



## WALUYA THE INTERNATIONAL SCIENCE OF HEALTH JOURNAL

# Air Quality Conditions (NO<sub>2</sub>) Around the Konawe Industrial area and the Resulting Respiratory Problems

Rahman Rauf, Yunita Amraeni, Erwin Azizi Jayadipraja

Mandala Waluya University, Indonesia  
Correspondence : rahmanrauf830@gmail.com

### ARTICLE INFO

#### Article history

Received : July 01<sup>th</sup>, 2023  
Revised : September 17<sup>th</sup>, 2023  
Accepted : September 27<sup>th</sup>, 2023

#### Keywords

Mining,  
Nickel,  
Health.

### ABSTRACT

**Introduction:** Air quality is strongly influenced by activities carried out by humans. This study aims to determine the NO<sub>2</sub> air quality around the Konawe industrial area as well as community activities and respiratory disorders experienced.

**Method:** The data used is a linear regression statistical test to determine the relationship between NO<sub>2</sub> air quality with community activity and respiratory disorders.

**Result:** This research was conducted in 6 villages around the Konawe industrial area. Most people carry out their daily activities around the industrial area, so some people experience respiratory problems. In the regression analysis, it is known that the activities of residents of the house affect the concentration of NO<sub>2</sub> by 4% and the concentration of these pollutants affects the respiratory disorders of residents of the house by 25%.

**Conclusion:** Activity in the house is not related to the concentration of NO<sub>2</sub> in the air and respiratory problems experienced by residents of the house are also not related to the concentration of NO<sub>2</sub> in the house. This study provides awareness that air quality in the house is important to maintain the health of residents of the house and to provide input for residents of the house to reduce activities that can interfere with air quality in closed rooms.

### Introduction

The World Health Organization (WHO) report says, there are 8 million people every day around the world die from air pollution, of which 4.3 million people die due to air pollution sourced from the activities of home residents. The short-term effects caused will increase the risk of death due to cardiovascular and respiratory disorders.

The effects of air pollution inside the house show that it is very important to pay attention to air quality inside the house because most humans do a lot of activities inside the house. Therefore, the existing air quality is greatly influenced by the activities carried out.<sup>[1]</sup>

The high concentration of pollutants can also be influenced by environmental activities around the house such as industrial activities and

transportation traffic. Outdoor environmental conditions also have an impact on increasing the concentration of air pollutants in the house.<sup>[2]</sup> The number of vehicles passing in front of the house or in surrounding settlements can be a source of pollutants for outdoor air or ambient air (outdoor air pollution) because of the pollutants released from the combustion of the vehicle's engine. If  $PM_{2.5}$  levels in ambient air increase by  $1\mu g/m^3$ , it will increase  $PM_{2.5}$  levels in indoor air by  $0.58\mu g/m^3$ , it shows that the intensity of vehicles passing can indirectly affect indoor and outdoor air quality.<sup>[3]</sup> The risk of ARI is also related to the ventilation condition of the house. If the ventilation of the house does not meet the specified requirements, namely the ventilation area of 10% of the floor area, it has a 2.56 times greater risk of suffering from ARI. The area of ventilation in the house is related to air circulation that occurs in the house, because if the size of the ventilation is too small it will cause the air to not circulate properly.<sup>[4]</sup>

The purpose of the research conducted was to determine the relationship between air quality around the Konawe industrial area with the activities of residents of the house that can trigger an increase in pollutants and the risk of respiratory problems experienced by the surrounding community. In this study, the air quality parameter used as research material is the concentration of  $NO_2$ .

## Method

The data analysis used in this study was using a linear regression statistical test with SPSS 16 to determine the relationship between test variables, namely air quality parameters ( $NO_2$ ) with the activity of house occupants and respiratory disorders.

## Result

### A. Characteristics of the Research Area

This research was carried out in residential areas around the Konawe Industrial area of PT. Virtue Dragon Nickel Industrial Park (PT. VDNIP), which consists of 6 locations of sampling points, namely in Morosi District (Morosi Village sampling Point 5 and Puuruy Village sampling

Point 6), Kapoiala District (Lalembue Jaya Village sampling Point 3 and Tani Indah Village sampling Point 4) and Motui Sub-district (Motui Village sampling Point 1 and Tobimeita Village sampling Point 2). This research will start in January 2023 until April 2023. The samples in this study consisted of 2, namely air samples and human samples. Air samples were taken at 6 points and human samples were 343 people.

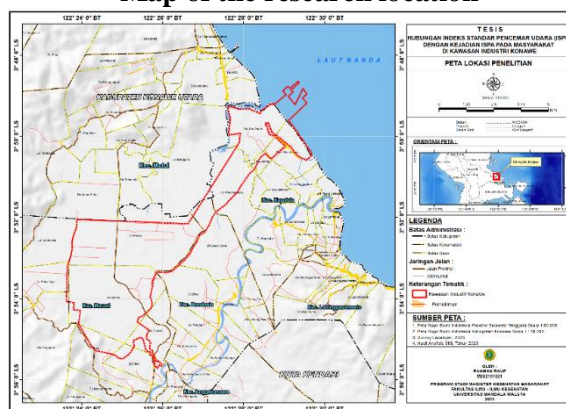
Astronomically, the location of the research area around the Konawe industrial area is located 435010 - 440727 South Latitude, and between 9572309 - 9575977 East Longitude.

Based on its geographical position, Konawe Industrial Estate has regional boundaries, namely:

- The north is bordered by Motui District.
- The east is bordered by Kapoiala District.
- The south side is bordered by Bondoala District.
- The west is bordered by Morosi District.

The research area is around the Konawe industrial area. The boundaries of each village can be seen in the following map image.

**Figure 1.**  
**Map of the research location**



Based on Figure 1, it can be seen that there are 87 respondents experiencing respiratory problems.

### B. Overview of Air Quality in the House

The number of locations around the Konawe Industrial Estate whose air quality was examined in this study was 6 locations in 3 districts. Air quality checks are focused on areas that are near the location of industrial estates, because the location of houses in the sub-district is adjacent to factories and power plants that are sources of

pollution. The results of air quality measurements can be seen in Table 1.

**Table 1.**  
**Air quality around Konawe Industrial area**

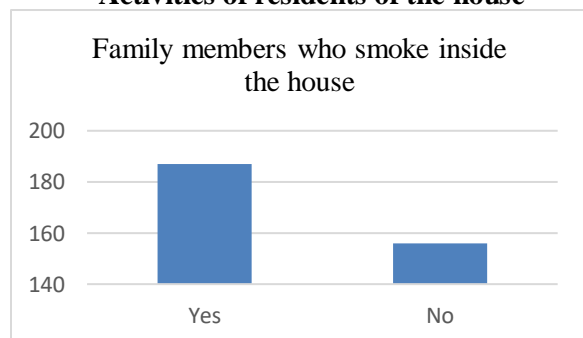
Parameters	Quality Standards	Unit	Test Results at 6 locations
NO <sub>2</sub>	200	µg/Nm <sup>3</sup>	<13

Table 1 shows the air quality around the study area examined referring to Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management, the quality standard for the NO<sub>2</sub> parameter is 200 µg/Nm<sup>3</sup> in 1 hour of measurement. Based on the air quality check, the NO<sub>2</sub> parameter at all measurement locations still meets the required quality standards.

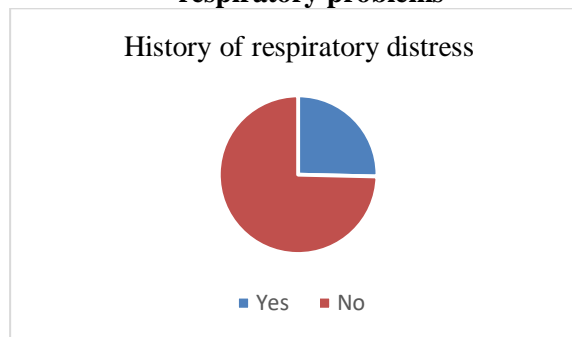
### C. Overview of Air Quality at the study site

Data on the activities of residents of the house used as research are smoking activities. Smoking activity in 343 houses based on Figure 1, as many as 187 houses have residents who smoke in the house which is mostly done by male parents.

**Figure 2.**  
**Activities of residents of the house**



**Figure 3.**  
**Number of houses whose residents experience respiratory problems**



### D. Air Quality and Occupant Activities

Analysis of the relationship between air quality in the house and occupant activity has been carried out using regression analysis. The results of the analysis can be seen in Table 2, namely the concentration of NO<sub>2</sub> is influenced by the activity of residents of the house as much as 4%. Based on the results of regression analysis, it is also known that smoking activity is not related to occupant activity with NO<sub>2</sub> concentration (p>0.05).

**Table 2.**  
**Coefficient of determination (R<sup>2</sup>) between air quality and the activities of residents of the house.**

Occupant Activities	NO <sub>2</sub>
Smoke	0,04

### E. Air Quality with Respiratory Disorders

The influence of air quality in the house with respiratory disorders experienced by residents of the house can affect each other, so regression analysis has been carried out on these two variables. Based on Table 3, it is known that respiratory disorders experienced by residents of the house are influenced by NO<sub>2</sub> contained in the house as much as 25%.

**Table 3.**  
**Coefficient of determination (R<sup>2</sup>) between  
respiratory disorders and air quality**

Occupant Activities	R <sub>2</sub>
NO <sub>2</sub>	0,25

## Discussion

This study provides an overview of the air quality conditions around the Konawe industrial area by looking at the activities of house residents carried out and respiratory problems experienced by house residents. The air quality examined, namely NO<sub>2</sub>, while for the activities of residents of the house that was used as research material, namely smoking activities.

Smoking activities carried out inside the house can contribute to an increase in the concentration of particulate matter (PM) in the air from cigarette smoke and if exposed continuously can result in death caused from respiratory disorders.<sup>[5]</sup> Research conducted by Klepeis et al. (2017) explained that of the 262 houses studied, as many as 55 houses with residents who smoke inside the house have higher pollutant particles compared to residents who do not smoke inside the house.<sup>[6]</sup> Burning tobacco from cigarettes produces a lot of PM<sub>2.5</sub> particles. Burning 1 cigarette will contribute 7-23 mg of PM<sub>2.5</sub> to the air. Particles of pollutants produced from cigarette smoke will stay long on hair, clothes and floors even though smokers have finished smoking activities.<sup>[7]</sup>

Parents who smoke in the house, indirectly have an impact on children, it is because children spend time with parents so that children can be at risk of suffering from coughing and if pregnant women are exposed to cigarette smoke it will have an effect on lower respiratory problems in children at birth.<sup>[8]</sup> Cigarette smoke that contains pollutants and toxic materials in it can increase the risk of disease 7.83 times if exposed to cigarette smoke continuously can cause cancer and asthma.<sup>[9]</sup>

NO<sub>2</sub> levels in the air of industrial areas are usually 10–100 times higher than in the air of

urban areas that are not industrial areas. NO<sub>2</sub> levels in the air of urban areas can reach 0.5 ppm Like CO, NO<sub>2</sub> emissions are influenced by population density because the main source of NO<sub>2</sub> produced by humans is from combustion and most combustion is caused by motor vehicles, energy production and waste disposal. Most man-made NO<sub>2</sub> emissions come from burning charcoal, oil, gas, and gasoline.<sup>[10]</sup>

The results of research in settlements around industrial estates showed that ISPU NO<sub>2</sub> parameters for 1 hour measurement were still in the good category and statistical test results were not significantly related to the incidence of respiratory problems around industrial areas where p-value 0.025 > p α (0.05). Factors that affect the formation of NO<sub>2</sub> are combustion temperature, the presence of excess air available because excess air at a certain concentration will dilute the combustion gases resulting in a lower combustion temperature resulting in a decrease in the amount of NO<sub>2</sub>.<sup>[11]</sup>

NO<sub>2</sub> gas can cause health problems in the form of increased inspiratory and expiratory resistance, the occurrence of lung puffs.<sup>[12]</sup> In addition, absorption of NO<sub>2</sub> gas by the mucosa can cause inflammation of the upper respiratory tract and irritation of the eye mucosa.<sup>[13]</sup> The results of the study are not significant may be due to meteorological factors such as temperature, wind speed, sunlight that affect the existence of a pollutant in a particular area. Factors that affect the formation of NO<sub>2</sub> are combustion temperature and excess air at certain concentrations that can dilute combustion gases, resulting in a decrease in the amount of NO<sub>2</sub>.<sup>[14]</sup>

## Conclusion

Based on the results of research that has been done, it is known that smoking activities in the house do not affect NO<sub>2</sub> concentrations. NO<sub>2</sub> pollutants do not affect respiratory disorders

suffered by residents of houses around the Konawe industrial area.

The limitations of the data contained in this study, for further researchers, it is necessary to add factors that affect air quality in the house such as the physical condition of the house, namely the area of the room, the area of ventilation, the number of ventilation, the use of the type of roof and other physical conditions and activities carried out by residents of the house, namely the frequency of cleaning the house, the use of home cleaning materials and other activities, in addition to outdoor activity factors such as environmental conditions in the home area, because outdoor activity factors can affect the air inside the house

## References

1. Ahluwika, S. K., & Matsui, E. C. The indoor environment and its effects on childhood asthma. *Current Opinion in Allergy and Clinical Immunology*. 2011; 11(2):137-143. doi: 10.1097/ACI.0b013e3283445921.
2. Azhar, K., Dharmayanti, I., & Mufida, I. Particulate dust (PM<sub>2.5</sub>) levels in homes and the incidence of ARI in toddlers in Kayuringin Jaya Village, Bekasi City in 2014. *Health Research and Development Media*. 2016; 26(1):45-52.
3. Baker, R. J., Hertz-Picciotto, I., Dostal, M., Keller, J. A., Nozicka, J., Kotesovec, F., Dejmek, J., Loomis, D., & Sram, Rj. (2006). Coal home heating and environmental tobacco smoke in relation to lower respiratory illness in Czech children, from birth to 3 years of age. *Environmental Health Perspectives*. 2006; 114(7):1126-1132.
4. Bestar, N. *Study and quantification of air pollution emissions due to open burning of household waste in Depok City (Thesis)*. Environmental Engineering Study Program, Faculty of Engineering, University of Indonesia, Depok; 2012.
5. Breyse, P. N., Diette, G. B., Matsui, E. C., Butz, A. M., Hansel, N. N., & McCormack, M. C. Indoor air pollution and asthma in children. *Proceedings of the American Thoracic Society*. 2010; 7(2): 102-106. doi: 10.1513/pats.200908-083RM.
6. Catiyas, E. *Factors related to the incidence of ARI in toddlers in Gombong District, Kebumen Regency, Central Java in 2012 (Thesis)*. Bachelor Program in Public Health, Faculty of Public Health, University of Indonesia, Depok; 2012.
7. Getrudis, T. *The relationship between particulate matter (PM<sub>10</sub>) levels in residential air and the incidence of ARI in toddlers around the cement factory of PT. Indocement, Citereup in 2010 (Postgraduate Thesis)*. Faculty of Public Health, University of Indonesia, Depok; 2010.
8. Huboyo, H. S., & Budiharjo, M. A. Measurement of PM<sub>10</sub> concentration in indoor air (Case study: wood- and kerosene-fired household kitchen). *Tropical Environments*. 2009; 3(2):105-114.
9. Klepeis, N. E., Belletiere, J., Hughes, S. C., Nguyen, B., Berardi, V., Liles, S., Obayashi, S., Hofstetter, C. R., Blumberg, E., & Hovell, M. F. Fine particles in homes of predominantly low-income families with children and smokers: key physical and behavioral determinants to inform indoor-air quality interventions. *Plos One*. 2017; 12(5). doi: 10.1371/journal.pone.0177718.eCollection 2017
10. Kumar, R., Nagar, J. K., Goel, N., Kumar, P., Kuswah, A. S., & Gaur, S. N. Indoor air pollution and asthma in children at Delhi, India. *Pneumonologia I Alergologia Polska*. 2015; 83(4): 275-282. doi: 10.5603/PiAP.2015.0047.
11. Lindawaty. *Particulate matter (PM<sub>10</sub>) of residential air that affects the incidence of acute respiratory tract infection (ARI) in toddlers (research in MampangPrapatan District, South Jakarta in 2009-2010 (Thesis)*. Faculty of Public Health, University of Indonesia, Depok; 2010.
12. Lu, F., Xu, D., Cheng, Y., Dong, S., Guo, C., Jiang, X., & Zheng, X. (2015). Systematic review and meta-analysis of the adverse health effects of ambient PM<sub>2.5</sub> and PM<sub>10</sub> pollution in

the chinese population. *Environmental Research*. 2015;136: 196-204. doi: 10.1016/j.envres.2014.06.029.

13. Mahalastri, N. N. D. The relationship between indoor air pollution and the incidence of toddler pneumonia. *Periodical Journal of Epidemiology*. 2014;2(3):392-403.
14. Mitsakou, C., Housiadas, C., Eleftheriadis, K., Vratolis, S., Helmis, C., & Asimakopoulus, D. Lung deposition of fine and ultrafine particles outdoors and indoors during cooking event and a no activity period. *Indoor Air*. 2007;17(2):143-152.