



Original Research article

Study of The Influence of Air Quality Index on Community Comfort in The Penggilingan Area, Cakung, East Jakarta

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ABSTRACT

The Penggilingan area, Cakung, East Jakarta, is a fast industrial growth area, this area is a center of industrial activity and distribution channels, attracting a large population to live and work in the surrounding area. Air pollution in the Penggilingan Area, Cakung, is caused by various factors, including emissions produced by industry, motorized vehicles and combustion activities. Community comfort is the main concern. Poor air quality can harm physical health, but it can also affect people's thermal comfort and psychological well-being. The Air Comfort Index (THI) is an important part of evaluating people's thermal comfort. This research aims to examine the relationship between air conditions, temperature and people's perception of comfort in the Penggilingan Area. This research was conducted in Penggilingan Village, Cakung District, East Jakarta City. This research was conducted during the period 15 April - 23 April 2024. The data analysis used in this research was qualitative analysis and qualitative descriptive. 67% of the air comfort index in the study area is uncomfortable, the remaining 33% is partly uncomfortable. The air quality index is in the range 107-164. The air quality index for the vulnerable has been included in the unhealthy air quality category for sensitive groups, and the unhealthy category. The air quality index and air comfort index affect the activities and health of people who live and work in the Penggilingan area, Cakung, East Jakarta.

Keyword: Air pollution; Air Comfort Index; Air quality; Industrial area

1. INTRODUCTION

The Penggilingan area, Cakung, East Jakarta, is an illustration of economic change and rapid industrial development in urban areas. The Cakung area is part of the capital Jakarta. The city of Jakarta itself is a city that has a large population and pollution, which is stated in a study that Indonesia is in the top 8 in deaths due to air pollution levels (Jakob et al., 2021; Kusumaningtyas et al., 2018). With rapid industrial growth, the area has become a center of industrial activity as well as a distribution channel, attracting a large population to settle and work in the vicinity. The presence of air has a vital role in the existence and survival of life. However, in the context of this era which is filled with rapid urban development, industry and transportation, air quality is changing due to air pollution. This includes changes in air

composition from its original normal state (Ismiyati et al, 2018). However, this growth also has an impact on the surrounding environment, with air pollution one of the main challenges faced by local communities.

Air pollution in the Penggilingan Area, Cakung, is caused by various factors, including emissions produced by industry, motorized vehicles and combustion activities. Air pollution is one of the most crucial health factors where globally, 9 out of 10 people in the world are contaminated with air pollution (Soemarko et al., 2023). Anthropogenic developments (human activities) have increased the amount of CO₂ emissions, especially in terms of direct and indirect fuel use. (Siregar et al, 2019). These emissions contain various dangerous air pollutants such as Particulate Matter (PM), Nitrogen Dioxide (NO₂), and Volatile Organic Compounds (VOCs), which have a negative impact on human health and the environment. If the rapid development of development and the increasing use of motorized vehicles is not accompanied by adaptation and mitigation efforts, it will worsen environmental conditions, thereby worsening air quality conditions (Setyaputri et al, 2023). A study conducted by Rendana and Komariah (2021) shows that traffic emissions themselves contributed to a greater reduction in air pollution compared to the industrial sector because the reduction in emissions was shown during the lockdown in 2019. Changes in air conditions during COVID-19 were shown in the air conditions before and after COVID-19 which showed Particulate Matter, such as PM 2.5, experienced a significant decrease in numbers (Pardamean et al. 2021).

Particulate matter or dust contributes to the majority of pollutant emissions originating from various sources such as vehicle activities, industry or community activities. Particulates consist of several sizes determined from the source, namely Total Suspended Particulate (TSP) with a size of <30µm, PM₁₀ with a diameter of <10µm, PM 2.5 measuring 2.5µm which will enter the lungs and cause several respiratory tract diseases, and particulates measuring 0.1 µm (Ihsan et al, 2021). Based on a statement released by the World Health Organization (WHO), the size of particulates in the air should be < 20 µg/m³. Meanwhile, PM 2.5 in Jakarta has a particulate size of around 160 and is categorized as unhealthy (Bikis, 2023; Kriswandanu et al., 2023). PM 2.5 can cause diseases including respiratory tract infections (ARI), lung cancer, cardiovascular disease, premature death, and chronic obstructive pulmonary disease (Maulana and Pamurti, 2023). In addition, hot and humid weather which generally occurs in the East Jakarta area can worsen air quality by triggering chemical processes that increase the formation of ozone and pollution particles.

Air health is an important thing because it can affect people's comfort, which is the main concern. This is because air pollution is vulnerable to attacking children and the elderly (Risma, 2020). It is important for the public to know information about air quality so that they



can know the air conditions in certain areas as the first preventive measure (Shriram and Malladi, 2020). Not only can poor air quality disrupt physical health, but it can also affect people's thermal comfort and psychological well-being. Factors such as air temperature, humidity, and air quality collectively influence people's perceptions of comfort around the Milling Area. Therefore, a deep understanding of the interactions between these factors is important to formulate effective strategies to improve people's comfort and quality of life.

Temperature Humidity Index(THI) is an index that can be used to determine heat conditions for human comfort by calculating the elements of air temperature and humidity (Soraya et al, 2020). The Air Comfort Index (THI) is an important tool in evaluating people's thermal comfort. THI combines air temperature and relative humidity to measure human thermal comfort levels. However, in the context of the Milling Area, Cakung, East Jakarta. Thermal comfort or is when the body responds to temperature with a hot or cold sensation, and is considered comfortable when there is a balance between the body and environmental temperature Zuraihan et al, 2023). Conditions of environmental discomfort due to air quality can cause illnesses such as sick building syndrome, fatigue, dizziness, sore throat and fever (Shidki et al, 2020).

Thus, this research aims to examine the relationship between air conditions, temperature and people's perceptions of comfort in the Penggilingan Area. This research will not only help in identifying factors that influence community comfort, but will also provide a strong basis for the development of environmental policies and mitigation strategies aimed at improving the quality of life and welfare of communities in this region.

2. RESEARCH METHOD

2.1. Research Location and Time

This research was conducted in Penggilingan Village, Cakung District, East Jakarta City. This location was chosen by considering suitability to the title raised and problem formulation. This research was conducted during the period 15 April - 23 April 2024. This research time was used to search for research data in the form of interviews and filling out questionnaires, as well as processing air quality index data and literature reviews.

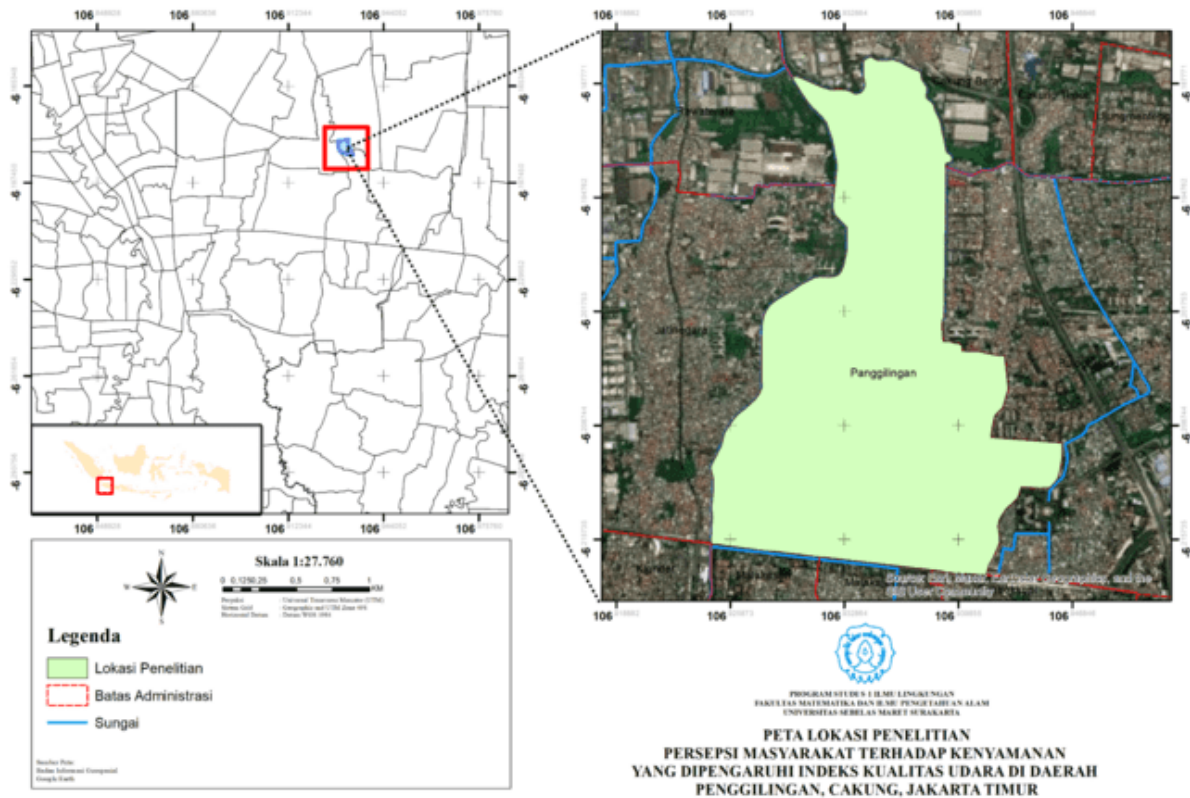


Figure 1. Research sites

2.2. Method of collecting data

Data collection in this research was carried out by means of interviews, questionnaires and literature studies. The data used in this research is primary data and secondary data. Primary data was obtained through interviews and distributing questionnaires. Secondary data was obtained through literature reviews from the Index Air Quality (IQair) website, the Accuweather website, articles, books and research journals.

2.3. Data analysis method

The data analysis used in this research is qualitative analysis and qualitative descriptive. Data analysis was carried out by describing the results of interviews and collecting questionnaires carried out by researchers. In addition, an analysis of how the air comfort index affects people's comfort at the research location was carried out which was used to analyze the air comfort index (THI) using the formula:

$$THI = 0,8 T + ((RH \times T) / 500)$$

Information:

THI : Temperature Humidity Index

Q : Temperature (Celsius)

RH : Relative Humidity

3. RESULTS AND DISCUSSION

3.1. Results

Table 1. Research result

| Date and time | Temperature (C) | | | Humidity (%) | PM 2.5 ($\mu\text{g}/\text{m}^3$) | Air Quality Index | Air Pollution Levels |
|---------------------------|-----------------|-----|---------|--------------|-------------------------------------|-------------------|--------------------------------|
| | Min | Max | Average | | | | |
| Monday, April 15, 2024 | 25 | 33 | 29 | 60 | 39 | 110 | Unhealthy for sensitive groups |
| Tuesday, April 16, 2024 | 26 | 33 | 29.5 | 70 | 50.7 | 138 | Unhealthy for sensitive groups |
| Wednesday, April 17, 2024 | 25 | 33 | 29 | 60 | 58 | 152 | Not healthy |
| Thursday, April 18, 2024 | 24 | 33 | 28.5 | 80 | 38.1 | 107 | Unhealthy for sensitive groups |
| Friday, April 19, 2024 | 25 | 34 | 29.5 | 70 | 65.9 | 156 | Not healthy |
| Saturday, April 20, 2024 | 25 | 33 | 29 | 80 | 51 | 139 | Unhealthy for sensitive groups |
| Sunday, April 21, 2024 | 25 | 33 | 29 | 60 | 48 | 132 | Unhealthy for sensitive groups |
| Monday, April 22, 2024 | 25 | 33 | 29 | 70 | 50.8 | 138 | Unhealthy for sensitive groups |
| Tuesday, April 23, 2024 | 25 | 34 | 29.5 | 70 | 69 | 164 | Not healthy |

3.2. Temperature

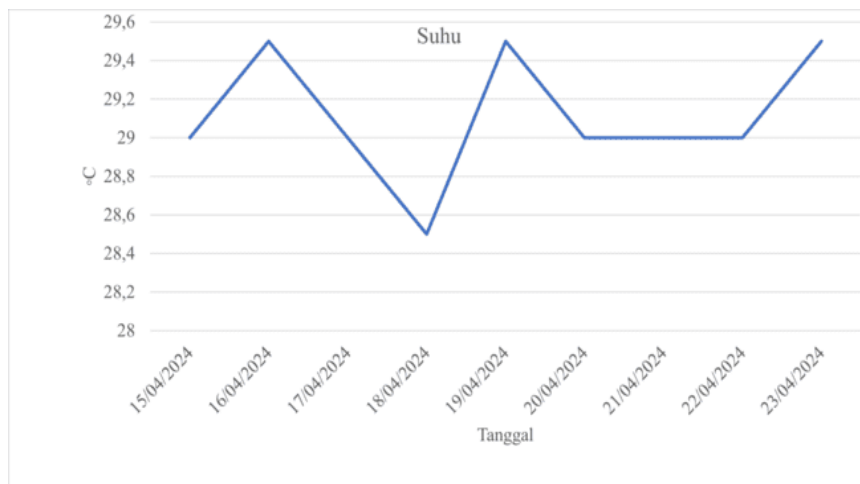


Figure 2. Air temperature graph

From the results of the research conducted. The highest temperature in the Palasan, Cakung, East Jakarta area was 29.5 degrees Celsius on April 16 2024, April 19 2024 and April 23 2024. A temperature of 29.5 is considered quite hot and can affect comfort. people who live or work in the Pgilan area, Cakung, East Jakarta. Meanwhile, the lowest temperature in the research area was 28.5 degrees Celsius on April 18 2024. The lowest temperature figure during the research period was only 1 degree Celsius difference from the highest temperature and a difference of 0.5 degrees Celsius from the average temperature during the research period of 29 degrees Celsius.

3.3. Humidity

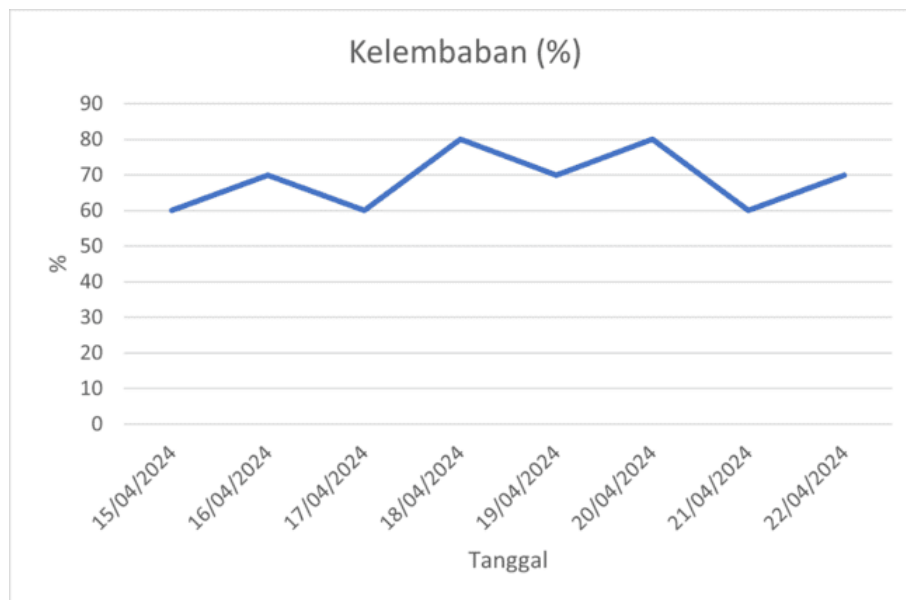


Figure 3. Air humidity level

Based on the results of research conducted in the Penggilingan area, Cakung, East Jakarta, the average humidity from April 15 to April 23 2024 was 68.88%. The humidity with the highest percentage in the research period was 80% on April 18 2024. On April 18 2024, it rained in the Palasan area, Cakung, East Jakarta. Meanwhile, the lowest humidity will be on April 15, April 17 and April 21 2024 with a humidity level of 60%. Air humidity has a relationship with air pollution because if the air humidity level is high, with the presence of urban forests, it can help the deposition of PM 2.5 more quickly and reduce air pollutants (Su et al., 2022).

3.4. Temperature Humidity Index (THI)

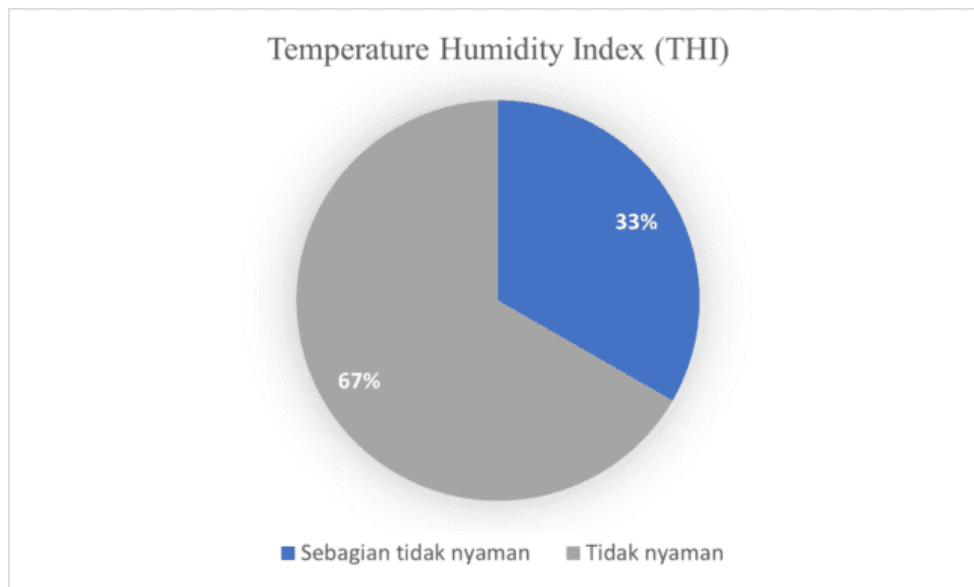


Figure 4. Temperature Humidity Index (THI) diagram

Temperature Humidity Index (THI) category:

Table 2. Temperature Humidity Index (THI) Classification

| No | THI (C) | Category |
|----|---------|------------------------|
| 1 | 21-24 | Comfortable |
| 2 | 25-27 | Some are uncomfortable |
| 3 | >27 | Uncomfortable |

The air comfort index is divided into 3 classifications, namely the range of 21-24 degrees Celsius for the comfortable category, 25-27 degrees Celsius for the partially uncomfortable category, and more than 27 degrees for the uncomfortable category. The results of the Temperature Humidity Index (THI) in the Palasan, Cakung, East Jakarta area during the research period of 15 April - 23 April 2024 showed that the results of the comfort index from calculating the Temperature Humidity Index (THI), 67% of the air comfort index in the research area was uncomfortable, where the criteria for discomfort are if the Temperature Humidity Index (THI) is above 27 degrees Celsius. The remaining 33% is partially uncomfortable with an air comfort index classification of 25-27 degrees Celsius. This needs to be a concern for relevant stakeholders. Of the three classifications, the Temperature Humidity Index (THI) is comfortable, some are uncomfortable, and some are uncomfortable. The Penggilingan area, Cakung did not reach the air comfort index in the comfortable category with a range of 21-24 degrees Celsius. Efforts to adapt and mitigate air comfort problems in the Penggilingan area, Cakung need to be a focus for relevant stakeholders.

3.5. Air Quality Index (AQI)

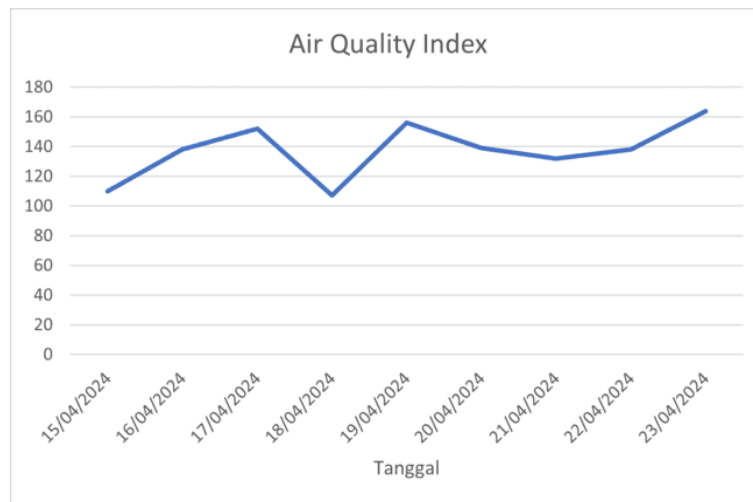


Figure 5. Air Quality Index (AQI) graph

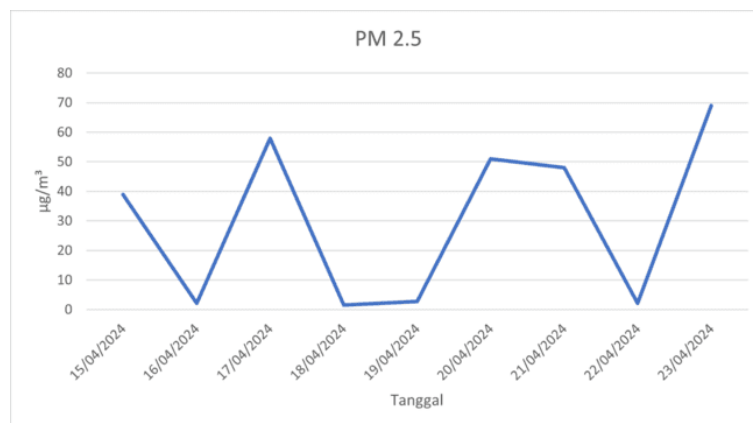


Figure 6. PM 2.5 concentration graph

Air Quality Index (AQI) Category

Table 3.Water Quality Index (AQI) Classification

| Category | Air Quality Index (AQI) | Pm 2.5 |
|--------------------------------|-------------------------|--------------|
| Good | 0-50 | 0 - 12.0 |
| Currently | 51-100 | 12.1 - 35.4 |
| Unhealthy for Sensitive Groups | 101-150 | 35.5 - 55.5 |
| Not healthy | 151-200 | 55.6 - 150.4 |

The Air Quality Index (AQI) is an index calculation developed by the United States Environmental Protection Agency (US-EPA) which categorizes air quality from healthy to unhealthy for sensitive groups (Cardito et al., 2023). The air quality index is categorized into 4 classes, including the good category with an air quality index of 0-50, the moderate category with a range of 51-100, the unhealthy category for sensitive groups with a range of 101-150,

and the unhealthy category with an air quality index range of 151-150. 200. The research results obtained through secondary data in the form of the air quality index (AQI), in the Penggilingan Area, Cakung, the air quality index is in the range 107-164. The air quality index for the vulnerable has been included in the unhealthy air quality category for sensitive groups, and the unhealthy category. This is also supported by PM 2.5 particulate data with a range of 35.5-150.4 in the same category as the air quality index (AQI) figures. This air quality index affects the comfort and health of people in an area, with the air quality index being included in the unhealthy category for sensitive and unhealthy groups, it needs serious attention from stakeholders to respond and overcome the increasingly deteriorating air quality index.

3.6. Respondent results

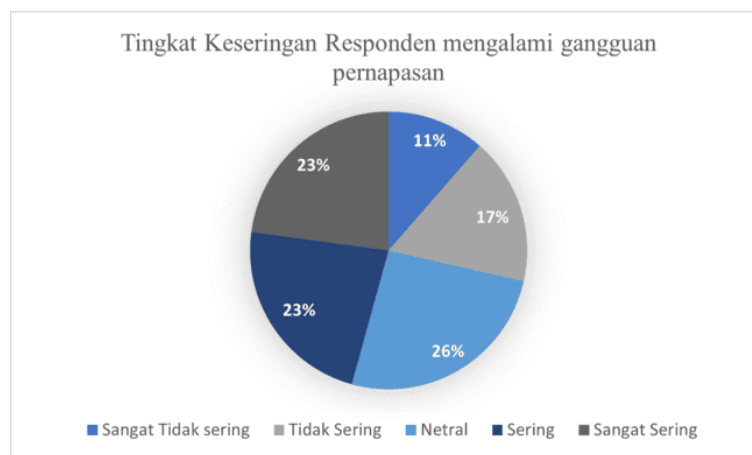


Figure 7. Respondents' results related to the frequency of experiencing respiratory problems

The results of the questionnaire were distributed to people who work or live in the Penggilingan area, Cakung, East Jakarta. There were 35 respondents who answered the questionnaire distributed. The results obtained from the question regarding the frequency with which respondents experienced respiratory problems were 23% of the respondents very often experienced respiratory problems, 23% often experienced respiratory problems, 26% of respondents were neutral about the question, 17% did not often experience respiratory problems, and 11% very rarely often experience respiratory problems.

The results of these respondents correlate with the air comfort index which tends to be uncomfortable and partly uncomfortable, as well as the air quality index for the Pggilan, Cakung area which falls into the unhealthy category for sensitive groups, and the unhealthy category. An unhealthy air quality index greatly influences respiratory disorders which can cause acute respiratory infections (ARI). This can be caused by the entry of PM 2.5 into the respiratory tract (Jin et al., 2024). Efforts need to be made to control air quality in the Penggilingan area, Cakung.

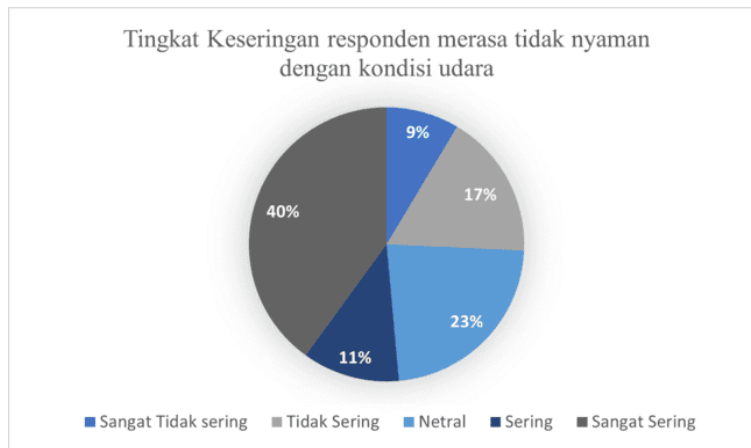


Figure 8. Respondents' results related to the level of frequency of feeling uncomfortable

From the results of research conducted regarding the frequency of respondents experiencing discomfort with the air conditions in the Pisiran area, Cakung, the results showed that 40% of respondents very often experienced discomfort with the existing air conditions, 11% of respondents often felt uncomfortable with the conditions. air in the research area, 23% of respondents were neutral with the question, 17% of respondents felt that it was not very often, and 9% of respondents very rarely felt uncomfortable with the air conditions in the Pggilan area, Cakung, East Jakarta.

The results of the level of respondents feeling uncomfortable with the air conditions in the Penggilingan area are positively correlated with the data *Temperature Humidity Index*(THI) where 67% were very uncomfortable, and 33% were uncomfortable. Factors that influence air discomfort in the Pggilan area, Cakung, East Jakarta are caused by high air temperatures in the area and low levels of humidity. Even though in urban areas like Jakarta, people spend more time indoors, air pollutants can still enter the room from outside and can still cause discomfort for respondents (Fu et al., 2022).

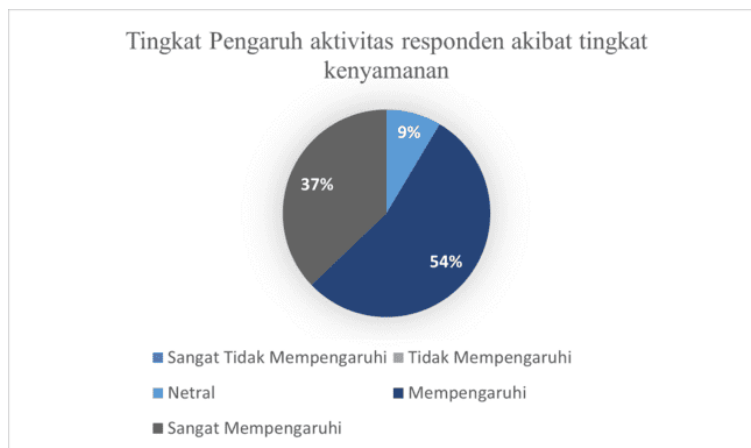


Figure 9. Respondents' results related to the level of influence of air quality on activities

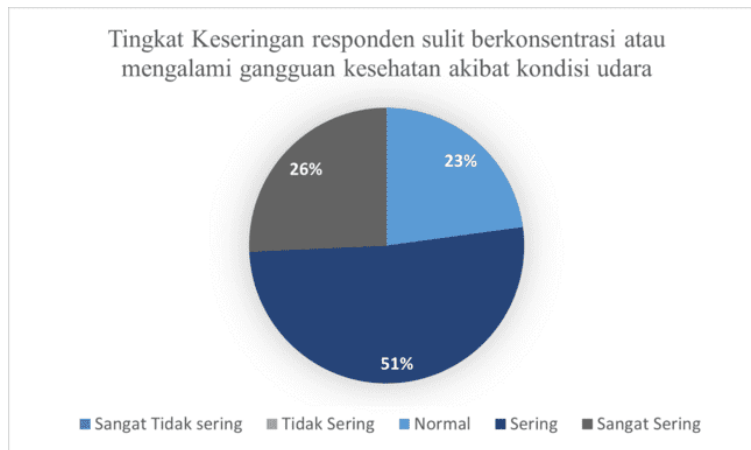


Figure 10. Respondent results related to the level of difficulty respondents had in concentrating due to air conditions

The results of the research stated that 40% of people often felt uncomfortable with the air conditions in the Penggilingan area, Cakung, East Jakarta, which could result in disruption to community activities. The level of influence of air comfort on respondents' activities was 37% strongly influenced, 54% influenced, and 9% were neutral with this question. Disruption of community activities due to high air temperatures can cause several disorders such as: *fatigue*, fatigue easily, and other diseases that have the potential to be caused by high air temperatures in the Penggilingan area, Cakung, East Jakarta. This is because working in an environment with high air temperatures can cause dehydration due to reduced body fluids caused by factors such as temperature, air humidity and air speed (Juliana et al. 2021).



Figure 11. Respondents' results related to improvements in air quality and comfort

The community really hopes for efforts to improve air quality to increase air comfort, so that the productivity of the community in the Penggilingan area, Cakung, East Jakarta is not disturbed. Efforts to improve air quality to increase comfort in the area require cooperation from multiple parties. This cooperation needs to be carried out between the community, industry in the area and the government. Each party can carry out tasks or efforts according

to their respective parts. One of the efforts that the government has made to reduce air pollution is the odd-even vehicle policy which has been in effect since 2016 on Monday-Friday from 6 am to 9 pm but unfortunately, in a study conducted by Zulkarnain and Ghiffary (2021) this policy has not yet been implemented. succeeded in reducing air pollution levels due to weak regulations in ongoing policies.

4. CONCLUSION

The air quality index in the Pggilan area, Cakung, East Jakarta is included in the unhealthy air quality category for sensitive and unhealthy groups. The air comfort index in the area is mostly uncomfortable. From the results of this research, the air quality index and air comfort index influence the activities and health of people who live and work in the Penggilangan area, Cakung, East Jakarta. Therefore, there is a need for adaptation or mitigation measures related to air quality in the area.

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REFERENCES

- Bikis, A. 2023. Urban Air Pollution and Greenness in Relation to Public Health. *Journal of Environmental and Public Health*, 2(1): 1-18.
- Cardito, A., Carotuneto, M., Amoruso, A., Libralato, G., and Lofrano, G. 2023. Air quality trends and implications pre and post Covid-19 restrictions. *Science of the Total Environment*, 879(2023) : 1-10.
- Fu, N., Kim, MK, Huang, L., Liu J., Chen, B., and Sharples, S. 2022. Experimental and numerical analysis of indoor air quality affected by outdoor air particulate levels (PM1.0, PM2.5 and PM10), room infiltration rate, and occupants' behavior. *Science of the Total Environment*, 851(2) : 1-15.
- Ihsan, IM, M. Yani, R. Hidayat, T. Permatasari. 2021. Fluctuations in Particulate Air Pollution and the Level of Risk to Public Health in Bogor City. *Journal of Environmental Technology*. 22 (1) : 38-47.
- Ismiyati, D. Marlita, D. Saidah, 2018. Air Pollution Due to Motor Vehicle Exhaust Gas Emissions. *Journal of Transportation and Logistics Management*. 1(3): 241-248
- Jakob, A., Hasibuan, S., and Fiantis, D. 2022. Empirical evidence shows that air quality changes during COVID-19 pandemic lockdown in Jakarta, Indonesia are due to seasonal variation, not restricted movements. *Environmental Research*, 208(2022) : 1-5.
- Jin, MY, Zhang, LY, Peng, ZR, He, H. Di, Kumar, P., and Gallagher, J. 2024. The impact of dynamic traffic and wind conditions on green infrastructure performance to improve local air quality. *Science of the Total Environment*, 917.



<https://doi.org/10.1016/j.scitotenv.2024.170211>

- Juliana, N., Mallongi, A., and Megasari, WO 2021. Analysis of Humidity, Temperature, Working Period, and Personal Protective Equipment in Home Industry at Gold Craftsmen. *Journal of Health Sciences*, 9(2): 1-9.
- Kusumaningtyas, SDA, Aldrian, E., Wati, T., Atmoko, D., and Sunaryo. 2018. The Recent State of Ambient Air Quality in Jakarta. *Aerosol and Air Quality Research*, 18: 2343–2354.
- Kriswandanu, AR, Muhtadi, MA, Suprayitno, E., Ahmaniyah, & Wardita, Y. (2023). Effects of urbanization, transport infrastructure, air quality, and health outcomes on the quality of life of Jakarta city population. *West Science Geoscience Journal*, 1(2), 54-63.
- Maulana NF, AA Pamurti. 2023. Analysis of the Level of Environmental Pollution in Residential Areas Around Mangkang Market, Semarang City. *Jayapangus Press*. 3(3): 268-276.
- Pardamean, B., Rahutomo, R., Cenggoro, TW, Budiarto, A., & Perbangsa, AS (2021). The impact of large-scale social restriction phases on the air quality index in Jakarta. *Atmosphere*, 12(7), 922. Setyaputri, AF, DD Ramadhani, W. Kisworo. 2023. Study of comfort in green open spaces based on THI in Sawahan Village, Ngemplak District, Boyolali Regency. *Nusantara Hasana Journal*. 2(8): 374-387.
- Risma , SS 2020. RELATIONSHIP BETWEEN AIR POLLUTION STANDARD INDEX (APSI) IN NORTH JAKARTA AND WEST JAKARTA USING VECTOR AUTOREGRESSIVE (VAR) MODELING. *GeoEco Journal*, 6(2): 185-195.
- Rendana, M., and Komariah, LN 2021. The relationship between air pollutants and COVID-19 cases and large-scale social restrictions' impact on the air quality in Jakarta, Indonesia. *Journal of Natural Resources and Environmental Management*, 11(1): 93-100.
- Shidki, H., I. Chandra, E. Djunaedy. 2020. Analysis of Indoor Air Quality in Open Offices at Telkom University. *E-proceeding of Engineering*. 7(1) : 2020.
- Shriram, P., and Malladi, S. 2020. A Study and Analysis of Air Quality Index and Related Health Impact on Public Health. *International Conference on IoT based Control Networks and Intelligent Systems*, 2(1) : 1-13.
- Siregar, DC, VP Ardah, RD Ninggar. 2019. Identification of Tanjungpinang City Comfort Based on the Humidex Heat Index. *Journal of Environmental Science*. 17 (2): 316-322.
- Soemarko, DS, Basrowi, RW, Setiawati, EP, & Megasari, D. (2023). Air pollution and its impact on child health in the Jakarta metropolitan area. *The Open Public Health Journal*, 16, Article e230831-2023.
- Soraya, SN, M. I, Jumarang, Muliadi. 2020. Study of Comfort Levels Based on Air Temperature, OLR (Outgoing Longwave Radiation) Humidity and Wind. *Prism Physics*. 8 (2) : 147-152.
- Su, TH, Lin, CS, Lu, SY, Lin, JC, Wang, HH, and Liu, CP 2022. Effect of air quality improvement by urban parks on mitigating PM2.5 and its associated heavy metals: A mobile-monitoring field study. *Journal of Environmental Management*, 323. <https://doi.org/10.1016/j.jenvman.2022.116283>

Zulkarnain., and Ghiffary. A. 2021. Impact of Odd-Even Driving Restrictions on Air Quality in Jakarta. *International Journal of Technology*, 12(5):925-934.

Zuraihan, A. Munandar, F. Muliani. 2023. Analysis of the Space Comfort Index Using a Climate and Material Approach. *Usakti Architectural Research and Scientific Work Journal*. 21 (2) : 135-149.

