughly 4 out of 15 million predicted fatalities occur annually among children under the age of 5, with two-thirds of these deaths specifically affecting babies. Acute Respiratory Infections (ARI) are a significant contributor to mortality rates among children residing in underdeveloped nations. Roughly 4 out of 15 million predicted fatalities occur annually among children under the age of 5, with two-thirds of these deaths specifically affecting babies (2).

Acute respiratory infection (ARI) is a contagious disease that affects various components of the respiratory system, ranging from the nasal passages to the alveoli in the lungs. This includes adjacent tissues such as the paranasal sinuses, middle ear canal, and pleura (3). Acute lower respiratory infection (ALRI) is a significant contributor to both morbidity and mortality in children, particularly in regions with limited resources and infrastructure for healthcare. Acute respiratory infection (ARI) ranks as the third most prevalent cause of mortality globally, accounting for 7.1% of all deaths. Notably, ARI assumes the foremost position as the primary cause of death in developing nations, responsible for 11.2% of fatalities (4). The user's text is too short to be rewritten academically. Indonesia is positioned as the sixth country globally with the highest number of instances of ARI, following India, China, Pakistan, Bangladesh, and Nigeria (5).

Children under five years of age (toddlers) are an age group that is vulnerable to nutrition and health. At this time, the child's immune system is still not strong, so the risk of the child suffering from infectious diseases

is higher. Infectious diseases that often occur in children under five include acute respiratory infections (ARI) (6).

Acute Respiratory Infection (ARI) is a disease that causes morbidity and even death throughout the world. According to WHO, that ± 13 million children under five in the world die every year and most of these deaths were in the State developing in Asia and Africa such as: India (48%), Indonesia (38%), Ethiopia (4.4%), Pakistan (4.3%), China (3.5%), Sudan (1.5%), and Nepal (0.3%) (4). Where is ARI is one of the main causes of death with kills ± 4 million of ± 13 million children under five every year (Yuhendri and Sekar Sri., 2019). In Indonesia, ARI always occupies the first position out of 10 cases disease with the highest number. The 2018 Riskesdas results reported that the prevalence of ARI was 9.3%. The population groups with the highest incidence of ARI occurred in 3 age groups, namely 1-4 years old at 13.7%, 15-24 years old at 10.6% and 9.6% at 65-74 years old. According to gender, there is no significant difference between men and women, namely 9.0% for men and 9.7% for women (7).

Climate is a synthesis of weather events over a long period of time, which is statistically sufficient to be used to indicate a statistical value that is different from a situation at any time (8). Climate occurs over a long period of time, generally 11-30 years, which is caused by the geographical location and topography of an area which influences the position of the sun towards areas on earth (9).

The position of the sun in the equator causes a tropical climate, while areas that receive little sun will cause a polar (cold) climate. Therefore, planet Earth has several climates based on the relative position of a place and differences and patterns of changes in air temperature. Several types of climate include: Tropical climate located between $0^{\circ} - 23\frac{1}{2}^{\circ}$ N/S. The characteristics of a tropical climate are that the average air temperature is high, because the sun is always vertical. The sub-tropical climate is located between $23\frac{1}{2}^{\circ} - 40^{\circ}$ N/S. This area is a transition between tropical and temperate climates⁸. The characteristics of a sub-tropical climate are that there are four seasons, namely summer, winter, autumn and spring. The temperate climate is located between $40^{\circ} - 66\frac{1}{2}^{\circ}$ N/S. The characteristics of a temperate climate are that there are many cyclonal air movements, air pressure that often changes, the direction of the blowing wind changes erratically, and sudden storms often occur. The cold climate (Pole) is located between $66, 5^{\circ}$ N- 90° N and 66.5° S- 90° S. The characteristics of the polar climate are that the cold winters are long and the cool summers are short. The temperature is constantly so low that there is eternal snow (10).

The last eleven years have been the warmest in global surface temperatures since 1850. The average rate of warming over the last fifty years is almost double the average of the last hundred years. Global average temperatures rose by 0.740C during the 20th century, with warming felt more in land areas than in oceans. The problem currently facing humans is that since the industrial revolution began 250 years ago, greenhouse gas (GHG) emissions have increased and increased GHG emissions in the atmosphere at a significant increasing rate. This has resulted in the largest change in atmospheric composition for 650,000 years. The global climate will continue to warm at a rapid rate in the coming decades, unless efforts are made to reduce GHG emissions into the atmosphere. The greenhouse effect occurs because sunlight in the atmosphere vibrates greenhouse gas molecules so that solar radiation energy is absorbed by these molecules. The solar radiation energy should be returned to space, but because of the presence of greenhouse gases, the solar radiation energy is trapped in the atmosphere and causes an increase in the earth's temperature (11).

Air quality is very important for human life, both indoors and outdoors. Decreased air quality has negative implications for human health, the emergence of various diseases such as respiratory tract infections (ARI), cancer and heart disease (12). Therefore, the objective of this study is to perform a comprehensive literature review relating to the impact of rainfall, air quality, and lighting on the occurrence of Acute Respiratory Infections (ARI) in Indonesia.

METHOD

The methodology employed in this scholarly publication involves conducting an electronic search for data and information from multiple sources, including Google Scholar and academia.edu. The search is conducted using specific keywords, namely: the correlation between climate and ARI, the association between rainfall and ARI, the connection between humidity and ARI, the link between air temperature and ARI, and the relationship between wind speed and ARI. The search results yielded a collection of 49 journals pertaining to ARI, which were subsequently consolidated into a single folder. A screening process was then conducted to determine the extent of title overlap among the journals.

RESULTS AND DISCUSSION

The process of data extraction involves the analysis of several data elements, such as the author's name, title, objectives, research methods, and outcomes. This analysis aims to identify and group significant data

points within the publication. The outcomes of the process of data extraction are observable in the following location.

Table 1. The findings of the research indicate

No	Authors/ Year	Title	Aim	Method	Result
1.	Resta Lestari, Budiyono, Nikie Astorina Yunita Dewanti / 2018 (13)	Comparison of the incidence of acute respiratory infection in children under five in the hilly and coastal areas of Semarang City in terms of climate components in 2012 - 2016	The objective of this study is to investigate and compare the incidence of ARI (Influenza-Like Illness) among children residing in mountainous areas and coastal areas within the city of Semarang.	The present study employs analytical techniques and adopts a cross-sectional research strategy. The study was carried out within the operational jurisdiction of the Mijen Community Health Center and Community Health Center.	The prevalence of ARI in the operational jurisdiction of the Mijen health center among young children from 2012 to 2016 has exhibited an upward trend, but in the Bandarharjo health center, it has seen a decline. The data collected from 2012 to 2016 indicates a notable rise in the air temperature in the regions of Mijen and Bandarharjo. Conversely, the humidity levels in these areas throughout the same period have exhibited a relatively consistent pattern.
2.	Ernyasih, Fini Fajrini, Noor Latifah / 2018 (11)	Analysis of the Relationship between Climate (Rainfall, Humidity, Air Temperature and Wind Speed) with ARI Cases in DKI Jakarta 2011 – 2015	The objective of this study is to examine the correlation between climatic factors, specifically rainfall, humidity, air temperature, and wind speed, and the incidence of ARI cases.	The research methodology employed in this study is an ecological study design with a temporal dimension.	The findings of the study indicate that the month with the largest number of monthly ARI instances between 2011 and 2015 was January 2011, with a total of 223,394 individuals affected. Conversely, the month with the lowest number of monthly ARI cases was October 2012, with a recorded count of 61,442 individuals affected
3.	Milawati Yusuf, Putu Sudayasa, Tomy Nurtamin / 2016 (14)	The study examines the correlation between the home environment and the occurrence of acute respiratory infections (ARI) in coastal communities, specifically focusing on Lapulu Village in the Abeli District during the year 2014.	In order to ascertain the correlation between the domestic environment and the prevalence of acute respiratory infections (ARI) within coastal populations, the Lapulu sub-district and Abeli sub-district are being investigated.	The present work employs an observational analytical approach, utilizing a cross-sectional study design. The study was conducted at Lapulu Village throughout the period of November to December 2014. The total population consisted of 983 households, from which a representative sample of 88	With a significance level of $\alpha=0.05$ and the statistical tests yielding a p-value of $p=0.001$ using the Chi-square test, it may be inferred that there is a significant relationship or association between the variables under investigation.

				households was selected using a proportional sampling method. The historical background of long-distance travel predates the commencement of formal research. During the period under investigation, the housewife in question was absent and expressed a lack of willingness to participate as a sample. The present study employs a set of exclusion criteria as a representative sample.	
4.	Dedi Mahyudin Syam, Ronny / 2016 (15)	The Influence of Temperature, Humidity, and Lighting on the Risk of Acute Respiratory Infections in Toddlers in the Balaesang District, Donggala Regency.	The objective of this study is to investigate the potential association between temperature, humidity, and lighting conditions and the occurrence of Acute Respiratory Infections (ARI) among toddlers residing in the Balaesang District of the Donggala Regency.	The research conducted in this study follows an observational analytic approach with a case-control study design. It involves the examination of risk variables through retrospective observations to analyze the relationship between these factors and the incidence of Acute Respiratory Infections (ARI) in toddlers residing in the Balaesang District of Donggala Regency during the year 2015.	The obtained p-value, which is below than the predetermined significance level α , indicates a statistically significant association between housing temperature and the incidence of ARI in toddlers residing in the Balaesang District. In the interim, the observed odds ratio (0.18) was obtained. Insufficient illumination has the potential to extend the viability of microorganisms present in airborne droplet nuclei. The findings of the study indicated that there were 33 toddlers residing in households that failed to fulfill the prescribed illumination standards. In the context of ARI incidence in toddlers, it was observed that 66.0% (n=33) of toddlers residing in households that do not meet lighting requirements experienced ARI. Conversely, 34% (n=17) of toddlers residing in such households did not experience ARI. Among

					the toddlers residing in households that meet lighting requirements, 26.0% (n=13) experienced ARI, while 74% (n=37) did not experience ARI. These findings were based on a sample of 50 toddlers who did not experience ARI.
5.	Lara Sati, Elvi Sunarsih, A. Fickry Faisya / 2015 (16)	This study examines the correlation between indoor air quality within the dormitories of Islamic boarding schools and the occurrence of acute respiratory illnesses in Raudhatul Ulum and Al-Ittifaqiah Islamic boarding schools located in Ogan Ilir Regency during the year 2015.	The objective of this study is to investigate the correlation between the indoor air quality in dormitories of Islamic boarding school students and the prevalence of acute respiratory infections inside Islamic boarding schools located in the Raudhatul Ulum and Al-Ittifaqiah areas of the Ogan Ilir district.	The present study employs a quantitative approach and adopts a cross-sectional methodology. The study was conducted within the premises of the female student dormitories at the Raudhatul Ulum and Al-Ittifaqiah Islamic Boarding Schools. The study's population consisted of only female students enrolled in two Islamic boarding schools, with a total sample size of 72 female students. The study focuses on examining the relationship between the incidence of ARI (Influenza-like Illnesses in School-Aged Children) among female students and several independent variables. The independent variables encompass physical air quality factors such as temperature, lighting, humidity, and ventilation rate, as well as biological air quality factors including air germ numbers.	The statistical analysis employed the Chi-square test to evaluate the data. Upon conducting an investigation, it was determined that there exists no statistically significant correlation between the quantity of airborne microorganisms in a room and the occurrence of Acute Respiratory Infections (ARI). This conclusion is supported by the observation that the p-value (0.170) exceeds the predetermined significance level (alpha) of 0.05. The findings of this study align with the research conducted by Meliza (2013), wherein the obtained p-value of 0.006 indicates a lack of statistical significance in the association between the quantity of airborne germs and the occurrence of acute respiratory infections (ARI). The findings from the observations indicate that there is no statistically significant correlation between the quantity of airborne microorganisms and the occurrence of Acute Respiratory Infections (ARI) within the female student dormitories at Raudhatul Ulum Islamic Boarding School and Al-Ittifaqiah. Upon examining the prevalence of acute respiratory infections

<p>Additionally, the study considers residential density, room cleaning behavior, and opening behavior as independent variables. The term "window" refers to a transparent opening in a wall or door that allows light. The employed sample strategy is random sampling, specifically utilizing the Stratified sampling method.</p>	<p>(ARI) among female students, it has been observed that the incidence is significantly higher in dormitory rooms that fail to meet the specified air germ rate requirements. Specifically, approximately 60% of ARI cases occur in dormitories that do not adhere to the air germ rate standards outlined in Minister of Health Regulation No. 1077/MENKES/PER/V/2011, which sets a maximum threshold of <700 CFU/m³.</p>
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A positive correlation exists between the occurrence of ISPA and rainfall, with a correlation coefficient of 0.871. The occurrence of Acute Respiratory Infections (ARI) may be influenced by variations in precipitation levels, namely low and high rainfall (13). According to Deng S Z et al research, it has been suggested that the rise in respiratory infections could perhaps be attributed to elevated levels of precipitation, leading to a decrease in temperature within a given region. The occurrence of respiratory illnesses tends to rise during the rainy season in tropical regions. Insufficient precipitation can lead to the occurrence of drought, resulting in an elevated presence of air pollutants. Motorized vehicles represent a mode of transportation that relies on the utilization of fossil fuels, which serve as the primary source for the generation of nitrogen oxide gas, hydrocarbons, and carbon monoxide. In addition, motorized vehicles emit sulfur dioxide gas and incorporate tetraethyl lead, a lead-based substance utilized as an additive in substandard gasoline (17).

A statistically significant association was observed between rainfall ($p = 0.013$) and the incidence of ARI cases in DKI Jakarta from 2011 to 2015. The correlation coefficient ($r = 0.318$) indicated a moderate positive link, suggesting that higher levels of rainfall were associated with an increase in ARI instances. The occurrence of intense precipitation has the potential to elevate the incidence of upper respiratory tract infections (ARI) due to the resultant cold and damp conditions in the affected region (11). Climate changes, such as the occurrence of intense precipitation, have the potential to amplify the emergence of novel illnesses and acute respiratory infections (ARI) (18). This finding aligns with the research undertaken by Mailepessov et al which shown a statistically significant negative correlation between temperature and rainfall, and the incidence of ISPA. A substantial U-shaped correlation was seen between relative humidity and acute respiratory infections (ARI). The findings from prior study are confirmed by the consistent influence and shape of the association between all meteorological indicators evaluated and the Annual Rainfall Index (ARI) up to a lag of 3 (19).

Theoretically, an increase in precipitation levels may have an impact on the prevalence of respiratory disorders (20). The occurrence of heavy precipitation can result in increased moisture levels within residential structures, hence leading to dampness. This issue is particularly prevalent among individuals residing in densely populated regions, as inadequate ventilation and sanitation practices contribute to the development of respiratory ailments. The density of housing during the rainy season has a significant impact on the occurrence of cross infection. In such conditions, individuals who are affected by an infectious disease and are in close proximity to one another inside the same room might accelerate the transmission process through coughing or sneezing, thereby facilitating the spread of the infection to others (21).

The statistical study utilizing the Chisquare test indicated that there exists no statistically significant association between the quantity of airborne microorganisms in a room and the occurrence of ISPA, as evidenced by the p-value (0.170) being greater than the predetermined significance level (alpha) of 0.05 (10). This study aligns with the research conducted by Meliza (2013), where the obtained p-value of 0.006 indicates the absence of a statistically significant association between the quantity of airborne germs and the occurrence of ISPA. Indoor air pollution can arise from two primary sources: equipment emissions and human activities. Equipment emissions contribute to air pollution through the release of particulate matter, while human activities contribute to biological air pollution. The latter can lead to the transmission of various diseases caused by viruses, bacteria, protozoa, and/or worms (22).

Poor air quality is a significant factor that influences the occurrence of high incidence of ISPA in a certain environment or region. The criterion utilized to assess air quality in terms of particulate matter is the dust parameter, specifically PM₁₀. The elevated values of the PM₁₀ measure can be attributed to the diminished levels of precipitation observed in the region (23). In September of 2005, the recorded rainfall reached its lowest point at 0.7 units, while the PM₁₀ air quality measure registered its lowest level of 138.75 units. The data presented indicates a positive correlation between high ARI numbers and high PM₁₀ air quality levels, as well as a negative correlation with rainfall levels. In the year 2006, the month of August experienced the lowest recorded rainfall, with a value of 1.28. Conversely, the months of October, November, and September exhibited the highest levels of air quality, specifically in terms of PM₁₀ parameters, with values of 902.73, 377.23, and 228.94, respectively. Additionally, the highest ARI figure, denoting a certain metric, was seen in the month of August, reaching a value of 16.76. The year 2007 witnessed the occurrence of the lowest recorded rainfall in the month of August, with a value of 1.28. Additionally, September exhibited the greatest level of PM₁₀ air quality, reaching a figure of 22.61. Furthermore, the highest ARI value was observed in January, measuring at 24.03. In the year 2008, the month of August experienced the lowest recorded rainfall figure of 4.0, while the month of September had the highest PM₁₀ air quality figure of 22.56. Additionally, the highest ARI figure of 10.0 was observed in the month of June. Moving on to the year 2009, the lowest recorded rainfall figure of 2.7 was observed in August, while the highest PM₁₀ air quality figure of 420.8 was recorded in September. Furthermore, the highest ARI figure of 15.85 was observed in August. Finally, in the year 2010, the lowest recorded rainfall figure of 13.77 occurred in August, while the highest PM₁₀ air quality figure of 12.97 was observed in the same month. Additionally, the highest ARI figure of 13.32 was recorded in December (24).

Insufficient illumination has the potential to extend the viability of microorganisms present in airborne droplet nuclei. The findings of the study revealed that there were 33 toddlers residing in households that failed to fulfill the prescribed illumination standards. In the context of ISPA incidence among toddlers, it was observed that 66.0% (n=33) of toddlers residing in households that fail to meet lighting requirements experienced ISPA. Additionally, 34% (n=17) of the total 50 toddlers in such households were affected by ISPA. Conversely, among the 50 toddlers who did not suffer from ISPA, 26.0% (n=13) resided in houses with adequate lighting, while the remaining 74% (n=37) did not experience ISPA despite living in houses that met the lighting requirements. According to the results of the Odds Ratio test, the calculated Odds Ratio (OR) is 0.181, with a lower limit value of 0.076 and an upper limit value of 0.428. These findings indicate that illumination is a statistically significant risk factor. As stated by the Department of Human Settlements and Regional Infrastructure (2002), the assessment of daytime natural lighting quality is influenced by various factors, including the provision of a minimum light aperture per tenth of the room's floor area and the requirement for at least one hour of direct sunlight penetration into the room. In addition to this, the arrangement of furniture inside the space and the spatial division of the area also exert an influence (15).

Based on the statistical tests conducted using Chi-square, with a significance level (α) of 0.05, the resultant p-value of 0.001 suggests a significant link between natural illumination and the incidence of ISPA in the coastal communities of Lapulu, Abeli District. The number 24 is the value provided by the user (14). This study aligns with the research conducted by Yustati (2020), which establishes a correlation between natural illumination and the occurrence of ISPA in toddlers residing in the villages of Sidomulyo and Penjaringan Sari. The statistical analysis yielded p-values of 0.027 and 0.047 for the respective villages, both of which were found to be statistically significant (p-value < 0.05). The presence of natural illumination plays a significant role in the reduction of air humidity and the eradication of harmful germs. Typically, bacteria and other microbes responsible for Acute Respiratory Infections (ARI) exhibit robust survival capabilities in the presence of ordinary light exposure. Nevertheless, the presence of ultraviolet (UV) light at high intensities can have lethal effects on bacterial proliferation due to the ionization of cellular constituents. Specifically, exposure to morning ultraviolet light with a wavelength of 4000 Å can result in the demise of bacteria (25).

CONCLUSION

The present literature evaluation demonstrates a discernible correlation between climate patterns and the occurrence of Acute Respiratory Infections (ARI). The occurrence of intense precipitation has the potential to amplify the incidence of acute respiratory infections (ARI) due to the resultant cold and damp conditions in the affected region. The occurrence of heavy precipitation can result in increased moisture levels within residential structures, leading to dampness. Individuals who are most affected by this issue tend to reside in densely populated regions, as inadequate ventilation and sanitation practices contribute to the development of respiratory ailments.

The correlation between air quality and the elevated prevalence of ISPA, a contributing factor affecting a specific geographical area, is the substandard air quality. Insufficient illumination has been identified as a risk

factor for Acute Respiratory Infections (ARI) in toddlers, as it can potentially prolong the viability of germs present in droplet nuclei suspended in the air. This association underscores the importance of adequate lighting in children under the age of five.

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