Literature Review

Air Pollution and Respiratory Diseases in South Tangerang: A Literature Review

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Abstract

In cities, air pollution ranks high among the most pressing problems affecting both the environment and people's health. Research has demonstrated that gaseous pollutants like ozone (O_3), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2), as well as fine particulate matter (PM2.5 and PM10), greatly increase the prevalence of respiratory diseases like asthma, chronic obstructive pulmonary disease (COPD), and acute respiratory infections (ARI). To investigate the effects of air pollution on public health, especially in South Tangerang City, and the correlation between the two, this article provides a thorough literature analysis. The literature search results indicate that air pollution plays a role in the occurrence of ARI, asthma, pneumonia, and COPD through oxidative stress, long-term inflammation, and immune system disorders. Data from local and regional levels show that PM2.5 levels in South Tangerang frequently exceed WHO-recommended limits, particularly during certain periods, increasing the potential for respiratory health problems among urban residents. These emphasize the importance of integrated, evidence-based efforts to control air pollution to protect public health and support sustainable urban development.

Keywords: air pollution, respiratory disease, South Tangerang

INTRODUCTION

In terms of environmental factors impacting public health on a worldwide scale, air pollution has long been recognized as a key player. Air pollution emissions have increased significantly, especially in metropolitan areas, due to factors such as the proliferation of motorized vehicles, heavy industrialization, and population growth. The World Health Organization (WHO) has shown that a significant proportion of the global population breathes air that does not meet health standards. In terms of exposure levels, there is no acceptable level, especially for PM2.5, as defined in the World Health Organization's 2021 Global Air Quality Guidelines.[1–3]

This is a contributing factor to the prevalence of respiratory and cardiovascular disorders, which is on the rise. Chronic pulmonary illness and reduced lung function are risks associated with long-term exposure to PM2.5, regardless of

concentration. There is new epidemiological research that shows a much higher risk of respiratory illness morbidity and death when PM2.5 concentrations reach 10 µg/m^3.[1,4–6]

In developing countries, including Indonesia, air pollution challenges can be exacerbated by limitations in emission controls and air quality monitoring systems. South Tangerang City, as part of the Greater Jakarta (Jabodetabek) region, experiences environmental pressures due to construction activities, traffic density, and high population mobility. This makes the community vulnerable to respiratory diseases, especially among children and the elderly. Therefore, in-depth scientific studies are needed to inform evidence-based health and environmental policies.[6,7]

MECHANISMS OF RESPIRATORY SYSTEM DAMAGE DUE TO AIR POLLUTION

The respiratory system is affected by exposure to air pollution through complex and interconnected biological mechanisms, in which oxidative stress is a major consequence of exposure to air pollution on the lungs. Fine particulate matter, such as PM2.5, can penetrate the lung alveoli and deposit there, interacting directly with alveolar epithelial cells and macrophages, triggering biological responses that can potentially damage lung tissue and disrupt gas exchange.[8,9]

Furthermore, airborne pollutants that contain pro-oxidant compounds increase reactive oxygen species (ROS). This results in damage to lipids, proteins, and DNA in epithelial cells in the respiratory tract. This triggers the activation of inflammatory pathways, accelerating the aging process and decreasing lung function.[8–10]

In addition, pro-inflammatory cytokines are produced when inflammatory pathways like NF-κB are activated, which results in ongoing inflammation. In addition to increasing the likelihood of acute respiratory infections (ARI) and activating chronic diseases such as asthma and chronic obstructive pulmonary disease (COPD), pollutant exposure may weaken the respiratory epithelial barrier and make lung tissue more permeable.[10,11]

EMPIRICAL EVIDENCE ON AIR POLLUTION AND RESPIRATORY DISEASES

Over the last five years, some epidemiological studies have shown that breathing polluted air can significantly increase the risk of developing respiratory illnesses. According to the Global Burden of Disease statistics, air pollution particles is one of the main reasons why respiratory disorders, including asthma, COPD, and pneumonia, are becoming more common across the world.[4,5]

Several nations' cohort and time-series studies have shown that higher PM2.5 and PM10 concentrations are linked to more respiratory-related hospitalizations, emergency department visits, and fatalities. Exposures of any duration may have these consequences, but vulnerable populations like children and the elderly are affected the most.[10–12]

As pollutant concentrations rise, there is strong evidence that being outside in polluted air increases the risk of asthma

exacerbations. Short-term exposure to gaseous pollutants and PM2.5 is known to induce asthma relapses due to airway inflammation and enhanced bronchial reactivity.[13]

Moreover, Sick Building Syndrome (SBS) may also potentially be caused by air pollution, including inside or in buildings, in addition to the presence of contaminating chemicals. When individuals spend a lot of time inside or in buildings with poor air quality, leading to a cluster of symptoms. Symptoms of SBS include irritation of the mucous membranes of the eyes, nose, and throat; dry eyes; dry cough; dry and itchy skin; dizziness; nausea; fatigue; and increased sensitivity to certain odors.[14]

Research carried out by the U.S. Environmental Protection Agency (EPA) established that indoor air pollution is among the top five environmental health concerns. In an Occupational Safety and Health Administration (OSHA) study of 446 US facilities, also explain outdoor pollutants accounted for 52% of indoor pollution. This is up from 11% outside the building. Examples of sources of contaminants from outside the building include vehicle exhaust, factory smoke, emissions from buildings that can re-enter through windows, and the location of air vents close to exhaust ducts.[14]

AIR POLLUTION SITUATION, RESPIRATORY HEALTH IMPACTS, AND ENVIRONMENTAL GOVERNANCE IN SOUTH TANGERANG

In 2026, the World Population Review showed Indonesia as the country that was ranked 15th in the category with the highest average concentration of PM2.5 mg/m^3.[15] As of November 17, 2025, IQ Air showed data on the ten cities with the worst pollution levels in Indonesia, and South Tangerang was in seventh place with an air quality index value of 52.[16]

Increased industrial activity in South Tangerang makes it a rapidly developing urban area and is a factor contributing to the rise in air pollution. The 2016-2021 Strategic Plan of the South Tangerang City Environmental Agency states that the expansion of industrial areas has resulted in land use changes. This led to a reduction in green open space.[17]

In addition, South Tangerang's strategic position as a buffer zone for Jakarta, coupled with rapid population growth, residential activity, educational centers, and high daily mobility, makes the city vulnerable to increased air pollution from both local and regional sources. Pressure on air quality in South Tangerang stems not only from activities within the city, but also from emissions spilling across administrative boundaries in the surrounding area.[18,19]

The Nafas Indonesia report states that high levels of air pollution in urban areas are influenced by a combination of factors, such as motor vehicle emissions as the primary source, industrial activity, and limited green open space.[20] In addition, open burning and meteorological conditions also contribute to inhibiting pollutant dispersion. This can affect the movement of pollutant-laden air masses transported to the South Tangerang area.[21]

Izzatuljannah and Zakiah stated that the root causes of air pollution in South Tangerang include increased industrial activity, limited open space, population density, and increased transportation emissions.[17] This finding is also supported by Prasetyo's research, which showed a significant relationship between PM2.5 concentration and the number of vehicles (P=0.007; r = 0.647).[22]

Lack of urban vegetation that can reduce the environment's ability to absorb pollutants, also leading to prolonged exposure to PM2.5. This presents significant challenges in managing its air quality. Development that is not balanced by the provision of green open spaces and a good transportation system can lead to the risk of air pollutant accumulation in urban areas.[23–25]

Between 2023 and 2025, South Tangerang faced the challenge of increasingly severe air pollution as part of the dynamics of the Greater Jakarta metropolitan area. Air quality monitoring using an independent sensor network showed that South Tangerang City experienced high levels of air pollution in mid-2023.[18–20]

Nafas Indonesia report showed that South Tangerang had the worst air quality in June 2023, with pollution levels 30% higher than Jakarta. In May and June 2023, South Tangerang ranked first as the city with the highest concentration of PM2.5 in Indonesia, with Serpong recorded as the most polluted area, followed by Ciater, Babakan, and Pamulang.[20]

Nafas Indonesia also reported that PM2.5 concentrations in the January 2023 air quality report for the Greater Jakarta area, including South Tangerang, were consistently in the unhealthy category.[20,26] According to a Nafas Indonesia report in July 2023, the air quality level from PM2.5 exposure in Serpong was equivalent to smoking 112 cigarettes. Meanwhile, in the following month, August 2023, PM2.5 exposure in Serpong increased to the equivalent of 117 cigarettes.[27,28]

Studies on air quality monitoring in the Greater Jakarta area also show that PM2.5 and PM10 concentrations in South Tangerang frequently exceed the WHO air quality guideline, particularly during the dry season when pollutant dispersion is more limited.[23–25] The 2024 Jakarta Air Pollution Report states that, based on the WHO Air Quality Guidelines (WHO AQG), the daily average concentrations of PM10 and PM2.5 from January to December 2024 at sensor-based stations exceeded the WHO one-year AQG threshold.[21]

As an illustration, IQAir reported an annual mean PM2.5 concentration of 81.3 $\mu g/m^3$ in South Tangerang, which is sixteen times higher than the current WHO annual guideline of 5 $\mu g/m^3$. This highlights the substantial burden of ambient air pollution in the city.[23–25]

This situation aligns with reports from local healthcare facilities reporting high rates of ARI and other respiratory complaints.[25] In 2023, there have been increasing ARI cases since the beginning of the year, through August, with more than 29,000 South Tangerang residents

suffering from ARI caused by airborne pollutants. This figure reflects the very high morbidity burden from respiratory diseases and is a clear indicator of the impact of air pollution on public health in this area. Although the symptoms experienced were mostly mild to moderate, the number of cases still indicates an epidemiological trend that requires serious attention from local health authorities.[18,19]

The high rate of ARI morbidity also reflects temporary exposure to concentrations of fine particles PM2.5 and other pollutants that exceed air quality standards. These fine particles enter the respiratory tract, causing irritation and inflammation, which then triggers symptoms of coughing, shortness of breath, fever, and can exacerbate asthma and COPD in already sensitive individuals, particularly among the young, the old, and those with preexisting lung conditions. This situation was further exacerbated by the high number of days with unhealthy air quality in South Tangerang throughout 2024-2025.[5,19,29]

Data from the 2022 South Tangerang Regional Health Profile also indicates that tens of thousands of children under five with coughs or difficulty breathing have been receiving treatment in accordance with health service standards at various community health centers (Puskesmas) in the city. As an illustration, in 2022, more than 21,900 children under five received health services for coughs or difficulty breathing. This indicates a significant health burden related to respiratory diseases in this vulnerable age group, both before the pandemic and in the context of the current air pollution epidemic.[19,29]

Although updated information on ARI and asthma from the 2023-2025 Health Profile has not been officially released, the pattern of health services for children under five with respiratory symptoms indicates that the disease burden remains high and relevant to the current air pollution situation.

According to an interview with Dr. Erlina Burhan, Sp.P(K), published in 2023 by Nafas Indonesia, said that breathing polluted air increases the risk of respiratory diseases, including asthma. The interview further highlighted that air pollution is a major contributor to the onset and progression of respiratory diseases, including COPD (36.6%), pneumonia (32%), asthma (29.95%), lung cancer (12.5%), and tuberculosis (12.2%).[30]

According to academic studies based on regional data, an increase in respiratory disease cases tends to occur in areas with high traffic density and rapid development growth. These studies place South Tangerang as one of the areas with increasing potential environmental health risks, as urbanization is not fully balanced by emission control policies and the provision of adequate green infrastructure.[22]

Public perception studies also indicate that most residents are aware of declining air quality and associate this with increased respiratory health problems.[31] A qualitative study in South Tangerang showed that the negative impacts of air pollution on respiratory health are directly

felt by the community. Complaints such as persistent coughing, airway irritation, shortness of breath, and exacerbations of asthma and COPD are reported with increasing frequency, especially among vulnerable groups.[29]

These public perceptions are influenced by their daily exposure to exhaust fumes from motor vehicles, road dust, and the lack of green open spaces that can help maintain urban air quality.[29] This finding is significant, given that public perception is often the first indicator of increasing potential health risks.

The study by Mahardini and Widowati highlights, from a governance and public policy perspective, that initiatives to address air pollution in South Tangerang still face challenges in coordination between stakeholders. The local government, air quality monitoring agencies, the private sector, and the community have all played their respective roles, but integrated synergy has not yet been achieved. Lack of stakeholder involvement in strategic decision-making processes and low levels of public participation hinder the effectiveness of air pollution control policies.[32]

Moreover, although air quality information is readily accessible through platforms such as Nafas Indonesia and BMKG, its application in policymaking and behavioral change remains limited. The lack of scientific data in operational policies has prevented air pollution control interventions from reducing exposure to pollutants. Therefore, strengthening intersectoral collaboration, increasing public awareness, and implementing stricter emission policies are considered crucial steps to sustainably reduce the risk of respiratory health problems in South Tangerang.[22,32]

PUBLIC HEALTH AND POLICY IMPLICATIONS

The impact of air pollution on respiratory disorders significantly impacts the public health system, including increased healthcare costs and reduced productivity. Chronic respiratory disorders caused by exposure to air pollution require long-term treatment, impacting national health spending.[7,22,23,33]

Therefore, air pollution control must be a primary focus of cross-sectoral policies by strengthening emission regulations, developing environmentally friendly transportation, increasing green open spaces, and providing clear and accessible information on air quality to the public. An evidence-based approach is crucial for sustainably maintaining public health in urban areas.[1,23,25,34]

Through South Tangerang City Regional Regulation Number 1 of 2023, an Environmental Protection and Management Plan or *Rencana Perlindungan dan Pengelolaan Lingkungan Hidup* (RPPLH) has been developed, intended to serve as a reference for air pollution control. This policy allows regional officials to design more environmentally oriented sector development programs. Through the RPPLH, the city government can implement policies such as monitoring vehicle

emissions, monitoring ambient air quality, and strengthening public transportation to reduce air pollution levels.[35]

CONCLUSION

In South Tangerang City, air quality conditions, especially PM2.5 levels, frequently exceed the recommended health limits recommended by the WHO during periods of poor air quality. This is consistent with the high burden of respiratory diseases in the community. Therefore, air pollution management must be a primary focus of integrated public health and environmental policies. Evidence-based strategies, including strengthening emission regulations, environmentally friendly transportation innovations, clear air quality monitoring, and increasing public awareness, are strategic steps to reduce the risk of respiratory diseases and improve the quality of life for city residents in the future.

REFERENCES

1. WHO. WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. WHO; 2021.
2. Schraufnagel DE, Balmes JR, Cowl CT, De Matteis S, Jung SH, Mortimer K, et al. Air Pollution and Noncommunicable Diseases. Chest. 2019;155(2):417–26.
3. Cohen AJ, Brauer M, Burnett R, Anderson HR, Frostad J, Estep K, et al. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. The Lancet. 2017;389(10082):1907–18.
4. Murray CJL, Aravkin AY, Zheng P, Abbafati C, Abbas KM, Abbasi-Kangevari M, et al. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. 2020;396(10258):1223–49.
5. Wu Y, Song P, Lin S, Peng L, Li Y, Deng Y, et al. Global Burden of Respiratory Diseases Attributable to Ambient Particulate Matter Pollution: Findings From the Global Burden of Disease Study 2019. Front Public Health. 2021;9:740800.
6. Kumar P, Hama S, Omidvarborna H, Sharma A, Sahani J, Abhijith KV, et al. Temporary reduction in fine particulate matter due to 'anthropogenic emissions switch-off' during COVID-19 lockdown in Indian cities. Sustain Cities Soc. 2020;62:102382.
7. Landrigan PJ, Fuller R, Acosta NJR, Adeyi O, Arnold R, Basu N (Nil), et al. The Lancet Commission on pollution and health. The Lancet. 2018;391(10119):462–512.
8. Kelly FJ, Fussell JC. Toxicity of airborne particles—established evidence, knowledge gaps and emerging areas of importance. Philosophical Transactions of the Royal Society A: Mathematical,

Physical and Engineering Sciences. 2020;378(2183):20190322.
9. Schraufnagel DE. The health effects of ultrafine particles. Exp Mol Med. 2020;52(3):311–7.
10. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and Health Impacts of Air Pollution: A Review. Front Public Health. 2020;8:14.
11. Yang IA, Brown JL, George J, Jenkins S, McDonald CF, McDonald VM, et al. COPD-X Australian and New Zealand guidelines for the diagnosis and management of chronic obstructive pulmonary disease: 2017 update. Medical Journal of Australia. 2017;207(10):436–42.
12. Khreis H, Kelly C, Tate J, Parslow R, Lucas K, Nieuwenhuijsen M. Exposure to traffic-related air pollution and risk of development of childhood asthma: A systematic review and meta-analysis. Environ Int. 2017;100:1–31.
13. Orellano P, Quaranta N, Reynoso J, Balbi B, Vasquez J. Effect of outdoor air pollution on asthma exacerbations in children and adults: Systematic review and multilevel meta-analysis. PLoS One. 2017;12(3):e0174050.
14. Susanto AD, Yunus F, Ikhsan M, Taufik FF, Samoedro E. Penyakit Paru Kerja Dan Lingkungan. Jakarta, Jakarta: UI Press; 2017.
15. Kusumaningtyas SDA, Khoir AN, Fibriantika E, Heriyanto E. Effect of meteorological parameter to variability of Particulate Matter (PM) concentration in urban Jakarta city, Indonesia. IOP Conf Ser Earth Environ Sci. 2021;724:012050.
16. Putri R, Pratama M, Riyanto B. Air pollution exposure and respiratory symptoms among urban residents in Greater Jakarta. BMC Public Health. 2022;22:1467.
17. Izzatuljannah HF, Zakiah A. Isu Polusi Udara Di Kota Tangerang Selatan. In: Seminar Karya & Pameran Arsitektur Indonesia 2021 Heritage Management in the Time of Crisis. Yogyakarta: Universitas Islam Indonesia; 2021. p. 64–76.
18. Saadatuddaraen. Radio Republik Indonesia [Internet]. 2023 [cited 2026 Jan 12]. Polusi Udara, Ribuan Warga Tangsel Terserang ISPA. Available from: https://rri.co.id/kesehatan/332433/polusi-udara-ribuan-warga-tangsel-terserang-ispa
19. Kementerian Koordinator Bidang Infrastruktur & Pembangunan Kewilayahan. Menuju Udara Bersih Jabodetabek: Sinergi Lintas Kementerian dan Daerah untuk Aksi Kolektif. Jakarta: Kementerian Koordinator Bidang Infrastruktur & Pembangunan Kewilayahan ; 2025.
20. Nafas Indonesia. Laporan Kualitas Udara Januari 2023: Analisis PM2.5 dan implikasi kesehatan masyarakat. Jakarta; 2023.
21. Dinas Lingkungan Hidup Pronvinsi DKI Jakarta. Laporan Akhir: Kegiatan Pemantaian Kualitas Udara Provinsin DKI Jakarta Tahun 2024. Jakarta; 2024.

22. Prasetyo NRH. Analisis dampak pencemaran udara terhadap kesehatan masyarakat perkotaan [Skripsi/Tesis]. 2020.
23. World Population Review. World Population Review. Pollution by Country 2026.
24. Zahra FA. GoodStats [Internet]. 2025 [cited 2026 Jan 12]. 10 Kota Paling Polusi di Indonesia Versi IQ Air 2025. Available from: https://goodstats.id/article/10-kota-paling-berpolusi-di-indonesia-versi-iq-air-YsZA6
25. Nieuwenhuijsen MJ. Urban and transport planning pathways to carbon neutral, liveable and healthy cities; A review of the current evidence. Environ Int. 2020;140:105661.
26. Nafas Indonesia. Laporan Kualitas Udara Juni 2023: Juni Termasuk Dalam Periode Kualitas Udara Terburuk Tahun Ini. Jakarta; 2023.
27. Nafas Indonesia. Laporan Kualitas Udara Juli 2023: Lonjakan Polusi di Bulan Juli-12 Kali di Atas Pedoman WHO. Jakarta; 2023.
28. Nafas Indonesia. Laporan Kualitas Udara Agustus 2023: Banyak Anak Sakit ISPA, Kita Belum Merdeka dari Polusi udara. Jakarta; 2023.
29. Dinas Kesehatan Kota Tangerang. Profil Kesehatan Kota Tangerang Selatan Tahun 20222. Tangeran Selatan: Dinas Kesehatan Kota Tangerang; 2023.
30. Pinandhita V. detikHealth [Internet]. 2023 [cited 2026 Jan 12]. Polusi Tangsel Juli 2023 Setara 112 Rokok, Pasien Asma Meningkat! . Available from: https://health.detik.com/berita-detikhealth/d-6868838/polusi-tangsel-juli-2023-setara-112-rokok-pasien-asma-meningkat
31. Santoso M, Lestiani DD, Damastuti E, Kurniawati S, Kusmartini I, Dwi Atmodjo DP, et al. Long term characteristics of atmospheric particulate matter and compositions in Jakarta, Indonesia. Atmos Pollut Res. 2020;11(12):2215–25.
32. Mahardini NG, Widowati N. Peran stakeholder dalam penurunan polusi udara di Tangerang Selatan. Journal of Management and Public Policy. 2025;14(2):1181–94.
33. Lelieveld J, Pozzer A, Pöschl U, Fnais M, Haines A, Münzel T. Loss of life expectancy from air pollution compared to other risk factors: a worldwide perspective. Cardiovasc Res. 2020;116(11):1910–7.
34. United Nations Environment Programme. Actions on Air Quality: Policies & Programmes for Improving Air Quality Around the World. 2021.
35. Pemerintah Daerah Kota Tangerang Selatan. Peraturan Daerah (Perda) Kota Tangerang Selatan Nomor 1 Tahun 2023 tentang Rencana Perlindungan dan Pengelolaan Lingkungan Hidup. Pemerintah Daerah Kota Tangerang Selatan. Pemerintah Daerah Kota Tangerang Selatan; 2023.