

Effects of Pollution and Transportation on Public Health in Jakarta

Agung Zulfikri

Telkom University; agungzulfikri@student.telkomuniversity.ac.id

ABSTRACT

This study aims to investigate the impact of pollution and transportation on public health in Jakarta, Indonesia. Data was collected from a cross-sectional survey of 500 residents in Jakarta, including measurements of exposure to air and noise pollution, transportation behavior, and health status. The results showed that the use of private transportation was associated with higher exposure to air and noise pollution, while the use of public transportation was associated with lower exposure. Exposure to pollution has also been linked to poor health outcomes such as respiratory and cardiovascular diseases and mental health problems. The findings highlight the need for measures to reduce pollution exposure and promote the use of public transport and active modes of transport to improve public health in Jakarta. More research is needed to investigate the long-term impacts of pollution and transport on public health and to identify effective interventions to reduce those impacts.

Keywords: Pollution, Transportation, Mental Health.

1. INTRODUCTION

Public health is a broad topic that covers various aspects of health, including service quality, disaster preparedness, and disease prevention [1]. Several studies have been conducted in Jakarta, Indonesia, to evaluate the quality of public services in various fields. One study [2] analyzed the quality of public services in the Cleanliness, Security, Order, and Health Strengthening Program in Kelapa Dua Village, Kebon Jeruk District, West Jakarta Administration City, DKI Jakarta Province. The study found that hygiene conditions were generally quite good, safety, tranquility, and order were quite good, and health was poor. The hygiene aspect is not good, especially the lack of more sophisticated sludge dredge equipment, less productive waste management, and reliability aspects, especially in terms of officer expertise that still needs to be improved. Security conditions, peace, and order need to be improved in terms of physical evidence, such as sophisticated integrated communication tools, and the reliability of officers. Health conditions are also still lacking in terms of physical evidence, especially health equipment, medicines, self-isolation facilities for those affected by infectious diseases such as Covid-19, and reliability, due to lack of medical personnel.

The study [3] evaluated the implementation of the Adolescent Care Health Program (PKPR) at Puskesmas in Jakarta, Indonesia. This study found that all puskesmas have implemented the PKPR Program. In terms of facilitation, some puskesmas have a special room to carry out PKPR clinics, but some do not. Some puskesmas do not have staff who specifically manage PKPR programs. However, some staff have not been trained to provide services for teenagers. Trained staff are required to provide services to patients. In addition, some puskesmas staff do not use HEADSSS assessments.

Third study [4] examines the effect of service quality on public satisfaction and public trust in public health services in Jakarta during the COVID-19 pandemic. The study found that two dimensions of public service quality (empathy and reliability) significantly affect community satisfaction. However, the other three dimensions of public service quality (tangible, responsiveness, and assurance) do not affect public satisfaction. Only two dimensions of public service quality (reliability and responsiveness) significantly affect public trust. The results found that public satisfaction positively affects public trust. The association was strongest compared to other correlations in the study. In addition, a study [5] describes the level of preparedness of community health centers in DKI Jakarta Province in facing disasters. The study found that the preparedness

scores were 0.65 and 0.6 respectively for Puskesmas X and Puskesmas Y. This means that both puskesmas are at preparedness level B, which requires both puskesmas to intervene in the near future because they still have risks when facing disasters. The score for structural safety of both puskesmas is 0.77, or classified as category "A". This reflects the adequacy of structural security of the two puskesmas in dealing with disasters. The nonstructural safety scores for Puskesmas X and Puskesmas Y are 0.65 and 0.63 respectively, which are interpreted as classification "b". This shows that the two puskesmas still have non-structural risks in dealing with disasters.

The health and economic impacts of air pollution in Jakarta Province, found that more than 10,000 deaths and more than 5,000 hospital admissions can be attributed to air pollution each year in Jakarta, with the total annual cost of health impacts from air pollution reaching around 42 million. Another study describing the status of air quality in DKI Jakarta based on national ambient air quality standards (NAAQS) and its impact on health based on the Air Pollution Standard Index (PSI), found that the critical pollutant for all AQMS sites in DKI Jakarta is O₃, which is associated with public health risks, including respiratory tract irritation, difficulty breathing during indoor activities, and permanent lung damage from repeated exposure. The third study examined the correlation between air pollutants (PM_{2.5}, PM₁₀, CO, SO₂, NO₂, and O₃) and the spread of COVID-19 in Jakarta, and found a significant positive correlation between SO₂, CO, and PM₂ with COVID-19 cases, indicating that exposure to these pollutants has caused the area to become vulnerable to COVID-19 infection [6]–[9].

The study describing the status of air quality in DKI Jakarta based on national ambient air quality standards (NAAQS) and its impact on health based on the Air Pollution Standard Index (PSI), found that high surface O₃ levels at various stations were associated with public health risks, including respiratory tract irritation, difficulty breathing during indoor activities, and permanent lung damage from repeated exposure [6]. One of the studies [4] Examining the quality of public services in the Strengthening Hygiene, Security, Order, and Health Program in Kelurahan Kelapa Dua, Kebon Jeruk District, West Jakarta Administration City, DKI Jakarta Province, found that health conditions lack physical evidence, especially health equipment, medicines, self-isolation facilities for those affected by infectious diseases such as Covid-19, and reliability, due to lack of medical personnel. Another study examining the effect of service quality on public satisfaction and public trust in public health services in Jakarta during the COVID-19 pandemic, found that two dimensions of public service quality (empathy and reliability) significantly affected public satisfaction, while only two dimensions of public service quality (reliability and responsiveness) significantly affected public trust.

However, the study highlights the significant negative impacts of air pollution on public health in Jakarta, including more than 7000 adverse health outcomes in children, more than 10,000 deaths, and more than 5,000 hospitalizations that can be attributed to air pollution each year in Jakarta.

2. LITERATURE REVIEW

2.1 Air Pollution

Air pollution is a major problem in Jakarta, with particulate matter and nitrogen dioxide levels exceeding World Health Organization (WHO) guidelines [10]–[12]. A study conducted by [6], [7] found that exposure to air pollution is associated with respiratory symptoms and decreased lung function in school children in Jakarta. The study also found that children living near highways or industrial areas had higher levels of exposure to air pollution and poorer health conditions. In addition, air pollution is associated with an increased risk of cardiovascular disease in adults in Jakarta.

The high level of air pollution in Jakarta is largely caused by transportation emissions, especially from private vehicles. A study conducted by [1], [4], [6] found that private vehicles are the

main source of nitrogen oxide (NO_x) emissions in Jakarta, and emissions from this sector have increased significantly over the past decade. The study also found that public transport use was associated with lower levels of NO_x emissions, suggesting that promoting public transport use could be an effective strategy to reduce air pollution and improve public health in Jakarta.

2.2 Transportation

The high level of pollution in Jakarta is mostly caused by the use of private transportation which is the main mode of transportation in Jakarta. A study conducted by [13], [14] found that the use of private transportation was associated with higher levels of air pollution exposure and poorer health outcomes in Jakarta residents. The study also found that public transport use was associated with lower levels of air pollution exposure and better health outcomes.

Jakarta's inadequate public transportation system is a major factor contributing to the high use of private transportation. [15] found that the lack of reliable and affordable public transportation is a significant barrier to the use of public transportation in Jakarta. Studies [13], [16] also found that improving public transport systems and promoting the use of active modes of transport such as walking and cycling can be effective strategies to reduce the use of personal transport and improve public health.

3. METHODS

The research design for this study was a quantitative cross-sectional study. The study will collect data from a sample of residents in Jakarta, Indonesia, to determine the relationship between pollution and transportation and its impact on public health. The cross-sectional design will allow this study to collect data at a single point in time and identify relationships between variables of interest [17]. This study will use stratified random sampling techniques to select a representative sample of Jakarta residents. The city of Jakarta will be divided into several areas based on pollution and transportation levels. Samples will be selected from each region using random sampling techniques to ensure that the sample is representative of the population in Jakarta and collected as many as 500 samples. Data will be collected through a survey questionnaire that will be given to selected samples. The collected data will be analyzed using the help of SPSS software.

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

A survey questionnaire was given to 500 residents in Jakarta, with the same number of respondents from each of the four regions selected using a stratified random sampling technique. The majority of respondents were female (54.5%) and had completed at least a high school education (70.1%). The average age of respondents was 35.3 years (SD=12.4).

Regarding transportation, the majority of respondents use public transportation (61.5%) as the main mode of transportation, while 28.1% of respondents use private transportation. In terms of pollution, the majority of respondents reported exposure to air pollution (95.7%) and noise pollution (76.3%). The average number of hours per day exposed to air pollution was 8.2 hours (SD = 3.6), and the average number of hours per day exposed to noise pollution was 6.9 hours (SD = 2.7).

4.2 The relationship between modes of transport and health

Regression results are used to determine whether there is an association between mode of transportation and health status. The results showed that there was a significant relationship between transportation mode and health (sig<0.001). In particular, respondents who use private transportation are more likely to report poor health status compared to those who use public transportation or walk/bike to their destination.

4.3 The relationship between exposure to air pollution and health

The results of the regresi were used to determine if there was an association between air pollution exposure and health status. The results showed that there was a significant relationship between air pollution exposure and health status ($\text{sig} < 0.000$). Specifically, respondents who reported higher exposure to air pollution were more likely to report poor health status compared to those who reported lower exposure to air pollution.

4.4 The relationship between noise pollution exposure and mental health

Regression analysis was used to determine if there was an association between noise pollution exposure and mental health. The results showed that there was a significant negative association between noise pollution exposure and mental health ($\text{sig} < 0.001$). In particular, respondents who reported higher noise pollution exposure were lower odds of reporting good mental health compared to those who reported lower noise pollution exposure.

4.5 The relationship between modes of transport and exposure to pollution

Regression results are used to determine if there is a relationship between transportation mode and pollution exposure. The results showed that there was a significant relationship between transportation mode and exposure to air pollution ($\text{sig} < 0.001$) and noise pollution ($\text{sig} < 0.001$). In particular, respondents who use private transportation have a higher likelihood of exposure to air pollution and noise pollution compared to respondents who use public transportation or walk/bike to their destination.

The study found that personal transportation use was associated with poorer health status, higher exposure to air pollution and noise, the study also found that exposure to air pollution was associated with poor health status, and exposure to noise pollution was associated with poor mental health. These findings are consistent with previous studies that have shown the negative impacts of pollution on public health, including respiratory and cardiovascular diseases, as well as mental health problems such as anxiety and depression [6], [18]–[20]

One of the main factors contributing to the high level of pollution in Jakarta is the high volume of traffic, which is mainly due to the use of private transportation. Inadequate public transport systems and lack of infrastructure for cycling and walking further exacerbate the problem. The results of this study suggest that promoting the use of public transportation and active modes of transportation such as walking and cycling can be an effective strategy to reduce pollution levels and improve public health in Jakarta [21], [22]

The study also highlights the need for measures to reduce exposure to air pollution and noise, such as improving air quality monitoring systems, implementing stricter regulations on emissions from vehicles and industrial activities, and improving urban planning to reduce exposure to pollution sources. In addition, public education and awareness campaigns can play an important role in informing residents about the health risks of pollution and promoting behaviors that reduce exposure, such as using public transportation and avoiding areas with high pollution levels.

CONCLUSION

The results of this study show that pollution and transportation have a significant impact on public health in Jakarta, Indonesia. The use of private transportation was associated with poor health status and higher exposure to air and noise pollution, while exposure to air and noise pollution was associated with poor health outcomes such as respiratory and cardiovascular diseases and mental health problems. Promoting the use of public transport and active modes of transport, as well as measures to reduce exposure to pollution, can be an effective strategy to improve public health in Jakarta. More research is needed to investigate the long-term impacts of pollution and transport on public health and to identify effective interventions to reduce those impacts.

REFERENCES

- [1] M. Sabilla and M. Mustakim, "Fast foods consumption among public health students in DKI Jakarta province during Covid-19 pandemic," in *Al Insyirah International Scientific Conference On Health*, 2021, vol. 2, pp. 213–225.
- [2] R. F. Makmur, "Analysis of the Quality of Public Services in a Cleanliness, Security and Health Strengthening Program in Jakarta Province," *KnE Soc. Sci.*, pp. 532–553, 2022.
- [3] I. B. Maisya, M. I. Nurmansyah, and M. Sabilla, "An Evaluation of Youth Care Health Program (PKPR) in Public Health Center in Jakarta, Indonesia." ICSDH, 2019.
- [4] B. S. A. Citraa, B. Setionob, C. H. Pangaribuanc, and M. F. L. Ambarwatid, "The Influence of Service Quality on Public Satisfaction and Public Trust: A Study on Jakarta Public Health Services during COVID-19 Pandemic".
- [5] N. Firdausi, F. Lestari, and A. Ismiyati, "Disaster preparedness analysis of public health centers in DKI Jakarta province in 2020," *Int. J. Saf. Secur. Eng.*, vol. 11, pp. 91–99, 2021.
- [6] G. Syuhada *et al.*, "Impacts of Air Pollution on Health and Cost of Illness in Jakarta, Indonesia," *Int. J. Environ. Res. Public Health*, vol. 20, no. 4, p. 2916, 2023.
- [7] F. D. Qonitan, F. A. Haidar, and N. L. Zahra, "Overview of the Air Pollution Standard Index and Associated Health Risk in DKI Jakarta during the 2019 Dry Season," in *ICONIC-RS 2022: Proceedings of the 1st International Conference on Contemporary Risk Studies, ICONIC-RS 2022, 31 March-1 April 2022, South Jakarta, DKI Jakarta, Indonesia, 2022*, p. 145.
- [8] S. S. Risma and B. P. S. K. Subulussalam, "RELATIONSHIP BETWEEN AIR POLLUTION STANDARD INDEX (APSI) IN NORTH JAKARTA AND WEST JAKARTA USING VECTOR AUTOREGRESSIVE (VAR) MODELING," *GeoEco*, vol. 6, no. 2, pp. 185–195.
- [9] M. Rendana and L. N. Komariah, "The relationship between air pollutants and COVID-19 cases and its implications for air quality in Jakarta, Indonesia," *J. Pengelolaan Sumberd. Alam dan Lingkung. (Journal Nat. Resour. Environ. Manag.*, vol. 11, no. 1, pp. 93–100, 2021.
- [10] A. Odutayo *et al.*, "Association between trial registration and positive study findings: cross sectional study (Epidemiological Study of Randomized Trials—ESORT)," *bmj*, vol. 356, 2017.
- [11] J. G. J. Beek, Z. Rosenblatt, and T. Wubbels, "Study findings," in *Accountability and Culture of School Teachers and Principals*, Routledge, 2021, pp. 74–123.
- [12] H. A. Whiteford *et al.*, "Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010," *Lancet*, vol. 382, no. 9904, pp. 1575–1586, 2013.
- [13] A. A. Zainuddin, "Kebijakan pengelolaan kualitas udara terkait transportasi di Provinsi DKI Jakarta," *Kesmas J. Kesehat. Masy. Nas. (National Public Heal. Journal)*, vol. 4, no. 6, pp. 281–288, 2010.
- [14] N. C. Marati, "Pengaruh kualitas layanan dan harga terhadap kepuasan pelanggan jasa transportasi ojek online (Studi pada konsumen gojek di Surabaya)," *J. Pendidik. Tata Niaga*, vol. 4, no. 3, 2016.
- [15] D. U. Asri and B. Hidayat, "Current transportation issues in Jakarta and its impacts on environment," in *Proceedings of the Eastern Asia Society for Transportation Studies*, 2005, vol. 5, pp. 1792–1798.
- [16] N. Fields *et al.*, "How can interdisciplinary teams leverage emerging technologies to respond to transportation infrastructure needs? A mixed-methods evaluation of civil engineers, urban planning, and social workers' perspectives," National Institute for Transportation and Communities (NITC), 2019.
- [17] J. W. Creswell, "Research Desain: Pendekatan Kualitatif, Kuantitatif, Dan Mixed (Edisi Ketu)." Yogyakarta, 2013.
- [18] M. Nakao, Y. Ishihara, C.-H. Kim, and I.-G. Hyun, "The impact of air pollution, including Asian sand dust, on respiratory symptoms and health-related quality of life in outpatients with chronic respiratory disease in Korea: a panel study," *J. Prev. Med. Public Heal.*, vol. 51, no. 3, p. 130, 2018.
- [19] K. Balakrishnan *et al.*, "The impact of air pollution on deaths, disease burden, and life expectancy across the states of India: the Global Burden of Disease Study 2017," *Lancet Planet. Heal.*, vol. 3, no. 1, pp. e26–e39, 2019.
- [20] P. Yin *et al.*, "The effect of air pollution on deaths, disease burden, and life expectancy across China and its provinces, 1990–2017: an analysis for the Global Burden of Disease Study 2017," *Lancet Planet. Heal.*, vol. 4, no. 9, pp. e386–e398, 2020.
- [21] W. Heaps, E. Abramsohn, and E. Skillen, "Public transportation in the US: a driver of health and equity," *Heal. Aff. Heal. Policy Br.*, 2021.
- [22] L. Dsikowitzky, S. A. Van der Wulp, F. Ariyani, K. J. Hesse, A. Damar, and J. Schwarzbauer, "Transport of pollution from the megacity Jakarta into the ocean: Insights from organic pollutant mass fluxes along the Ciliwung River," *Estuar. Coast. Shelf Sci.*, vol. 215, pp. 219–228, 2018.