

REVIEW ARTICLE

The role of environmental factors on disease and transmission of infectious diseases

Rizki Muhammad Gifari¹, Arina Azmina Ahmad Zubir^{2*}

¹Departement of Public Health, Universitas Nahdlatul Ulama Surabaya, Indonesia

²Faculty of Civil Engineering Technology, University Malaysia Perlis, Malaysia

*Corresponding author: arinaazmina92@gmail.com

Article history:

Received : 2024/09/02

Revised : 2024/09/20

Accepted : 2024/10/26

Available Online : 2024/11/05

DOI : [110.33086/etm.v4i3.7099](https://doi.org/10.33086/etm.v4i3.7099)

Abstract

Infectious diseases remain a major global health problem, with environmental factors playing a significant role in the transmission and burden of disease, especially in densely populated areas. This literature review aims to evaluate the impact of environmental factors on infectious diseases. Data were collected from previous studies through platforms such as Google Scholar. The results showed that poor environmental conditions such as air pollution, lack of access to clean water, inadequate sanitation, and poor waste management contribute to increased incidence of diseases such as ARI, tuberculosis, and diarrhea. The studies analyzed highlighted significant associations between these environmental factors and health outcomes. This review underscores the need for targeted interventions to improve environmental conditions and reduce the burden of infectious diseases in communities. By understanding the relationship between environmental factors and disease transmission, we can develop effective prevention strategies to reduce exposure to pathogens and improve public health.

Keywords: Environment, Disease, Transmission.

INTRODUCTION

Infectious diseases continue to be a significant global health challenge, with high morbidity and mortality rates worldwide. Environmental factors play a crucial role in the transmission and burden of infectious diseases, especially in areas with high population density. Unfavorable environmental conditions, such as low sanitation, lack of access to clean water, and air pollution, can increase the risk of respiratory and gastrointestinal infections. Inadequate sanitation and hygiene can lead to a variety of diseases, including pneumonia, diarrhea, trachoma, soil-transmitted helminth infestations, respiratory infections, and pulmonary tuberculosis. Diarrheal diseases and cholera are often associated with dirty environments. In addition, air pollution has been shown to be associated with increased visits to emergency departments for infectious diseases (Tanjung et al., 2023).

Increasing population density, especially in urban areas, is often correlated with low sanitation, lack of access to clean water, and inadequate waste management (Hasibuan, 2024). These conditions create an ideal environment for the growth and spread of pathogens that cause infectious diseases such as diarrhea, typhus, and respiratory tract infections (Ismiati and Wijayanti, 2021). These diseases not only impact individual health but also add to the burden on public health systems, resulting in increased health care costs and reduced productivity. In addition, vulnerable groups such as children, the elderly, and those with weakened immune systems are at greater risk of being negatively impacted by low sanitation conditions.

Population density also acts as a risk factor for the spread of infectious diseases. low water quality and sanitation problems are also caused by high levels of pollution in rivers. These environmental factors can have a significant impact on public health, especially on vulnerable groups such as adolescents. Understanding how these factors contribute to the spread of disease is critical to developing effective prevention strategies. There by reducing exposure to pathogens and promoting a healthy immune response.

MATERIALS AND METHODS

This study adopts a literature review approach by collecting information from various previous studies to evaluate the Role of Environmental Factors on Disease and Transmission of Infectious Diseases. 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. By utilizing this database, this study aims to present a comprehensive picture of the challenges posed by environmental factors on infectious diseases. So that substantive steps can be taken to protect public health and well-being in the face of infectious diseases.

RESULTS AND DISCUSSION

Environmental factors are closely related to human health, such as air pollution, climate change, low water quality, and infrastructure problems can have a major impact on public health (Nurhayani et al., 2024). Air pollution, caused by both natural sources and human activities, can trigger various health problems. Air pollutants enter the body through the respiratory system, causing upper respiratory tract infections (URTIs), asthma, bronchitis, and other respiratory disorders (Lestari et al., 2024). Climate change also plays a role by increasing the planet's temperature and the frequency of heavy rains and floods, increasing the risk of neurological, respiratory and diarrheal diseases.

low water quality due to chemical contamination can cause serious health problems. Consuming contaminated water can potentially cause gastrointestinal diseases, nervous system disorders, reproductive problems, and chronic diseases such as cancer (Pakpahan and Pakpahan, 2023). Harmful microbes that live in water, soil, and air can also cause diseases such as E. coli food poisoning, urinary tract infections, and respiratory problems. low sanitation and hygiene can lead to a variety of diseases, such as diarrhea, cholera, and respiratory infections. In addition, lack of access to clean water and proper sanitation can also increase the risk of infectious diseases (Prüss-Ustün et al., 2014).

Incidence of Acute Respiratory Infections (ARI) due to Low Sanitation

ISPA is one type of environmental-based disease whose transmission is greatly influenced by environmental aspects (Paneo et al., 2023). The increasing incidence of environmental-based diseases must be prevented, so that the health of individuals, families, and communities can be realized as desired. The availability of basic sanitation facilities such as clean water, use of toilets, wastewater disposal, garbage disposal, healthy homes and environments and cultivating clean and healthy living behaviors in everyday life are absolutely necessary.

Low sanitation conditions lead to ARI through several key mechanisms. First, inadequate access to clean water increases the risk of exposure to respiratory pathogens through contaminated water used for consumption or personal hygiene, with studies showing a 5.8-fold increase in risk (Ariano

et al., 2019). Second, low waste management triggers the proliferation of bacteria and viruses through piles of organic waste, while generating air pollutants from open burning of waste that irritate the respiratory tract (Prajwalita, 2016). Third, inadequate wastewater disposal systems (SPAL) lead to the accumulation of waste that becomes a medium for the development of pathogenic microorganisms and produces harmful gases such as ammonia that damage the respiratory epithelium (Ramayanti et al., 2022). Fourth, low home ventilation increases indoor humidity and pollutant concentrations, creating an ideal environment for the growth of mold and bacterial aerosols (Leky et al., 2022). Fifth, high residential density facilitates the transmission of droplet-borne pathogens through intensive close contact, with a 3.2 times greater risk of infection. Finally, cross-contamination between environmental sanitation and disease vectors such as flies and cockroaches accelerates the spread of respiratory pathogens through contaminated surfaces (Damanik, 2021).

Research conducted by Susanti et al., 2024 showed that out of 80 respondents with inadequate access to clean water, 57 (71.3%) had experienced symptoms of ARI, while out of 70 respondents with adequate access to clean water, 21 (30%) had experienced ARI, the results of the study showed a relationship between access to clean water and symptoms of ARI. The results of the study showed that out of 91 respondents with low waste management, 65 (71.4%) had experienced symptoms of ARI, while out of 59 respondents with good waste management, 13 (22.0%) had experienced ARI, the results of the study concluded that there was a relationship between waste management and symptoms of ARI. The results of the study showed that out of 81 respondents with inadequate SPAL, 54 (66.7%) had experienced symptoms of ARI, while out of 69 respondents with adequate SPAL, 24 (34.8%) had experienced ARI, the results of the study concluded that there was a relationship between SPAL and symptoms of ARI.

Incidence of Tuberculosis due to Low Sanitation

Low sanitation conditions increase the risk of tuberculosis (TB) transmission through several key mechanisms. Firstly, inadequate ventilation of houses leads to restricted air circulation, allowing the bacteria *Mycobacterium tuberculosis* to survive longer in the air in the form of aerosols from droplets of patients (Martinez et al., 2019). Secondly, high humidity and minimal lighting in slum environments create ideal conditions for TB bacterial growth, as the pathogen can survive for hours in dark, damp spaces. Third, overcrowding increases the frequency of close contact between occupants, expanding the spread of respiratory droplets containing bacteria (Qian and Zheng, 2018). Fourth, indoor air pollution from cigarette smoke or garbage burning damages the airway mucociliary system, reducing the body's ability to ward off infection. Fifth, low environmental sanitation such as improper waste management increases exposure to pollutants that weaken immunity, making individuals more susceptible to infection (Rahayu, 2012). Lastly, the absence of natural ultraviolet light in lowly ventilated homes eliminates the bactericidal effect of sunlight, which can kill TB germs within 1-2 hours (Suprijandani et al., 2024).

Research conducted by Mardianti et al., 2020 Showing from 17 respondents who were affected by TB showed that the lighting intensity that did not meet the requirements caused respondents to suffer from pulmonary TB (76.5%), this shows that there is a relationship between lighting intensity and the incidence of pulmonary TB, p value = 0.038 and the Odds Ratio (OR) value = 5.958; 95% CI = 1.332-26.662. Air humidity that did not meet the requirements caused respondents to suffer from pulmonary TB (82.4%), this shows that there is a relationship between air humidity and the incidence of pulmonary TB, p value = 0.034 and the Odds Ratio (OR) value = 6.667; 95% CI = 1.377-32.278. Housing density that did not meet the requirements caused respondents to suffer from pulmonary TB (88.2%) This shows that there is a relationship between housing density and the incidence of pulmonary TB, p value = 0.002 and the Odds Ratio (OR) value = 18.000; 95% CI = 5.250- 109.658. Unqualified house temperature causes respondents to suffer from pulmonary TB (82.4%), this shows that there is a relationship between house temperature and the incidence of pulmonary TB, p value = 0.006 and Odds Ratio (OR) value = 11.200; 95% CI = 2.204-56.925. .

Diarrhea Occurrence due to Low Sanitation

Low sanitation conditions cause diarrhea through a complex mechanism involving environmental contamination by pathogens. First, limited access to clean water forces people to use fecally contaminated water sources, which contain bacteria such as *Escherichia coli* and *Vibrio cholerae*. Second, indiscriminate fecal disposal and inadequate waste management lead to cross-contamination of water and food sources, facilitating fecal-oral transmission of enteric pathogens (Rasyidah, 2019). Third, low food sanitation allows the growth of enteropathogenic bacteria such as ETEC and EPEC that produce toxins causing excessive fluid secretion in the gut. Fourth, lack of healthy latrine facilities increases the risk of direct contact with pathogenic microorganisms through contaminated soil or surfaces. Fifth, low personal hygiene practices such as not washing hands after defecation accelerate the spread of bacteria through cross-contamination when preparing food (Herawati et al., 2023). Lastly, slum environments attract disease vectors such as flies that carry contaminated fecal particles to food and tableware (Fauziyah and Siwiendrayanti, 2023).

Based on research conducted by Bangun, Nababan, et al., 2020 The incidence of diarrhea in children aged 0–4 years in Durian Village, Pantai Labu District in this study was 63.9%. In this study, the results showed that there was a relationship between basic sanitation and the incidence of diarrhea in children aged 0–4 years. The bivariate results of the relationship between basic sanitation and the incidence of diarrhea were: there was a relationship between the availability of healthy toilets that did not meet the requirements with the incidence of diarrhea in children aged 0–4 years in Durian Village, with a p-value of 0.046. There was a relationship between clean water facilities that did not meet the requirements with the incidence of diarrhea in children aged 0–4 years in Durian Village, with a p-value of 0.009. The relationship between temporary waste disposal facilities and the incidence of diarrhea in children aged 0–4 years in Durian Village could not be analyzed statistically, because the value of temporary waste disposal facilities was constant, namely 100% of temporary waste disposal facilities did not meet the requirements. Based on the literature review theory, factors that influence the incidence of diarrhea state that the condition of temporary waste disposal facilities that do not meet the requirements can cause diarrhea, so it is concluded that there is a relationship between temporary waste disposal facilities that do not meet the requirements and the incidence of diarrhea in children aged 0–4 years in Durian Village. There is a significant relationship between the availability of SPAL that does not meet the requirements and the incidence of diarrhea in children aged 0–4 years in Durian Village, with a p-value of 0.015.

CONCLUSIONS

Low environmental conditions have a significant impact on public health. Air pollution, contaminated water, inadequate sanitation, and low waste management contribute to increased incidence of infectious diseases such as ARI, TB, and diarrhea. Research shows a strong association between these environmental factors and disease incidence, with inadequate access to clean water, low waste management, and substandard wastewater treatment facilities significantly increasing the risk of ARI. Similarly, unhealthy housing conditions such as low lighting and ventilation, high humidity, overcrowding, and inappropriate temperatures are associated with TB incidence. This evidence highlights the need for targeted interventions to improve environmental conditions and reduce the burden of infectious diseases in communities. Addressing the challenges posed by environmental factors to infectious diseases requires an integrated approach that combines environmental science, epidemiology, and health policy. Improved urban planning, air quality regulation, better health infrastructure, and community engagement are essential to optimize policy effectiveness. By encouraging interdisciplinary collaboration and evidence-based policy adjustments, we can take substantive steps to protect public health and well-being in the face of infectious diseases.

Author contributions

Rizki Muhammad Gifari, Arina Azmina Ahmad Zubir: 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.

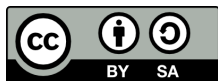
Data availability

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

REFERENCES

- Ariano, A., Bashirah, A. R., Lorenza, D., Nabillah, M., Apriliana, S. N., Ernawati, K., et al. (2019). Hubungan faktor lingkungan dan perilaku terhadap kejadian infeksi saluran pernafasan akut (ispa) di desa talok kecamatan kresak. *Jurnal Kedokteran Yarsi*, 27(2), 076–083.
- Bangun, H. A., Nababan, D., et al. (2020). Hubungan sanitasi dasar dengan kejadian diare pada balita di desa durian kecamatan pantai labu kabupaten deli serdang. *Jurnal Teknologi Kesehatan dan Ilmu Sosial (Tekesos)*, 2(1), 57–66.
- Damanik, H. D. L. (2021). Kondisi sanitasi rumah dengan kejadian infeksi pernafasan atas pada balita di kota palembang. *Jurnal Sanitasi Lingkungan*, 1(1), 35–40.
- Fauziyah, Z., & Siwiendrayanti, A. (2023). Kondisi sanitasi dasar dengan kejadian diare. *HIGEIA (Journal of Public Health Research and Development)*, 7(3), 430–441.
- Hasibuan, K. (2024). *Hubungan sanitasi lingkungan dengan kejadian stunting pada balita di wilayah puskesmas kahean kota pematang siantar* [Doctoral dissertation, UIN Surmatra Utara Medan].
- Herawati, H., Rahman, H. F., & Alfani, E. M. (2023). Studi hubungan personal hygiene dengan kejadian diare di puskesmas panarukan, kabupaten situbondo. *TRILOGI: Jurnal Ilmu Teknologi, Kesehatan, dan Humaniora*, 4(3), 191–202.
- Ismiati, A. T., & Wijayanti, Y. (2021). Kondisi kamar hunian, sanitasi dasar, dan keluhan kesehatan di asrama mahasiswa. *Indonesian Journal of Public Health and Nutrition*, 1(1), 101–113.
- Leky, A. S., Setyobudi, A., & Nabuasa, C. D. (2022). Hubungan antara kondisi sanitasi rumah dan perilaku penghuni dengan kejadian ispa pada balita di desa kayang kabupaten alor. *Sehat Rakyat: Jurnal Kesehatan Masyarakat*, 1(3), 215–229.
- Lestari, I. M. T., Nuroktaviany, F., Fajar, I. A., & Ogawa, K. D. (2024). Pemulihan dampak pencemaran udara bagi kesehatan dan angka harapan hidup masyarakat indonesia. *Jurnal Ilmiah Kajian Multidisipliner*, 8(12).
- Mardianti, R., Muslim, C., & Setyowati, N. (2020). Hubungan faktor kesehatan lingkungan rumah terhadap kejadian tuberkulosis paru (studi kasus di kecamatan sukaraja kabupaten seluma). *Naturalis: Jurnal Penelitian Pengelolaan Sumberdaya Alam dan Lingkungan*, 9(2), 23–31.
- Martinez, L., Verma, R., Croda, J., Horsburgh Jr, C. R., Walter, K. S., Degner, N., Middelkoop, K., Koch, A., Hermans, S., Warner, D. F., et al. (2019). Detection, survival and infectious potential of mycobacterium tuberculosis in the environment: A review of the evidence and epidemiological implications. *European Respiratory Journal*, 53(6).
- Nurhayani, N., Alya, R., Ringkat, G. H. F., & Barella, Y. (2024). Dinamika kependudukan dan dampaknya terhadap lingkungan. *Dewantara: Jurnal Pendidikan Sosial Humaniora*, 3(2), 236–244.

- Pakpahan, E. L. E., & Pakpahan, E. H. (2023). Management pengelolaan dampak lingkungan kegiatan pabrik es dan cold storage di kabupaten pesisir selatan sumatera barat. *Agriprimatech*, 6(1), 106–115.
- Paneo, F. D., Irwan, I., Jusuf, M. I., Kadir, S., & Paneo, I. (2023). Environmental health factors associated with the incidence of acute respiratory infection in toddlers. *Journal La Medihealtico*, 4(1), 63–74.
- Prajwalita, M. K. (2016). Pengaruh sanitasi rumah dan polusi udara terhadap kejadian infeksi saluran pernafasan akut (ispa) pada balita di kecamatan ngariboyo kabupaten magetan. *Swara Bhumi e-Journal Pendidik Geogr FIS Unesa*, 4(1).
- Prüss-Ustün, A., Bartram, J., Clasen, T., Colford Jr, J. M., Cumming, O., Curtis, V., Bonjour, S., Dangour, A. D., De France, J., Fewtrell, L., et al. (2014). Burden of disease from inadequate water, sanitation and hygiene in low-and middle-income settings: A retrospective analysis of data from 145 countries. *Tropical medicine & international health*, 19(8), 894–905.
- Qian, H., & Zheng, X. (2018). Ventilation control for airborne transmission of human exhaled bio-aerosols in buildings. *Journal of thoracic disease*, 10(Suppl 19), S2295.
- Rahayu, S. (2012). Pengaruh lingkungan fisik terhadap kejadian tb paru.
- Ramayanti, F., Nurfadhilah, N., Srisantyorini, T., & Ernyasih, E. (2022). Gambaran pelayanan klinik sanitasi pada penyakit ispa dan tuberkulosis di masa pandemi. *ENVIRONMENTAL OCCUPATIONAL HEALTH AND SAFETY JOURNAL*, 3(1), 11–20.
- Rasyidah, U. M. (2019). Diare sebagai konsekuensi buruknya sanitasi lingkungan. *KELUWIH: Jurnal Kesehatan Dan Kedokteran*, 1(1), 31–36.
- Suprijandani, S., Thohari, I., & Narwati, N. (2024). Pendampingan keluarga penderita tb paru dalam meningkatkan sanitasi rumah di wilayah kerja puskesmas driyorejo kabupaten gresik. *Ahmar Metakarya: Jurnal Pengabdian Masyarakat*, 4(1), 146–152.
- Susanti, N., Rasyid, Z., Hasrianto, N., Redho, A., & Fadhli, R. (2024). Analisis penyakit diare di desa cipang kiri hulu dan faktor lingkungan fisik yang mempengaruhinya. *Jurnal Kesehatan Lingkungan Indonesia*, 23(3), 374–381.
- Tanjung, N., Auliani, R., Rusli, M., Siregar, I. R., & Taher, M. (2023). Peran kesehatan lingkungan dalam pencegahan penyakit menular pada remaja di jakarta: Integrasi ilmu lingkungan, epidemiologi, dan kebijakan kesehatan. *Jurnal Multidisiplin West Science*, 2(09), 790–798.



This is an open access article distributed under the Creative Commons Attribution-ShareAlike 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cite. ©2023 The Author(s)