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The Relationship between Air Quality and The Incidence of ARI Respiratory Infections in Communities Around Mining-Industrial Locations (Pomalaa District) and Non-Mining-Industrial Locations (Wundulako District) in Kolaka Regency

Musrifa Kudus[1], Sunarsih[2], Erwin Azizi Jayadipraja[2]

[1] Kolaka Regency Environmental Health Service, Indonesia
[2] Mandala Waluya University, Indonesia
Correspondence : ivhaputri971@gmail.com

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ABSTRACT

Introduction: Initial observation of mining industry community in Kolaka Regency Poor air circulation causes smoke to not be able to fully exit through the chimney, so that the combustion chamber looks dirty and dusty and exits through the existing gaps to the community's residential environment. This study is to analyze the relationship between air quality and the incidence of respiratory infections of ARI in communities around the mining industry location (Pomalaa District) and non-mining industry location (Wundulako District) in Kolaka Regency.

Method: Quantitative research using Descriptive Retrospective research design. The target population in this study is the entire community in the area around the Nickel Mining and industrial centers in Kolaka Regency. Samples were taken using the stratified random sampling method totaling 126 respondents.

Result: There is a very strong relationship between the results of air quality measurements of PM_{10} and CO parameter values with an increase in the incidence of ARI. While for the $PM_{2.5}$ air quality value there is a strong relationship, and for other air quality parameters such as SO2, NO2, and O3 there is no relationship with the incidence of ARI or a moderate or even weak relationship.

Conclusion: Reducing the use of private vehicles by providing public transportation, or the company providing employee buses to reduce the intensity of air quality decline due to dense vehicles around mining and non-mining areas.

Introduction

The rapid development of the industrial world, especially in the mining and mineral and coal sectors, has resulted in the use of energy continuing to increase.[1] Energy released by industrial processes results in increased pollutants in the air as a result of the combustion process. These pollutants can be COx, NOx, SOx, or TSP which can reduce environmental quality.[2]

Indoor air pollution can be particularly dangerous because its sources are directly close to humans.[3] In developing countries an important indoor air pollution problem is pollution in homes due to cooking or burning wood for heating without adequate chimneys.[4] This pollution can be caused by carbon monoxide (CO).[5]

Carbon monoxide (CO) gas is produced by incomplete combustion of fossil fuels.[6] The threshold value of carbon monoxide pollutant in the air is 26 ppm. The level of pollutants in the air is influenced not only by the number of pollutant sources, but also meteorological parameters that affect the level of pollutants in the air so that environmental conditions cannot be ignored.[7] Air speed and air temperature are part of meteorological parameters that can affect the level of air pollutants outside the building. In addition to pollution outside the building, there is also pollution inside the building.[8]

In a room, climate factors are one of the references that influence indoor air quality, including temperature and air speed.[9] It is further stated that the characteristics of areas with a humid tropical climate such as Indonesia are relatively hot air temperatures that reach an average maximum value of 27°C-32°C, an average minimum air temperature of 20°C-23°C, and good indoor humidity and wind speed if 0.15-0.255 ms^{-1}.[10]

Based on the latest data as of March 24-March 26, 2023 from the sitehttps://www.iqair.com/id/indonesia/southeast-sulawesi/kolakaobtained information that the air quality index in Kolaka Regency is still in the Good category, although the status of $PM_{2.5}$, namely air particles with a size of less than 2.5 micrometers that can reach the alveoli of human lungs, is still at a level of 1.2 times that standardized by WHO. as shown in the following image.

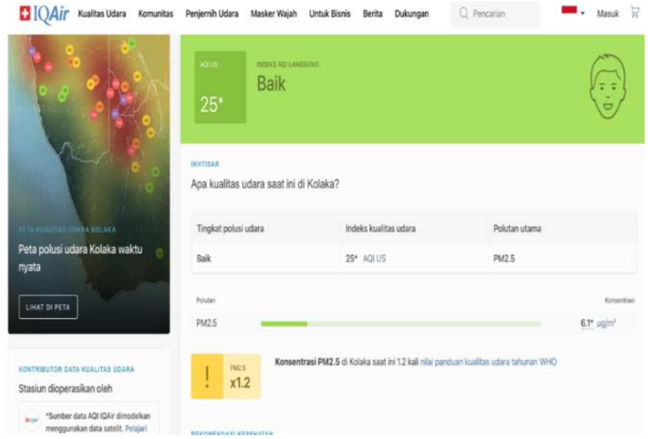

Figure 1. Air Quality Index in Kolaka Regency

However, this condition does not specifically explain the area around the mining area in Kolaka Regency. We know that in mining areas such as Pomalaa there are nickel mining activities and their processing which contribute to pollutants every day.

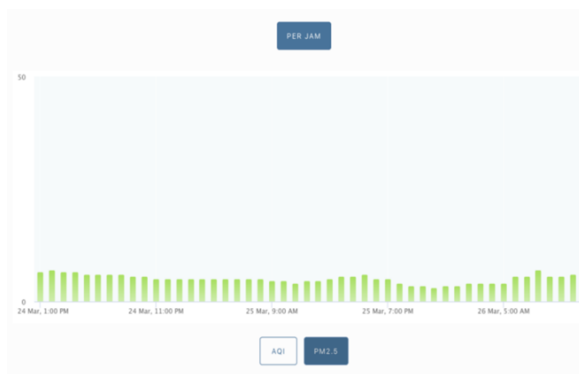

Figure 2. $PM_{2.5}$ Status Graph in Kolaka Regency

In addition to climate factors, cigarette smoke is also a factor causing indoor pollution. Exposure to cigarette smoke is complex and is influenced by the number of cigarettes smoked and the pattern of smoking.[11] WHO estimates that every year there are around 3 million deaths due to air pollution, 2.8 million of which are due to indoor air pollution and 0.2 million due to outdoor pollution.[12] Based on research by the American College of Allergies, around 50% of diseases are caused by indoor air pollution.[13]

Based on data from WHO, the death rate due to indoor air pollution in 2008 in the Southeast Asia region, Indonesia was ranked third after India and Bangladesh.[14] Cases of death due to indoor air pollution are due to disorders of the respiratory system, namely 88.3% are caused by cardiopulmonary disease, 11% lung cancer and 0.7% respiratory infection.[15]

Many cities in the world are plagued by environmental problems, especially air pollution problems as a result of the rapid growth of industry and transportation which have become demands in today's era.[16] According to WHO, air pollutant gases produced by transportation, waste disposal and industry are estimated to cause the deaths of 3.7 million people worldwide in 2012. These deaths were caused by several diseases caused by air pollutants such as ischemic heart disease and stroke which contributed 40% to deaths, Chronic Obstructive Pulmonary Disease 11%, lung cancer 6%, and Acute Respiratory Infection in children 3%.

Initial observation results, mining industry communities in Kolaka Regency are effectively active for 8-12 hours every day. Mining processing activities are carried out in a closed space with a limited number of chimneys (1 chimney for 3-4 furnaces). The fuel storage area is one with the combustion chamber. Poor air circulation causes smoke to not be able to fully exit through the chimney, so that the combustion chamber looks dirty and dusty and exits through the existing gaps towards the community's residential environment. This has resulted in an increase in cases of ARI also increasing around the community.

Acute Respiratory Infection Disease is an environmental disease caused by poor air quality. This disease is a global concern because it is one of the main causes of morbidity and mortality in children under five years of age (Toddlers) in the world.[17] According to WHO, 1.9 million toddlers die from ARI every year. Around 70% of ARI cases occur in Africa and Southeast Asia.[18]

Based on epidemiological research, it is estimated that the incidence of ARI in developing countries reaches 25% in children under five years of age.[19] Meanwhile, Indonesia is ranked fifth as the country with the highest incidence of ARI in the world. ARI is the main cause of patient visits to health centers (40%-60%) and hospitals (15%-30%) in Indonesia.[20] According to Riskesdas data, it is known that the period prevalence of ARI cases in 2007 was 25.5%. and decreased to 25%. The proportion of toddler mortality due to ARI ranks second after diarrhea.[21]

Meanwhile, the period prevalence of cases can affect public health. In 2010, it was known that around 1.6 million people died from diseases caused by indoor air pollution.[22] The community groups at risk of ARI due to indoor air quality are women and children. This is because most of the time women and children spend indoors.

When viewed in terms of location, Kolaka district is included in an area at risk for the development of ARI. This is because the location of Kolaka district is surrounded by mining industrial areas, namely the southern area in Pomalaa sub-district and the northern area in Wolo sub-district. Industrial areas have low ambient air quality. This is proven by the results of ambient air quality measurements around the Pomalaa mining area with TSP (Total Suspended Solid) parameters that have exceeded the standard quality value, which is 411 µg / m3 per 24 hours with a standard quality value of 230 µg / m3 per 24 hours. The results of these measurements indicate that 28.8% of people living around the mining area in Kolaka are exposed to ARI. This data was obtained from the Integrated Management Register report for Healthy Toddlers at the Pomalaa Health Center Clinic. Based on interviews with the Head of the Pomalaa Health Center and the holder of the Integrated Management Program for Healthy Toddlers at the Pomalaa Health Center Clinic, it is known that ARI is the number one disease in toddlers.

The description of the incidence of ARI in toddlers and the air conditions in the environment around Kolaka Regency, especially the problematic mining areas, are interesting environmental health problems to study. Therefore, researchers are interested in conducting research on the relationship between Air Quality and the Incidence of ARI in Kolaka Regency.

Method

Quantitative research uses a Retrospective Descriptive research design. The target population in this study is the entire community in the area around the Nickel Mining and industrial centers in Kolaka Regency. According to the results of a survey conducted by researchers in January 2021, the mining industry in the Kolaka area consists of 2 National Mining and 8 Local Mining that already have IUPs. The total population of Pomalaa District based on BPS statistical data is 33,344 people and 1587 people live around the mining area. The sample was taken using the stratified random sampling method totaling 126 respondents.

Results

Table 1 shows that air quality measurements at location 1 Kel. Pomalaa with coordinates S: 04° 17' 82.34" and coordinates E: 121° 06' 11.71" were SO2 (13.20 µg/Nm³), CO (1900 µg/Nm³), NO2 (19.30 µg/Nm³), O3 (57.9 µg/Nm³), $PM_{2.5}$ (15.7 µg/Nm³) and PM_{10} (28.5 µg/Nm³). Location 2 Pesouha Village with coordinates S: 04° 17' 82.34" and coordinates E: 121° 06' 11.71" of SO2 (10.20 µg/Nm³), CO (2200 µg/Nm NO2 (12.80 µg/Nm³), O3 (26.10 µg/Nm³), $PM_{2.5}$ (8.5 µg/Nm³) and PM_{10} (17.7 µg/Nm³). Location 3 Wundulako Village with coordinates S: 04° 17' 82.34" and coordinates E: 121° 06' 11.71" of SO2 (12.60 µg/Nm³), CO (1200 µg/Nm³), NO2 (14.30 µg/Nm³), O3 (24.10 µg/Nm³), $PM_{2.5}$ (5.3 µg/Nm³) and PM_{10} (9.3 µg/Nm³). And at location 4 Towua Village with coordinates S: 04° 17' 82.34" and coordinates E: 121° 06' 11.71" of SO2 (6.70 µg/Nm³), CO (1000 µg/Nm³), NO2 (8.90 µg/Nm³), O3 (24.36 µg/Nm³), $PM_{2.5}$ (6.8 µg/Nm³) and PM10 (9.7 µg/Nm³). Thus, based on the results of all measurements at each location, it was found that each measurement parameter was in Below Standard Quality.

Table 2 shows that the air quality scale in the study area for all locations, all parameters have values below 50 or are in the Good Category.

Table 3 The value of the ARI incident was obtained and then analyzed using air quality data (SO2, NO2, CO, O3, $PM_{2.5}$ and PM_{10}) which had been calculated according to the Air Pollution Standard Index (APSI), then the results of the simple linear regression analysis were obtained as follows:

Sulfur Dioxide (SO_2)

Based on the measurement results, the value of the level of air quality content of the SO_2 parameter at the research location in settlements around mining and non-mining areas obtained the results of the APSI Air Quality value for 1 day (average <10) which is still categorized as good. The linear relationship between SO_2 Air Quality and the occurrence of ARI shows a linear relationship that is not statistically significant where the magnitude of the correlation or relationship value (R) with a moderate relationship strength of 0.314. From this output, a determination coefficient (R Square) of 0.172 was obtained, which means that the influence of the independent variable (SO_2 air quality) on the dependent variable (ARI) is 17.2%.

Nitrogen Dioxide (NO_2)

Based on the measurement results, the value of the level of air quality content of the NO_2 parameter at the research location in settlements around mining and non-mining areas obtained the results of the APSI Air Quality value for 1 day (average <10) which is still categorized as good. The linear relationship between NO_2 Air Quality and the occurrence of ARI shows a linear relationship that is not statistically significant where the magnitude of the correlation or relationship value (R) with a weak categorized relationship strength of 0.051. From this output, a determination coefficient (R Square) of 0.064 was obtained, which means that the influence of the independent variable (NO_2 air quality) on the dependent variable (ARI) is 6.4%.

Carbon Monoxide (CO)

Based on the measurement results, the value of the level of air quality content of the CO parameter at the research location in settlements around mining and non-mining areas obtained the results of the APSI Air Quality value for 1 day on average which is still classified as good. The linear relationship between CO Air Quality and the occurrence of ARI shows a statistically significant linear relationship where the magnitude of the correlation or relationship value (R) with the strength of the relationship is categorized as very strong, which is 0.932. From this output, a determination coefficient (R Square) of 0.809 is obtained, which means that the influence of the independent variable (CO2 air quality) on the dependent variable (ARI) is 80.9%. The pattern of the linear relationship between the dependent variable and the independent variable is positive, meaning that every increase in the number of independent variables, the number of dependent variables also increases.

Ozone (O3)

Based on the measurement results, the value of the level of air quality content of the O_3 parameter at the research location in settlements around mining and non-mining areas obtained the results of the APSI Air Quality value for 1 day (average <10) which is still categorized as good. The linear relationship between Air Quality O_3 and the incidence of ARI shows a linear relationship that is not statistically significant where the magnitude of the correlation or relationship value (R) with a moderate relationship strength of 0.371. From this output, a determination coefficient (R Square) of 0.241 was obtained, which means that the influence of the independent variable (air quality O_3) on the dependent variable (ARI) is 24.1%.

Particulate Matter ($PM_{2.5}$)

Based on the measurement results, the value of the level of air quality content of $PM_{2.5}$ parameters at the research location in settlements around mining and non-mining areas obtained the results of the APSI Air Quality value for 1 day on average which is still categorized as good. The linear relationship between $PM_{2.5}$ Air Quality and the occurrence of ARI shows a statistically significant linear relationship where the magnitude of the correlation or relationship value (R) with a strong categorized relationship strength of 0.693. From this output, a determination coefficient (R Square) of 0.520 was obtained, which means that the influence of the independent variable ($PM_{2.5}$ air quality) on the dependent variable (ARI) is 52.0%.

Particulate Matter (PM_{10})

Based on the measurement results, the value of the level of air quality content of PM_{10} parameters at the research location in settlements around mining and non-mining areas obtained the results of the APSI Air Quality value for 1 day on average which is still classified as good. The linear relationship between PM_{10} Air Quality and the occurrence of ARI shows a statistically significant linear relationship where the magnitude of the correlation or relationship value (R) with the strength of the relationship is categorized as very strong, which is 0.825. From this output, a determination coefficient (R Square) of 0.643 is obtained, which means that the influence of the independent variable (PM_{10} air quality) on the dependent variable (ARI) is 64.3%.

Table 1.
Concentration of Air Quality Measurements at Research Locations Around Mining and Non-Mining Areas in Kolaka Regency

No	Location	Coordinate	Parameter	Unit	Quality standards	Measurement results	Information
1	Point 1 (Pomalaa Subdistrict)	S : 04° 17' 82.34" E :121° 06' 11.71"	SO2	µg/Nm3	150	13.20	Below Standard Quality
			CO	µg/Nm3	10000	1900	Below Standard Quality
			NO2	µg/Nm3	200	19.30	Below Standard Quality

No	Location	Coordinate	Parameter	Unit	Quality standards	Measurement results	Information
			O3	µg/Nm3	150	57.9	Below Standard Quality
			PM2.5	µg/Nm3	55	15.7	Below Standard Quality
			PM10	µg/Nm3	75	28.5	Below Standard Quality
2	Point 2 (Pesouha Village)	S : 04° 17' 82.34" E :121° 06' 11.71"	SO2	µg/Nm3	150	10.20	Below Standard Quality
			CO	µg/Nm3	10000	2200	Below Standard Quality
			NO2	µg/Nm3	200	12.80	Below Standard Quality
			O3	µg/Nm3	150	26.10	Below Standard Quality
			PM2.5	µg/Nm3	55	8.5	Below Standard Quality
			PM10	µg/Nm3	75	17.7	Below Standard Quality
3	Point 3 (Wundulako Village)	S : 04° 17' 82.34" E :121° 06' 11.71"	SO2	µg/Nm3	150	12.60	Below Standard Quality
			CO	µg/Nm3	10000	1200	Below Standard Quality
			NO2	µg/Nm3	200	14.30	Below Standard Quality
			O3	µg/Nm3	150	24.10	Below Standard Quality
			PM2.5	µg/Nm3	55	5.3	Below Standard Quality
			PM10	µg/Nm3	75	9.3	Below Standard Quality
4	Point 4 (Towua Village)	S : 04° 17' 82.34" E :121° 06' 11.71"	SO2	µg/Nm3	150	6.70	Below Standard Quality
			CO	µg/Nm3	10000	1000	Below Standard Quality
			NO2	µg/Nm3	200	8.90	Below Standard Quality

No	Location	Coordinate	Parameter	Unit	Quality standards	Measurement results	Information
			O3	µg/Nm3	150	24.36	Below Standard Quality
			PM2.5	µg/Nm3	55	6.8	Below Standard Quality
			PM10	µg/Nm3	75	9.7	Below Standard Quality

Table 2.
APSI Values for Each Air Quality Parameter

No	Test Parameters	APSI value (rounded)			
		Point 1 (Pomalaa Subdistrict)	Point 2 (Pesouha Village)	Point 3 (Wundulako Village)	Point 4 (Towua Village)
1	SO2	7	5	6	3
2	NO2	7	5	5	3
3	CO	13	10	9	6
4	O3	13	6	6	5
5	PM2.5	13	9	5	7
6	PM10	21	17	12	9

Table 3.
Simple Linear Regression Analysis of Air Quality Relationship (SO_2, NO_2, CO, O_3, $PM_{2.5}$ and PM_{10}) with ARI events

No	APSI Variable	Analysis	
		R	R Square
1	SO2	0.314	0.172
2	NO2	0.051	0.064
3	CO	0.932	0.809
4	O3	0.371	0.241
5	PM2.5	0.693	0.520
6	PM10	0.825	0.643

Discussion

Air quality measurements of Sulfur Dioxide (SO_2) parameters with ARI incidents

The air quality parameter SO_2 for 1 day averaged <10 which is still considered good with a statistical test result of 17.2% influence, meaning there is no significant relationship or a moderate relationship. According to Kurniawati, the amount of SO_2 formed in the air is influenced by reaction conditions, especially available oxygen and temperature, sunlight and water vapor/humidity.[23]

It can also be seen from previous research by Saputra, which found that the SO_2 gas levels in homes ranged from 0.19 to 1.62 mg/m3 with an average of 0.42 mg/m3.[24] Based on the results of statistical analysis, both independent variables and confounding variables were not related to the incidence of ARI, so this study could not statistically prove the relationship between SO_2 pollution in homes and the incidence of ARI.

In a similar study conducted by Rahmadhani, obtained results at 6 locations in settlements around the industrial area of PT. Semen Tonasa, Pangkep Regency, the APSI values obtained were all in the good category or in the range of 0-50.[25] In addition Anwar cited in the study, who conducted research at the Makassar Power Terminal, showed that the APSI SO_2 value was in the range of 100-199, which is a level of air quality that is detrimental to humans or sensitive animal groups, although it does not cause damage to plants or aesthetic value.[26]

In previous research by Kurniawan before the pandemic, the results of the APSI analysis on weekdays showed an APSI value of 358 which is categorized as dangerous, while on holidays the APSI value obtained was 281 which is categorized as very unhealthy. Which is based on the effect of SO_2 gas concentration on living things. The APSI value in the range of 200-299 is categorized as very unhealthy, exposure to SO_2 gas will increase cardiovascular in people who are not smokers but have heart disease, and there will be visible weakness. While at an APSI value above 300 or which is categorized as dangerous, exposure to carbon monoxide gas can be dangerous for all populations.[27]

This is in line with research conducted by Kurniawan continuous measurement of air quality parameters was carried out in Bukit Kototabang which showed that the air quality in the area was still good, indicated by 353 days classified as clean (index 0-50), 10 days classified as moderate (index 51-100) and 1 day classified as very unhealthy (index 200-299). That means 3% of daily air quality in Bukit Kototabang in 2017 was classified as poor.[27]

Air quality measurements of Nitrogen Dioxide (NO_2) parameters with ARI incidents

NOx levels in the air of industrial areas are usually 10–100 times higher than in the air of non-industrial urban areas. NOx levels in the air of urban areas can reach 0.5 ppm. Like CO, NOx emissions are influenced by population density because the main source of NOx produced by humans is from combustion and most combustion is caused by motor vehicles, energy production and waste disposal. Most man-made NOx emissions come from the combustion of charcoal, oil, gas and gasoline.[23]

The results of the study in settlements around mining and non-mining areas showed that the NO_2 APSI Parameter for 1 was still in the good category and the results of the statistical test were not significantly related to the incidence of ARI around the settlement where the relationship was categorized as weak with a percentage of only 6.4%. Factors that influence the formation of NO_2 are combustion temperature, the presence of excess air available because excess air at a certain concentration will dilute the combustion gases so that it produces a lower combustion temperature so that there is a decrease in the amount of NO_2.[28]

NO_2 gas can cause health problems in the form of increased inspiratory and expiratory resistance, and pulmonary edema.[29] In addition, absorption of NO_2 gas by the mucosa can cause inflammation of the upper respiratory tract and irritation of the eye mucosa.[30]The insignificant results of this study were caused by meteorological factors such as temperature, wind speed, and sunlight which influence the existence of a pollutant in a particular area.

Results of air quality measurements of Carbon Monoxide (CO) parameters with ARI incidents

The problem of air pollution due to mining activities and motor vehicle emissions can be said to have reached a worrying point due to the increase in mining activities and the high increase in the number of motor vehicles that will use fossil fuels and play a significant role in contributing to pollution due to the increasing levels of CO pollutants as emissions released into the ambient air.[31]

Based on the results of the study of air quality parameters of CO, it was found that the level of CO content for 1 day was still included in the good category and the relationship between air quality parameters of CO and the incidence of ARI was statistically significant where the relationship was categorized as very strong with a percentage of 80.9% with a correlation value or relationship (R) = 0.932. The fairly high levels of CO in the ambient air at the research location in settlements around mining and non-mining areas are likely to come from mining activities and the increasing number of motorized vehicles. Smoke emitted through chimneys or exhaust from burning fossil fuels is a contributor to CO which can affect air quality in these settlements.

The results of this study are quite relevant to previous theories that air pollutants can interfere with the upper respiratory tract and cause irritation where residents with low immune systems are groups at high risk in air pollution events. Just like children and the elderly, they are more susceptible to respiratory infections compared to adults because their lung function is also different.[32]

Air quality measurements of Ozone (O_3) parameters with ARI incidents

The results of the research on the APSI O_3 parameters in ambient air at the research location in residential areas around mining and non-mining areas are still categorized as good for 1 day and statistical tests show an insignificant linear relationship or moderate relationship between the air quality of the O_3 parameters and the incidence of ARI at the research location in residential areas around mining and non-mining areas.

Based on the research results of Hrp, it is known that the monthly average of the O_3 index in September 2017. The highest incidence of ARI was in February 2017. The monthly average of the three variables is in the good category, namely O_3 (37.29). The variable that is significantly related to the incidence of ARI based on the results of the correlation and regression analysis is O_3 (r = 0.513).[33] The relationship between Ozone (O_3) and the incidence of ARI is one of the interesting topics to explore. Thus, there is a positive relationship between the concentration of O_3 in ambient air and the incidence of ARI. This means that the higher the concentration of O_3, the higher the risk of ARI. This is because O_3 can damage the mucous membranes in the respiratory tract and cause inflammation, coughing, shortness of breath, and infection.[34]

The results of this study are not in line with the results of research conducted by previous researchers.[35] which reveals that the number of ARI patients with the number of O_3 has a positive correlation that has a moderate relationship but approaches a strong relationship (r = 0.507). The correlation value between the number of ARI patients and the area of burned land also has a positive correlation value that has a moderate relationship (r = 0.377), while the relationship between the number of hotspots and the area of burned land has a positive correlation value that has a very strong relationship (r = 0.938). This can be interpreted that by taking into account the number of ARI patients, there is still a positive correlation between the number of hotspots and the area of burned land even though the relationship is not strong.

Air quality measurements of Particulate Matter ($PM_{2.5}$) parameters with ARI incidents

The results of a simple regression test conducted between the air quality parameter Particulate Matter ($PM_{2.5}$) and the occurrence of ARI at the research location in settlements around mining and non-mining areas showed a statistically significant relationship where the relationship was categorized as strong (percentage 52.0%) with R = 0.693. So based on this study it can be concluded that there is a relationship between the dust particle parameter ($PM_{2.5}$) and the occurrence of ARI.

Dust particles ($PM_{2.5}$) mostly come from combustion processes such as in industrial activities and motor vehicles so that high levels of dust particles around industrial areas are the impact of industrial development and the increase in the number of motor vehicles in addition to other community activities. Industrial progress is always accompanied by an increase in population so that increased population activity will potentially result in $PM_{2.5}$ pollution (dust particles).

The existence of a statistically significant linear relationship between $PM_{2.5}$ and the incidence of ARI is relatively in accordance with the theory.[36] Where $PM_{2.5}$ can cause acute respiratory infections (ARI) in the lower respiratory tract such as pneumonia and bronchitis in both children and adults. This is possible because $PM_{2.5}$ contains sulfuric acid mist which can irritate some mucous membranes in the respiratory tract and can damage the respiratory defense tract (nasal hair, mucous membranes) so that germs can enter easily.

Fine particle materials can affect the respiratory tract from the nose to the alveoli. Large particles can be expelled through impaction from the nose and throat. Small particles are difficult to expel and can cause sedimentation. While the smallest particles (diameter 0.1 microns) can reach the alveoli and will cause diffusion to the alveolar walls.[37]

Air quality measurements of Particulate Matter (PM_{10}) parameters with ARI incidents

Based on the category distribution, the results of air quality measurements of PM_{10} parameter values for 1 day are also still at the good category level (scale 1-50), namely PM_{10} concentration, although it does not cause direct health problems.

The results of a simple regression test conducted between the air quality parameters of Particulate Matter (PM_{10}) and the occurrence of ARI at the research location in settlements around mining and non-mining areas showed a statistically significant relationship where the relationship was categorized as very strong (percentage 64.3%) with R = 0.825. So based on this study it can be concluded that there is a relationship between the parameters of dust particles (PM_{10}) and the occurrence of ARI.

Dust particles (PM_{10}) mostly come from combustion processes such as in industrial activities and motor vehicles so that high levels of dust particles around industrial areas are the impact of industrial development and the increase in the number of motor vehicles in addition to other community activities. The rapid mining industry is always accompanied by an increase in population so that increased population activity will potentially result in PM_{10} pollution (dust particles).

The existence of a statistically significant linear relationship between PM_{10} and the incidence of ARI is relatively in accordance with the theory.[38] Where PM_{10} can cause acute respiratory infections (ARI) in the lower respiratory tract such as pneumonia and bronchitis in both children and adults. This is possible because PM_{10} contains sulfuric acid mist which can irritate some mucous membranes in the respiratory tract and can damage the respiratory defense tract (nasal hair, mucous membranes) so that germs can enter easily.

Meanwhile, another theory states that the high prevalence of respiratory tract infections (URTIs) must be watched out for because it is a risk factor for respiratory disorders and is related to the occurrence of Chronic Obstructive Pulmonary Disease.[39]

Conclusion

There is a very strong relationship between the results of air quality measurements of PM10 and CO parameter values with an increase in the incidence of ARI. While for the PM2.5 air quality value, there is a strong relationship, and for other air quality parameters such as SO2, NO2, and O3, there is no relationship with the incidence of ARI or a moderate or even weak relationship.

Reducing the use of private vehicles by providing public transportation, or the company providing employee buses to facilitate employees in transportation from their homes to their workplaces in order to reduce vehicle use so as to reduce the intensity of air quality decline due to dense vehicles around mining and non-mining areas.

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