

REVIEW ARTICLE

The impact of air pollution from motor vehicles on public health: a comprehensive analysis

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Abstract

The presence of hazardous gas and particle emissions has a significant impact on human health. Therefore, a review is needed to analyze the impact of air pollution so that the public can be more aware of the importance of air pollution problems that occur around them. This review contains information related to the impact of air pollution collected from several previous studies that focus on air pollution and its impacts. The negative impacts on health caused by air pollution include lung disorders, heart disorders, immune system disorders, allergies, developmental disorders, cancer, and mental health disorders. The implementation of Environmental Tax, the use of corn cobs as activated carbon as an adsorbent, improving infrastructure and empowering mass transportation, and replacing BBM fuel with Hydrogen are some of the efforts that have been made to reduce air pollution due to gas emissions. In an effort to prevent the negative impacts of air pollution, consistency and commitment are needed from various sectors.

Keywords: Air Pollution, Emission, Health Impact.

INTRODUCTION

Air is made up of a mixture of different types of substances. In general, the composition of air includes 20.93% oxygen, 78.1% nitrogen, and 0.3% carbon dioxide, plus other gases such as argon, neon, krypton, xenon, and helium. In addition, air also contains water vapor, bacteria, dust particles, and plant remains. However, the air quality on our planet is getting worse over time due to pollution. Air pollution causes changes in the composition of the atmosphere, where increased concentrations of pollutants can damage objects, endanger living things, and disrupt overall air quality (Alisain et al., 2024).

Air pollution is one of the most pressing environmental problems in the world today, with significant impacts on human health and ecosystems. This pollution occurs due to emissions of harmful gases and particles from various sources, such as motor vehicles, industry, fossil fuel combustion,

and agricultural activities. This phenomenon occurs when harmful substances, whether physical, chemical, or biological, enter the atmosphere in quantities that can endanger the health of living things and damage the environment. The main cause of air pollution in Indonesia comes from motor vehicle emissions, which contribute more than 70% of total pollution. Motor vehicles release various hazardous substances that have negative impacts on human health and the environment. These hazardous substances include lead (Pb), suspended particles (SPM), nitrogen oxides (NO_x), hydrocarbons (HC), carbon monoxide (CO), and photochemical oxides (O_x). Specifically, motor vehicles are responsible for almost 100% of lead emissions, 13–44% of SPM, 71–89% of hydrocarbons, 34–73% of NO_x, and almost all carbon monoxide (CO) emissions in the air (Indriastiningsih, 2021).

The sources of air pollution in urban environments are diverse, including emissions from motor vehicles, industry, biomass burning, and construction activities. Motor vehicles are a major contributor to pollutant emissions, including carbon monoxide (CO), nitrogen dioxide (NO₂), and fine particulate matter such as PM_{2.5} and PM₁₀. Exposure to these pollutants has been shown to have adverse effects on public health, increasing the risk of respiratory diseases such as asthma and bronchitis, and cardiovascular diseases, including heart attacks and strokes (Umah and Gusmira, 2024).

The smoke produced by motor vehicles continues to increase along with the increasing number of users, which contributes to air pollution. In addition, waste from the agricultural sector, such as excessive use of fertilizers, produces ammonia gas which can pollute the atmosphere and is one of the causes of acid rain. Mining activities also play a role in air pollution, because the process of extracting resources from the earth releases various pollutants, including chemicals and dust in large quantities. In addition, the burning of garbage or piles of waste by humans produces a very pungent odor, which also pollutes the surrounding air (Yasir, 2021).

Carbon monoxide (CO) pollution produced by motor vehicles has a significant negative effect on human health. As a toxic gas compound, carbon monoxide reacts strongly with hemoglobin (Hb), a molecule that is responsible for delivering oxygen to all parts of the body. When CO binds to hemoglobin, the oxygen transport function is disrupted. As a result, the body's oxygen supply decreases drastically, causing symptoms of shortness of breath. If not immediately suspected and treated with fresh air, this can be fatal (Gunawan et al., 2020).

Pollutants such as fine particulate matter (PM_{2.5} and PM₁₀), nitrogen dioxide (NO₂), and tropospheric ozone can damage air quality and affect respiratory health. Long-term exposure to air pollution has been shown to increase the risk of serious diseases, including lung cancer, heart disease, and chronic respiratory disorders. In addition to health impacts, air pollution also contributes to climate change and environmental degradation, further worsening living conditions on our planet.

This study aims to analyze the impact of air pollution on public health, especially those caused by pollutants produced by motor vehicles. By understanding the relationship between air pollution and various health problems, it is hoped that the public can be more aware of the urgency of air pollution problems that occur around them. This awareness is important to encourage collective action in reducing vehicle emissions and improving air quality, so as to protect the health of individuals and the community as a whole. Through this study, it is hoped that the information obtained can be the basis for more effective public policies and environmental initiatives.

MATERIALS AND METHODS

This study adopts a literature review approach by collecting information from various previous studies to analyze the impact of air pollution on public health, especially those caused by pollutants produced by motor vehicles. In this process, several relevant literature sources were used, including a search through Google Scholar, which is an effective platform for finding scientific articles and journals related to health and environmental issues.

RESULTS AND DISCUSSION

Impact of Air Pollution on Health

Exposure to gas emissions from vehicles that enter the environment directly can have a negative impact on human health. In general, the term used to describe this danger is the impact of pollutants that can increase the risk of disease or other medical conditions, both in individuals and groups (Arwini, 2019). Exposure to gaseous emissions, both from natural sources and human activities, is becoming an increasingly pressing global environmental issue. Emissions of gases such as carbon dioxide, methane, nitrous oxide and other greenhouse gases contribute significantly to climate change, global warming and other adverse impacts on the environment and human health. Understanding the sources, types and impacts of gaseous emissions is crucial for mitigating and adapting to climate change and protecting public health. Therefore, it is important to identify sources of gaseous emissions and take strategic measures to reduce exposure to gaseous emissions and their negative impacts.

Epidemiological and experimental studies have shown that fine particulate matter (PM2.5) can penetrate deep into the lungs and even enter the bloodstream, which can trigger systemic inflammation and oxidative stress. Tropospheric ozone, which is formed through chemical reactions between sunlight and pollutants such as volatile organic compounds (VOCs) and nitrogen dioxide (NO₂), can irritate the respiratory tract and worsen asthma. Nitrogen dioxide (NO₂), produced from motor vehicle emissions and fossil fuel combustion, has the potential to cause inflammation of the respiratory tract and reduce lung function. In addition, sulfur dioxide (SO₂), produced from fossil fuel combustion and volcanic activity, can cause irritation to the eyes, nose, and throat and worsen respiratory diseases. (Umah and Gusmira 2024). According to the Secret (2023) Air pollution can have a significant impact on human health, including:

1. Respiratory disorders: Air pollutant particles, including dust, smoke, and harmful chemicals, can enter the respiratory tract and lungs. This can cause irritation of the respiratory tract, leading to symptoms such as coughing, runny nose, and throat discomfort. Prolonged exposure to air pollution can contribute to the development of chronic lung diseases, such as chronic bronchitis and emphysema, and increase the risk of developing lung cancer.
2. Heart and blood vessel disorders: Air pollution has a significant impact on the cardiovascular system. Small particles of air pollutants can enter the bloodstream, triggering inflammation of the blood vessels, and increasing the risk of coronary heart disease, heart attacks, and strokes. In addition, prolonged exposure to air pollution can cause increased blood pressure and damage blood vessel function.
3. Immune system disorders: Air pollution can negatively impact immune system function, increasing the body's susceptibility to respiratory infections, including pneumonia, bronchitis, and sinus infections.
4. Allergy and asthma problems: Exposure to allergens found in air pollution, such as pollen, animal dander, and dust mites, can trigger allergic reactions and asthma attacks in sensitive individuals. In addition, air pollution can also worsen existing asthma symptoms in sufferers.
5. Child developmental disorders: Children exposed to air pollution during their developmental years are at risk of developing abnormalities in lung development, decreased lung function, and potential impairments in cognitive function.
6. Cancer risk: Prolonged exposure to certain air pollutants, such as fine particulate matter (PM2.5) and chemicals such as benzene and formaldehyde, has been linked to an increased risk of lung cancer, upper respiratory tract cancer, and other types of cancer.

- 7. Mental health disorders: Several studies have shown a link between exposure to air pollution and an increased risk of mental health disorders, including depression, anxiety, and neurological disorders in children.

Air pollution, both indoor and outdoor, makes a substantial contribution to increasing the risk of lung cancer (Buana and Harahap, 2022). Some air pollution factors that contribute to increased risk of lung cancer include:

- 1. Particulate Matter: Small particles in the air, such as industrial pollutants, vehicle exhaust, or dust, can be inhaled and enter the lungs. These particles may contain carcinogens or other harmful substances that can cause damage to lung tissue over time.
- 2. Hazardous Chemicals: Exposure to hazardous chemicals such as arsenic, asbestos, radon, and industrial chemicals can increase the risk of lung cancer. Sources of these chemicals can come from outdoor air pollution or from materials used in certain industrial sectors.
- 3. Indoor Air Pollution: Air pollution, both outdoor and indoor, can increase the risk of lung cancer. For example, exposure to secondhand smoke, fumes from cooking, chemicals in household products, and the use of solid fuels for cooking or heating indoors can produce harmful pollutants. All of these contribute to an increased risk of lung cancer (Ua et al., 2023).

The results of research conducted by Inaku and Novianus, 2020, there is an influence of PM 2.5 and PM 10 on respiratory complaints of children in open spaces in DKI Jakarta, which were studied in three locations. Complaints that arose included coughing, runny nose, and sore throat. Children playing in green open spaces reported these complaints, with coughing and eye irritation being the most common health problems experienced by groups exposed to PM 2.5 and PM 10, namely 70% and 47%, respectively. Meanwhile, the unexposed group showed lower health problems, with only 10% experiencing coughing and runny nose.

Air Pollution Control Efforts

The increasing health risks due to air pollution, especially those caused by vehicle emissions, require serious attention from the government and the public. To address this issue, effective policies must be implemented to control vehicle emissions. Steps such as implementing stricter emission standards. With a combination of the right policies and active participation from the public, we can create a healthier environment and reduce the risk of air pollution-related diseases. The following is a table of efforts made to control air pollution:

Table 1. Previous research related to Air Pollution Control Efforts

Method	Results	Reference
Implementing Environmental Taxes to control negative externalities on the environment	The results of the implementation of Road Pricing in Singapore show a decrease in congestion levels of up to 75 percent. This means that people tend to reduce the use of private vehicles, which in turn contributes to reducing emissions from vehicles.	Dewi et al., 2022
Utilizing corn cob adsorbent as activated carbon to reduce motor vehicle gas emissions	Reducing the hydrocarbon (HC) content in the use of Pertamina Plus from the initial value of 398 ppm to 96 ppm resulted in a percentage reduction in HC of 0.53%.	Gunawan et al., 2020
Infrastructure improvement and mass transportation empowerment	Statistical data shows that the odd-even policy has succeeded in reducing congestion by around 25%. In addition, the widening project of Jalan Sudirman and Thamrin is also effective, with increased road capacity capable of reducing congestion levels by around 30%.	Putra and Lutfi, 2021

Table 1. Previous research related to Air Pollution Control Efforts

Method	Results	Reference
Replacing fuel with hydrogen	Hydrogen has the potential to be a renewable energy source because it can be used in motor vehicles. Research shows that by adding hydrogen produced through the electrolysis process of hydroxide solution, the energy consumption of vehicles traveling at a speed of about 40 km/h decreased by 29.72% when using a voltage input of 12 volts and a current of 5 amps. In addition, under the same conditions, there was a reduction in fuel consumption of 43.24% at a voltage input of 12 volts and a current of 5 amps.	Alfani, 2021
Biomass Processing Using Waste as Raw Material to Become Electrical Energy	Can reduce dependence on fossil-based energy sources, such as petroleum, natural gas, and coal.	Pramudiyanto and Suedy, 2020

From the table above, various emission control policies and efforts have proven effective in reducing air pollution levels in many countries. For example, the implementation of strict emission standards for motor vehicles and industry, as well as the promotion of renewable energy, have shown positive impacts in reducing pollutant concentrations in the atmosphere. However, to achieve sustainable results, consistency and commitment from all parties, including government, industry, and society, are needed. Without coordinated and sustainable efforts, air pollution will remain a serious challenge that threatens public health and the environment. With increasing urbanization and industrialization, air pollution is becoming a serious challenge that requires global attention. Efforts to reduce pollutant emissions through strict environmental policies, the use of clean technology, and public awareness of the importance of maintaining air quality are essential to protect human health and environmental sustainability. Therefore, it is important to continue to strengthen regulations, increase public awareness, and encourage environmentally friendly technological innovation to ensure that air pollution control efforts can be realized effectively.

CONCLUSIONS

Various measures that have proven effective in many countries, including the promotion of renewable energy and the use of clean technologies, are showing a positive impact in reducing air pollution. However, to achieve sustainable results, consistency and commitment from all parties to government, industry, and society are required. Without coordinated and sustained efforts, air pollution will continue to be a serious challenge that threatens public health and the environment. With increasing urbanization and industrialization, it is important to strengthen regulations, raise public awareness on air quality, and encourage innovation of environmentally friendly technologies. These efforts are critical to protecting human health as well as preserving the environment. Through collaboration and shared commitment, we can create a healthier environment and reduce the risk of air pollution-related diseases.

Author contributions

Mimin Indriani Mulia, Nabilah Aminah Lutpi: Conceptualization, analysis, draft writing, and editing.

Conflict of Interest

There is no conflict of interest in this study.

Acknowledgment

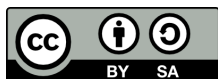
The researcher would like to thank all who contributed to this research.

Data availability

Data related to the findings of this study are available at the corresponding author.

REFERENCES

- Alfani, G. (2021). Pengaruh gas hidrogen dari larutan sodium hidroksida terhadap emisi buang dan konsumsi bahan bakar pada kendaraan bermotor. *Jurnal Simetrik*, 11(1), 417–421.
- Alisain, M., Rosdiana, R., & Assiddieq, M. (2024). Analisis tingkat pencemar sulfur dioksida (so₂) akibat aktivitas kendaraan bermotor di kota kendari:(studi kasus: Jalan christina marta tiahahu kelurahan lepo-lepo, kecamatan baruga). *Jurnal TELUK: Teknik Lingkungan UM Kendari*, 4(1), 014–018.
- Arwini, N. P. D. (2019). Dampak pencemaran udara terhadap kualitas udara di provinsi bali. *Jurnal Ilmiah Vastuwidya*, 2(2), 20–30.
- Buana, I., & Harahap, D. A. (2022). Asbestos, radon dan polusi udara sebagai faktor resiko kanker paru pada perempuan bukan perokok. *AVERROUS: Jurnal Kedokteran dan Kesehatan Malikussaleh*, 8(1), 1–16.
- Dewi, S. P., Alsakinah, R., Sara, S. A., & Amrina, D. H. (2022). Pajak lingkungan sebagai upaya pengendalian pencemaran udara dari gas buang kendaraan bermotor di indonesia. *Jurnal Ilmiah Ekonomi Dan Pajak*, 2(1), 7–13.
- Gunawan, S., Hasan, H., & Lubis, R. D. W. (2020). Pemanfaatan adsorben dari tongkol jagung sebagai karbon aktif untuk mengurangi emisi gas buang kendaraan bermotor. *Jurnal Rekayasa Material, Manufaktur dan Energi*, 3(1), 38–47.
- Inaku, A. H. R., & Novianus, C. (2020). Pengaruh pencemaran udara pm 2, 5 dan pm 10 terhadap keluhan pernapasan anak di ruang terbuka anak di dki jakarta. *ARKESMAS (Arsip Kesehat. Masyarakat)*, 5(2), 9–16.
- Indriastiningsih, E. (2021). Jurnal nasional analisis dampak pencemaran udarapt delta duniatextile terhadap kondisi masyarakat. *Jiki*, 14(1), 20–29.
- Pramudiyanto, A. S., & Suedy, S. W. A. (2020). Energi bersih dan ramah lingkungan dari biomassa untuk mengurangi efek gas rumah kaca dan perubahan iklim yang ekstrim. *Jurnal Energi Baru Dan Terbarukan*, 1(3), 86–99.
- Putra, E., & Lutfi, A. (2021). Strategi pemerintah provinsi dki jakarta dalam rangka pengendalian ruang terbuka hijau melalui pbb-p2. *Syntax Literate: Jurnal Ilmiah Indonesia*, 6.
- Ua, A. M. S., Marpaung, E. S. K., Ong, J., Savinka, M., Nurhaliza, P., Ningsih, R. Y., et al. (2023). Penggunaan bahasa pemrograman python dalam analisis faktor penyebab kanker paru-paru. *Jurnal Publikasi Teknik Informatika*, 2(2), 88–99.
- Umah, R., & Gusmira, E. (2024). Dampak pencemaran udara terhadap kesehatan masyarakat di perkotaan. *Profit: Jurnal Manajemen, Bisnis dan Akuntansi*, 3(3), 103–112.
- Yasir, M. (2021). Pencemaran udara di perkotaan berdampak bahaya bagi manusia, hewan, tumbuhan dan bangunan.



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