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RESEARCH

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Association Between Weather Variations and the Incidence of Acute Respiratory Infections in Semarang City

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Abstract

Acute Respiratory Tract Infection (ARI) is still a huge public health problem globally and is associated with high morbidity. While the number of ARI cases in Semarang City from 293,408 (2023) to 380,486 (2024) increased by 29.7%. This study analyzes the relationship between meteorological factors and the incidence of ARI in Semarang City in 2025, using secondary data on weekly ARI cases obtained from the Semarang City Health Office and meteorological variables (air temperature, humidity, rainfall, and wind speed) from Meteorology and Climatology Agency. This study uses a time-series ecological study design with Spearman's rank correlation test. The results of the study, using a significance level of $p < 0.05$, indicate that air temperature and rainfall were not significantly related to ARI incidence at any lag period ($p > 0.05$). During the period of one to four weeks, there is a significant and negative correlation between humidity levels and the number of ARI cases. However, this correlation was not strong. Indicating that periods of increasing humidity generally were accompanied by a subsequent decline in ARI cases the week after. Wind speed showed a positive correlation with ARI incidence at a four-week lagged interval ($r = 0.336$; $p = 0.020$). Wind speeds were thus considered higher four weeks before ARI incidences occurred. Conclusion The results indicate that both humidity and wind speed affect ARI incidence in a temporal context, implying that surveillance and intervention efforts must keep them in mind.

Keywords: ARI, climate, ecological studies.

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1. INTRODUCTION

Acute Respiratory Infections (ARIs) is still a global public health problem including in Indonesia. The latest studies show the epidemiologic impact of ARI in the world. Respiratory diseases account for 7% of the global burden of disease, according to WHO and over 500 million cases are reported each year. Acute respiratory infections (ARI) which is a leading cause of morbidity and mortality among children in the developing countries. This figure demonstrates the significant impact of ARI on the global health system, both in the number of patients requiring treatment and in the costs borne by governments and individuals. Low- and middle-income countries bear a greater burden of ARI, according to estimates of its global incidence. WHO estimates that the incidence of ARI in developing countries is 0.29%, equivalent to 151 million people, while in industrialized countries it is 0.05%, equivalent to 5 million people. This indicates that the burden of ARI is highly unevenly distributed across the globe. (Wahyudi et al., 2025).

Previous research has found that although the strength and direction of the correlation between weather variables and the number of respiratory tract infections in tropical regions vary, there is a correlation between meteorology and these cases (Mailepessov et al., 2021). Furthermore, a meta-analysis shows that this pattern does not hold across all study locations, as pathogen factors, environmental conditions, and regional geographic characteristics influence the effect of temperature on respiratory diseases. The findings suggest that the nexus between weather variability and ARI incidence is nuanced. Regional studies in diverse contexts are still warranted. Both heat and cold stress may be associated with increased ARI risk, and it was observed that high relative humidity was able to increase the rate of infectious microorganism dissemination. On the other hand, each weather variable relate positively to ARI, but there is high variability in their relationships especially during humid conditions (Pramudita & Ernyasih, 2025). Therefore, the effect of weather variations on ARI incidence cannot necessarily be generalized across different geographic and climatic settings, underscoring the need for a locally contextualized study such as the present one conducted in Semarang City.

Semarang City, the capital of Central Java Province, has the characteristics of a coastal city, high urbanization, and a growing population. These conditions make Semarang City vulnerable to environmental changes and weather changes. According to data from the Semarang City Health Office, the number of ARI cases increased from 293,408 in 2023 to 380,486 in 2024, an increase of approximately 29.7% (Dinas Kesehatan Kota Semarang, 2024). As a result of the shift in the global climate phenomenon from El Niño to La Niña, the average air temperature increased from 27.8°C to 28.3°C in 2023 and from 28.2°C to 30.0°C in 2024. Rainfall also increased from approximately 170–210 mm per month to 285–350 mm per month. Then, humidity increased to 84% during the wet period, up from an average of around 77% the previous year. Although wind patterns vary with the season and local atmospheric conditions, wind speeds are relatively stable, ranging from 8.5 to 11 km/h (Badan Meteorologi, Klimatologi dan Geofisika 2025). There is a suspected relationship between weather dynamics and cases of acute respiratory infections (ARI) in Semarang City, as changes in various weather elements coincide with increases in case numbers.

The findings suggest that the nexus between weather variability and ARI incidence is nuanced. Regional studies in diverse contexts are still warranted. Both heat and cold stress may be associated with increased ARI risk, and it was observed that high relative humidity was able to increase the rate of infectious microorganism dissemination. On the other hand, each weather variable relate positively to ARI, but there is high variability in their relationships especially during humid conditions. Studies that simultaneously analyze air temperature, humidity, rainfall, and wind speed using weekly, time-lagged data remain very limited.

Using a weekly data analysis resolution that incorporates lag effects ranging from Lag 0 to Lag 4 weeks is methodologically superior for capturing relevant biological dynamics. The average incubation periods for common acute respiratory infection (ARI) pathogens range from 1–7 days for the influenza virus, 2–14 days for RSV, and 2–5 days for rhinovirus ([Tang et al., 2021](#)). A weekly resolution enables researchers to map the actual biological lag between exposure to meteorological conditions and the clinical manifestations detected at healthcare facilities. Furthermore, a distributed lag model approach using weekly intervals accounts for the cumulative effect of mucociliary immune suppression; this process is not instantaneous and requires sustained exposure over 2–4 weeks to impair airway mucociliary clearance significantly. Studies in East Asian metropolitan areas have confirmed that weekly data resolution, combined with lag analysis, yields more precise Relative Risk (RR) estimates and narrower confidence intervals than monthly approaches ([Lee et al., 2026](#)). Adopting this methodology in the context of studies in Indonesia represents a scientifically sound and urgently needed improvement in the quality of environmental epidemiology research.

From the definition, a research gap exists due to insufficient empirical understanding of the simultaneous association between different weather elements and ARI incidence using tropical urban area weekly data. The aim of this research is to investigate the relationship between meteorological variables (air temperature, air humidity, rainfall and wind speed), as time series and time lag from weekly incidence of ARI in Semarang City Year 2025 for 52 weeks of observation. This study utilizes a time-series and time-lag method over 52 weeks of observations, to investigate the relationships between air temperature, air humidity, rainfall, wind speed with acute respiratory infection (ARI) cases in Semarang City. This method can explain the relationships to weather factors and possible lag effects on ARI cases. The overall aim of the current research is to better understand how occupant meteorology triggers respiratory diseases in tropical environment, highlighted for further improvement of environmental epidemiology. The research can also help local governments and the health sector create weather-based early warning systems for diseases and design better ARI prevention and control programs. This research is important for supporting evidence-based public health policies, given the high number of ARI cases in Semarang City and the increasing variability in weather due to climate change.

2. RESEARCH METHOD

This research was designed as a time series ecological study using secondary data on ARI incidence and weather variation in Semarang City, Central Java Province, covering the period from January to December 2025. Data collection, processing, and analysis were carried out in 2026, after the complete 52-week dataset for 2025 became available. ARI incidence data were collected weekly from Dinas Kesehatan Kota Semarang over 52 weeks of observation. Currently, meteorological data can be accessed from the Badan Meteorologi, Klimatologi, dan Geofisika (BMKG) melalui laman Data Online BMKG: <https://dataonline.bmkg.go.id/data-harian>. In this study, weather variations refer to weekly variations in four meteorological variables: air temperature (°C), relative humidity (%), rainfall (mm), and wind speed (m/s). Those variables are chosen because it is related to the weather variables that examined with weekly ARI cases in Semarang City. Three meteorological observation stations owned by BMKG, namely the Stasiun Meteorologi Ahmad Yani Semarang, Stasiun Klimatologi Jawa Tengah, and Stasiun Meteorologi Maritim Tanjung Emas Semarang, are used to provide a more representative picture of weather conditions for the Semarang City area, which has coastal, urban, and lowland geographical characteristics. Average daily data from the three observation stations were used to calculate the values of each meteorological variable. These values were then combined into weekly data to align with the reporting period for ARI cases.

Data were analyzed with univariate and bivariate approach. As the weekly meteorological variables and weekly ARI cases did not meet the assumption of normality, Spearman's rank

correlation was applied to examine the association between them. The analysis was performed for lags 0–4 weeks in order to assess whether variation in weekly ARI cases on the subsequent week was associated with meteorological conditions of the previous weeks. Since observations constitute a time series then the bivariate correlation results should be read as temporal associations and not as independent observations. Autocorrelation, seasonality, or long-term temporal trends are not specifically controlled for in the current analysis. Spearman's rank correlation was used because the study variables did not meet the assumption of normality, as indicated by a Kolmogorov–Smirnov test p -value < 0.05 . This test is based on the characteristics of time series data that do not meet the assumption of normality throughout. Testing was conducted at five time points: lag 0 (weather conditions in the same week as ARI cases) and lags 1 to 4 (weather conditions 1 to 4 weeks prior to ARI cases, respectively), to assess the possibility of a delayed (lag) effect of weather on ARI incidence. The maximum lag of four weeks was set based on the biological rationale outlined in the Introduction: the incubation periods of common ARI pathogens (1–14 days) and the cumulative process of mucociliary immune suppression, which requires sustained exposure for approximately 2–4 weeks to impair airway clearance significantly. The correlation coefficient r measured the direction and strength of the relationship.

3. RESULTS AND DISCUSSION

Weekly air temperatures in Semarang City in 2025 reached around 30.0°C during weeks 41 and 42. The lowest temperature, around 26.5°C, occurred in week 5. Weekly air temperatures throughout 2025 averaged around 28.3°C. Temperatures were relatively low at the beginning of the year and showed a gradual rising trend toward the middle and end of the year (Figure 1).

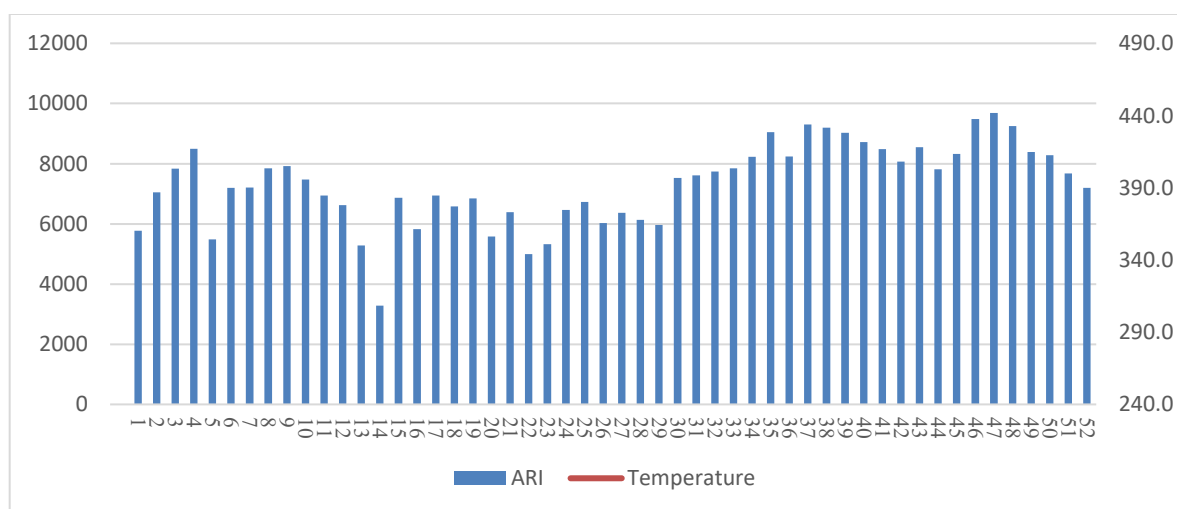


Figure 1 ARI Events and Weekly Temperature in the City of Semarang 2025

Weekly air humidity in Semarang City in 2025 fluctuated between approximately 65% and 80%. The highest humidity values occurred in weeks 43 to 50, while the lowest occurred around week 36; the average air humidity during the observation period was 78.28%. The weekly distribution of humidity indicates that air humidity was relatively stable throughout the year, with minimal variation. At the end of the year, air humidity tended to be higher than in mid-year. (Figure. 2).

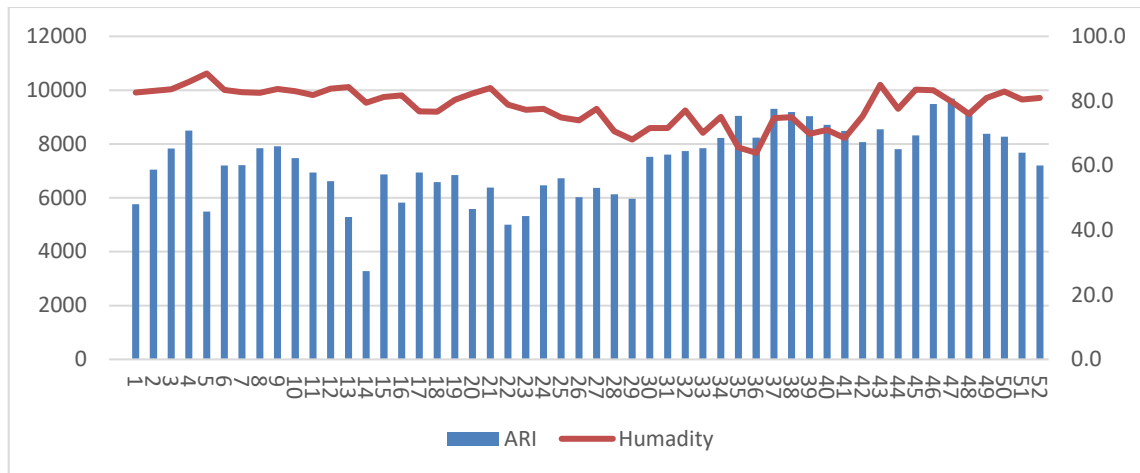


Figure 2 ARI Events and Weekly Humidity in the City of Semarang 2025

Weekly rainfall in Semarang City in 2025 showed significant fluctuations throughout the observation period. The highest rainfall occurred around week 37, with values approaching 1,700 mm, while the lowest rainfall occurred in several observation weeks, with values reaching 0 mm. Rainfall throughout 2025 averaged around 523.9mm. (Figure. 3).

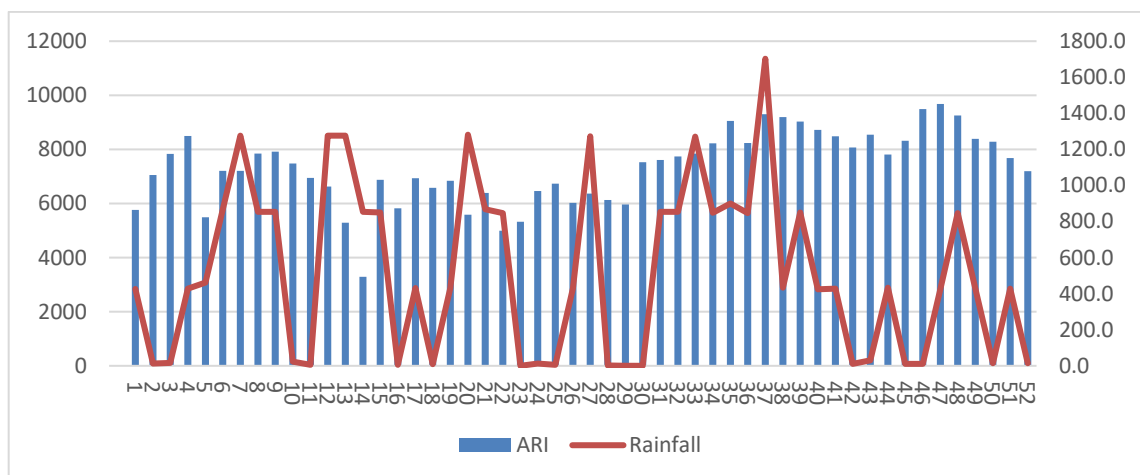


Figure 3 ARI Events and Weekly Rainfall in the City of Semarang 2025

Weekly wind speeds in Semarang City in 2025 fluctuated between approximately 1.5 m/s and 3.5 m/s. The highest wind speeds occurred around week 5, while the lowest occurred in several mid-year weeks. Average air humidity during the observation period 2.1m/w (Figure 4).

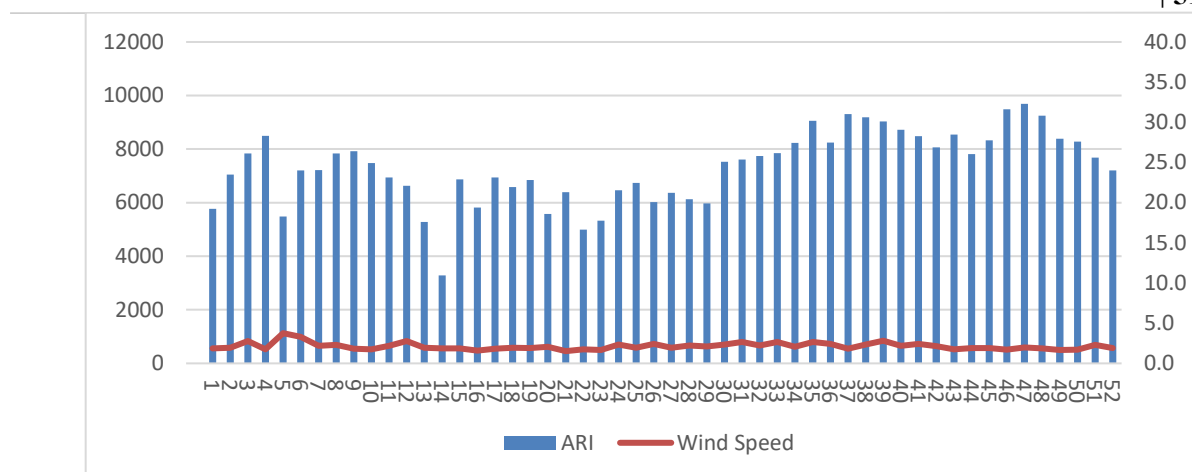


Figure 4 ARI Events and Weekly Wind Speed in the City of Semarang 2025

The Kolmogorov–Smirnov normality test showed that most study variables had p-values <0.05 , indicating that the data were not normally distributed. Therefore, the relationship between meteorological variables and ARI incidence was analyzed using Spearman's rho. Bivariate analysis was conducted to determine the relationship between weekly air temperature and ARI incidence in Semarang City using a time lag approach: the same week (lag 0), one week prior (lag 1), two weeks prior (lag 2), three weeks prior (lag 3), and four weeks prior (lag 4).

Table 1. Results of Bivariate Weather Variation and ISPA Events in Semarang City in 2025

Lag	Temperature		Humidity		Rainfall		Wind speed	
	P value	r	P value	r	P value	r	P value	r
0	0.344	0.134	0.225	-0.171	0.799	0.036	0.755	0.044
1	0.292	0.150	0.041	-0.287	0.751	-0.046	0.218	0.176
2	0.414	0.118	0.023	-0.322	0.760	0.044	0.391	0.124
3	0.599	0.077	0.041	-0.286	0.503	0.098	0.155	0.206
4	0.334	0.143	0.008	-0.381	0.562	0.86	0.020	0.336

A significant negative relationship between humidity and the number of ARI cases was consistently observed from lag 1 to 4 weeks. Relationship at lag time becomes stronger over the time and reach maximum effectiveness with 4 week lag ($r=0.381$; $p=0.008$). The inverse relationship shows that lower previous 1—I weeks humidity increases the odds of ARI cases in the week of observation. A positive correlation at 4-week lag wind speed ($r=0.336$; $p=0.020$) was observed. This shows a positive association between increased ARI cases and wind speed at preceding 4 weeks.

Table 2. Results of Univariate Weather Variations and ISPA Events in Semarang City

Variable	N	Average	Std. Deviation	Variance	Min	Max	Kolmogorov smirnov
ARI	52	7,329.94	1,337.334	1788490.09	3,285	9,685	0.200
Temperature	52	28.3	0.6633	0.440	26.5	30.1	0.200
Humidity	52	78.28	5.6554	31.984	64	88.5	0.038
Rainfall	52	523.9	468.5256	219516.226	0.2	1,702.9	0.000
Wind Speed	52	2.1	0.4339	0.188	1.5	3.8	0.000

DISCUSSION

a. Temperature and Weekly ARI cases

Temperature can influence the prevalence of respiratory diseases through several interconnected mechanistic pathways. Extreme temperatures can affect the human immune system, increase susceptibility to acute respiratory infections (ARI), and contribute to a higher incidence of these diseases (Pramudita & Ernyasih, 2025). Biologically, temperature changes can affect the survival of pathogenic microorganisms in the environment and interactions between microbes and human hosts (Pramudita & Ernyasih, 2025). The resilience of the human immune system and the way people interact and move can increase or reduce the risk of disease transmission (Pramudita & Ernyasih, 2025). Irritation of the airway mucosa increases susceptibility to pathogen invasion because high temperatures accelerate the rate of evaporation and reduce relative humidity; conversely, prolonged exposure to low temperatures can inhibit mucociliary function, which is the main defense mechanism of the airways to remove pathogens from the epithelial surface, thus facilitating viral and bacterial colonization of the respiratory tract (Kudo et al., 2019).

Spearman's rank correlation test results were obtained at lags 0, 1, 2, 3, and 4. All p-values were above the significance limit of 0.05, indicating no significant relationship between air temperature and ARI incidence either in the same week or several weeks prior. Although all correlation coefficients were positive, the strength of the relationship was very weak. This indicates that a consistent and significant increase in ARI incidence did not directly follow an increase in air temperature. Air temperature did not have a direct or delayed effect on the increase in ARI cases in Semarang City. This condition may be caused by the relatively stable characteristics of the tropical climate, such that temperature fluctuations were not large enough to affect the pattern of respiratory disease transmission significantly.

Previous research concluded that the relationship between temperature and ARI incidence varies across regions. This variation is influenced by climate characteristics, environmental conditions, and social factors, so temperature is not always a primary predictor of ARI incidence (Pramudita & Ernyasih, 2025). Previous studies on high-frequency ecological analysis in Thailand indicated that ambient temperature was significant primarily during dramatic seasonal transitions, rather than during small temperature swings within the generally steady tropical range (Choo et al., 2023).

Furthermore, a global meta-analysis of 47 studies from tropical countries found that the correlation coefficient between temperature and ARI was generally very weak to weak ($r < 0.3-0.5$), with significance varying by analysis method, observation period, and study-region characteristics. The r values found in this study (0.118–0.599) are consistent with the distribution of values reported in meta-analyses, indicating that the influence of climate factors on respiratory infections is highly dependent on the type of pathogen and regional characteristics. This study confirmed that the relationship between temperature and respiratory disease shows high heterogeneity across countries and climatic zones, resulting in insignificant results in the study (Shang et al., 2025).

Previous research demonstrates that indoor air pollution is now a significantly more important respiratory risk factor than outdoor meteorological exposure. The BMKG (*Badan Meteorologi, Klimatologi, dan Geofisika*) records ambient temperatures, which are artificially controlled in air-conditioned indoor locations (Radbel et al., 2024). As a result, temperatures recorded at meteorological stations at certain elevations and locations do not accurately represent the temperatures that people actually feel when they are susceptible to infections.

b. Humidity and Weekly ARI cases

Humidity is expressed in percentage relative humidity (%), which affects the survival of pathogenic microorganisms in the air, the stability of aerosol particles as a transmission medium, and the ability of the natural mucosal defense system of the human respiratory tract (Guarnieri et al., 2023). Humidity that is too low can dry out the airway mucosa, which is the

first line defense mechanism that clears pathogens from the respiratory epithelium, this increases susceptibility to infection because it interferes with mucociliary clearance (Xuan et al., 2025). Exposure to dry air at low humidity inhibits mucociliary clearance, weakens innate antiviral defense, and inhibits the epithelial tissue repair process (Kudo et al., 2019). Low indoor air humidity increases acute respiratory symptoms, reduces mucociliary output, weakens immune defenses, and increases the amount of virus-laden aerosols exhaled by infected people. The lowest risk of infection is found in the 40–60% humidity range, well below the 84% recorded in Semarang City during the dry season (Wolkoff, 2024).

The results of the analysis show that the significance value (p-value) at lag 0 is greater than 0.05, indicating that there is no significant relationship between humidity and the incidence of ARI in that period. Meanwhile, from lag 1 to lag 4, the p-value was less than 0.05, indicating a significant relationship. The correlation coefficient (r) value for all lags is negative, so the direction of the relationship between humidity and ARI events is opposite. This indicates that an increase in humidity tends to be followed by a decrease in the incidence of ARI, although the strength of the relationship obtained is relatively weak.

The results show a time effect between changes in air humidity and ARI cases. The significant relationships at lags 1 to 4 indicate that the influence of humidity on ARI cases does not occur in the same week but takes time. The results of this study are consistent with previous research, which reported that meteorological factors, including air humidity, influence the incidence of respiratory diseases by altering aerosol stability and airway physiological responses. The research shows that drier atmospheric conditions tend to increase the risk of respiratory disorders compared with higher-humidity conditions. The similarity of these results suggests that humidity is an environmental factor influencing the dynamics of respiratory diseases, although the strength of the relationship may vary by region (Lee & Yoon, 2024).

This research is consistent with prior studies, which have shown that low air humidity is associated with increased acute respiratory symptoms and decreased effectiveness of the airway mucosal defense system. They provide evidence that low humidity makes people more vulnerable to respiratory infections (Wolkoff, 2024). These study results support other previous studies, in which there were statistically significant association between household humidity and ARI incidence 23in toddlers in Bekasi Regency ($p = 0.013$). These results indicate the humidity conditions that exceed the time standard for health requirements which increases infection risk against acute respiratory infections (ARI) by making it easier for new viruses to enter or multiply (Rahmadanti & Darmawansyah Alnur, 2023).

Our previous research shows that dropping distance of influenza and rhinovirus-containing droplets in the 60–80% relative humidity range is shorter than abnormally dry conditions (Aganovic et al., 2022). SARS-CoV-2 aerosol stability decreases with half-lives ranging from several minutes to three hours based on droplet chemical composition and humidity (Haddrell et al., 2023). Droplets at high humidity hold more water for less evaporation of this free liquid from the droplet, so that the salt concentration in the droplet itself is low. However, for certain viruses, these conditions actually accelerate inactivation through osmotic mechanisms and pH changes. Conversely, at low humidity, droplets dry more quickly, forming solid residues that can protect virions from denaturation and allow the virus to persist longer as dry aerosols (droplet nuclei (Haddrell et al., 2023). High humidity can reduce the formation of droplet nuclei from respiratory emissions because evaporation proceeds more slowly, resulting in fewer small aerosol particles that remain airborne (Ijaz et al., 2023).

c. Wind speed and Weekly ARI cases

In terms of environmental health, wind affects the spatial distribution of pathogenic microorganisms, air pollutant levels, and thermal conditions in the area. Low-speed winds tend to collect dust particles, smoke, and pollutants in one place rather than distribute them evenly

(Rendana, 2020). This increases pollutant concentrations and the risk of human exposure (Yan et al., 2021). However, higher wind speeds can help disperse and dilute pollutants, but can also expand the spread of pathogenic aerosol particles to more people (Xuan et al., 2025).

No significant relationship was observed between wind speed and ARI incidence at lag 0, lag 1, lag 2 and lag 3 ($p > 0.05$). The values of the correlation coefficient (r) between wind speed and ARI incidence by lag periods were all positive, indicating a positive association that an increase in wind speed would be associated with an increase in ARI incidence. The nature of the relationship was very different when analysis at Lag 4 (4 weeks prior) was entered. In this four-week time-lag model, a correlation coefficient $r = 0.336$ was obtained with a significance level $p = 0.020$, which is below 0.05 ($p < 0.05$). This significant positive correlation indicates a proportional, unidirectional relationship. In other words, the increase in wind speed that occurred in the previous four weeks had a significant linear correlation with the increase in the number of ARI cases.

The results of this study align with previous research that found that local characteristics of the study area significantly influence the relationship between meteorological variables and respiratory infections. This variation indicates that the influence of wind speed on respiratory diseases depends on many factors, including geographic location, urbanization level, air quality, and community activity patterns (Hyrkäs-Palmu et al., 2025). Air quality parameters strongly influenced by wind speed, a pollutant dispersion factor, show a positive correlation with the incidence of ARI, with linear regression coefficients between PM10 and ARI of $r = 0.649$ (2018) and $r = 0.630$ (2019). This study confirms that wind speed affects ARI indirectly via an air-pollutant dispersion pathway, rather than through a direct pathway detectable at short time lags (Surury et al., 2022).

Systematic studies by previous researchers show that the relationship between air quality parameters (including the influence of wind speed as a dispersion factor) and the incidence of respiratory diseases varies widely across studies, influenced by differences in geographic location, level of urbanization, statistical analysis methods, and lag periods. In addition, this study shows that inconsistent findings across studies suggest complex causal pathways between meteorological factors and respiratory disease cases. In addition, research with longer lag periods tends to find relationships that are not visible in short-lag analyses (Wardono et al., 2024).

d. Rainfall and Weekly ARI cases

In terms of environmental health, high rainfall can increase humidity and promote the growth of pathogenic microorganisms around settlements (Verma et al., 2025). In addition, heavy rains that trigger evacuations and flooding can rapidly increase residential density, thereby accelerating the spread of aerosols and droplets that cause respiratory infections, especially among vulnerable groups such as children and the elderly (Gherasim et al., 2024). Mechanically, rainfall can also affect indoor air quality by increasing humidity, which promotes the growth of mold and bacteria and their accumulation in closed, unventilated spaces (Abrescia et al., 2025).

The results of the correlation analysis show that at lag 0, the p-value is 0.799 and the correlation coefficient (r) is 0.036. The p-value at lag 1 is 0.751 with an r value of -0.046, the p-value at lag 2 is 0.760 with an r value of 0.044, the p-value at lag 3 is 0.098 with an r value of 0.503, and the p-value at lag 4 is 0.562 with an r value of 0.086. The results show that there is no significant correlation between rainfall and ARI incidence during the entire lag period. The total p-value is greater than 0.05. Therefore, the hypothesis that rainfall is related to ARI cannot be accepted in this study. Compared with other lags, the correlation coefficients at lags 3 and 4 indicate a stronger positive relationship, although this is not statistically significant.

These results indicate that changes in rainfall require time to affect ARI cases in society. This indicates that changes do not always influence the number of ARI cases during the observation period in rainfall. The research results are in line with previous research, which

found that the correlation between rainfall at lag 0 and lag 2 was very weak ($r = -0.046$ to $r = 0.044$) and not significant ($p > 0.05$), indicating that rainfall cannot directly explain the number of ARI incidents (Chan et al., 2023).

This finding is consistent with previous research, namely that the relationship between rainfall and ARI is not necessarily linear and may be influenced by other environmental factors (Lasari et al., 2020). Previous research in Banjarmasin City also reported no consistent association between rainfall and ARI incidence (Lasari et al., 2020). This finding suggests that rainfall alone may not adequately explain variations in ARI incidence in tropical settings. Local seasonal patterns and other environmental factors may contribute to the observed relationship. These findings are also influenced by local seasonal characteristics and the fact that air pollutants, which are confounding variables, are not always correlated with other factors (Wu et al., 2022).

The government, especially Dinas Kesehatan Kota Semarang, must improve environment-based disease monitoring systems, increase public health education on preventing ARI, and create an early warning system that accounts for weather and other environmental factors. In addition, further research with longer observation times is needed. Research must include additional risk factors, such as population mobility, environmental sanitation conditions, population density, socio-economic factors, public health behaviors, and other factors that may influence ARI cases in Semarang City.

4. CONCLUSION

In line with the analysis of the relationship between meteorological factors and weekly ARI incidence in Semarang City during 2025, this study found that air temperature and rainfall were not significantly associated with ARI incidence at any lag period. In contrast, air humidity was significantly and negatively associated with ARI incidence at lag 1 through lag 4, and wind speed was significantly and positively associated with ARI incidence at lag 4. Humidity and wind speed, but not temperature and rainfall, consistently affect temporal variation in ARI incidence in Semarang City, Indonesia, which suggests that other environmental and behavioral factors have an important role on ARI incidence beyond the examined meteorological variables. Until potential vaccines, ARI prevention will still depend on healthy behaviors, mask wearing for symptomatic individuals; indoor air quality; and health maintenance in the form of immune system strengthening from a healthy way of life.

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