Effects of Environmental Pollution on Public Health in Dhaka City, Bangladesh

Najmun Nahar[1*], Sanjia Mahiuddin[2], Md. Faruk Hossain [3]

[1]*Associate Professor at Earth and Life Sciences Faculty, Jagannath University, Dhaka, Bangladesh*
[2]*Officer, Research and Knowledge Management, DM Watch Limited, Dhaka, Bangladesh*
[3]*Associate Professor at Earth and Environmental Sciences Faculty, University of Dhaka, Dhaka, Bangladesh*
Corresponding author: najmun.nahar@geography.jnu.ac.bd

Abstract: Dhaka is the most polluted city in Bangladesh compared to other cities. Rapid urbanization and uncontrolled population growth result in the mismanagement of urban amenities in this city, which concurrently generates air, water, land, and noise pollution, adversely affecting public health. Therefore, the paper attempts to represent the status of the effects of significant environmental pollution on public health in the study area. The study was mainly based on primary data, although secondary data was also used. Four hundred respondents suffering from health issues due to environmental pollution were randomly selected and interviewed using a semi-structured questionnaire across ten zones of Dhaka North City Corporation and Dhaka South City Corporation. The study found that the health of 90% of respondents was affected by air pollution, 60% by water pollution, 55% by noise pollution, and only 2% by soil pollution in the study area, considering multiple response criteria. Air, water, and noise pollution significantly impacted the respondents' health, considering all age groups except for soil pollution. The study's outcomes strongly support the need for more analysis to reduce the effects of pollution and provide a safe and healthier environment for the people of Dhaka City.

Keywords: Urbanization, Environmental pollution, public health, Dhaka City

1. Introduction

Environmental pollution is a crucial global issue that affects public health [1]. It is estimated that environmental factors account for 24% of deaths worldwide [2], and about one-third of the disease burden is created by environmental pollution [3]. In 2021, 8.1 million people died worldwide due to air contamination, and it is the second most important risk factor for premature mortality after high blood pressure. It also reduces people's usual life expectancy by one year and eight months [4]; [5]. Every three people out of ten are harmed by traffic-related noise pollution, affecting individual work performance during the day and causing hypertension and cardiovascular diseases [6]. WHO also admits that marginal and low-income populations often have higher occurrence rates of diseases adversely affected by air pollution [3]. Subsequently, each year, more than 8,42,00 people die from Diarrhea globally due to exposure to water contamination [7].

The burden of pollution is not evenly distributed globally. Approximately 92% of environmental deterioration-related fatalities happen in low- and middle-income countries (LMICs) [1]. LMICs bear the brunt of environmental pollution due to weaker regulatory frameworks, rapid industrialization, and inadequate waste management infrastructure. Sub-Saharan Africa, South Asia, and parts of Latin America experience some of the highest pollution-related mortality rates [8]. As a developing nation, Bangladesh is one of the most polluted countries globally due to upholding vigorous economic development during the last ten years [9]. Consequently, the country experiences distressing environmental degradation, which severely affects public health, and every year, about 272,000 people die early, which equals 17.6% of the GDP of this country in 2019 [10]. Dhaka, the capital of Bangladesh, is not only one of the most polluted cities in this country but also the third most polluted city worldwide [11]; [12]; [13]; [14]. Rapid and unplanned urbanization with uncontrolled population growth creates the mismanagement of urban services and deteriorates the environmental quality of this city [15]. Thus, the city has serious pollution problems concerning a lack of water supply and sanitation facilities, congested living conditions, poor waste management, inadequate drainage system, and untreated industrial waste disposal, which are responsible for air pollution, water pollution, soil pollution, noise pollution, etc. [13]; [16]; [17]; [18]; [19].

Severe environmental pollution, such as air, water, land, and noise pollution, causes various adverse health effects for dwellers of Dhaka City [20]; [21]; [15]. The Department of Environment (DoE) has found that air quality in Dhaka has remained consistently unhealthy to highly unhealthy for nearly half of the year, indicating high levels of air pollution. [22]. With

ongoing economic development and increased sources such as passenger cars and brick kilns, Dhaka's air quality declined from 1996 to 2015 [23]; [24]. In 2019, air contamination in Dhaka City resulted in the fatalities of almost 22,000 individuals [25]. There are several studies on environmental pollution and public health in Dhaka City; however, there is limited research on the combined health impacts of various pollution scenarios. Researchers' investigations concentrate on certain pollution levels and their associated health problems among urban residents. Compared to other forms of pollution, studies on air pollution are more widespread [20], [26], [27]. Therefore, the present study tried to represent the impact of significant environmental pollution on public health in the capital city. This research aims to understand better the pollution-related diseases suffered by the residents of the study area.

2. Material and Methods

2.1. Study area

Dhaka City is located in the central part of Bangladesh at 23°42' and 23°54' north latitude and 90°20' and 90°28' east longitude, on the eastern banks of the Buriganga River [28]. The total number of households in Dhaka City is 15,76,746 [29]. For administrative purposes, the city was divided into Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) in 2011, and each city corporation is divided into five zones. As the capital of Bangladesh, it is the country's central economic and political hub, attracting people from the entire country [30]. Additionally, Dhaka has been identified as one of the cities where pollution negatively affects its inhabitants. [20]. The study area's population now suffers from environmental pollution-related issues due to unplanned urbanization, rapid population growth, improper waste management, climate change impacts, and unsatisfactory environmental behaviour [21]. In this regard, Dhaka City was chosen as the study area to understand the impact of pollution-related diseases on its inhabitants based on their observations of the surrounding environment (Figure 1).
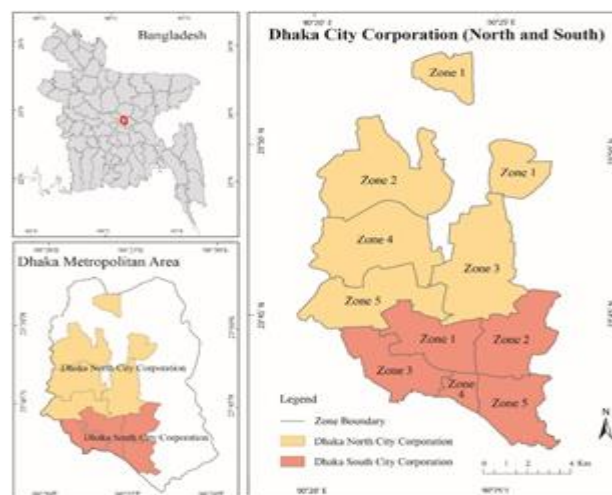

Figure 1. Location map of the study area [21]; [30].

2.2. Methods

2.2.1. Sampling and questionnaire survey

This study is based on a survey conducted in different areas of Dhaka in 2018. Primary Data was collected using a semi-structured questionnaire to understand people's opinions about pollution-related health issues, the occurrence of diseases based on seasonal variations, and their duration. Secondary Data was collected from books, journals, reports, dissertations, theses, newspapers, and online sources. A simple random sampling method was used with 95% confidence and ± 9.3% precision level to select 400 respondents (who experienced health problems as a result of environmental contamination) from jointly10 zones of DNCC and DSCC in Dhaka City using the formula of Cochran (1963) for the unknown population [31]. Above 18 years old people were considered as respondents. The sampling technique was adopted from another study [30].

2.2.2. Data processing and analysis

Data were processed and analyzed separately using the computer software SPSS version 20 and MS Excel. Frequency, percentage distribution, multiple responses, and crosstab analysis are done to assess the study findings. After evaluation, data were incorporated into the text, tables, and graphs. To understand the respondents' responses towards pollution-related diseases based on their gender, age, season, frequency of occurrence, and duration of different environmental pollutions, average frequency (n) and percentage (%) distribution and multiple response analysis were used. Percentage of responses is considered in case of multiple responses.

3. Results and Discussion

3.1. Demographic information of the respondents of the study area

A total of four hundred respondents were interviewed during the survey. About 66.3% of

respondents were males, and around 33.8% were females. Considering age, around 44.8% of total respondents belonged to the age group of 31–40 years, followed by nearly 27.8% of respondents in the age group of 21–30 years, and 26% are over 40 years. The rest of them (1.5%) were in the age group of 18–20 years. The survey findings demonstrate that half of the surveyed people (45.8%) lived in the study area for over ten years. About 26% of respondents live from 5 to 10 years, and 19% live from 3 to 5 years [21]; [30]. Information about the family members affected by pollution is considered, focusing on their gender and age group, as described in (Figure 2), to understand the health impacts of various pollution. They share their views about the health impacts of different types of pollution by answering questions about the diseases they experience, the duration of their suffering, the seasons affected, and the frequency of their occurrence.
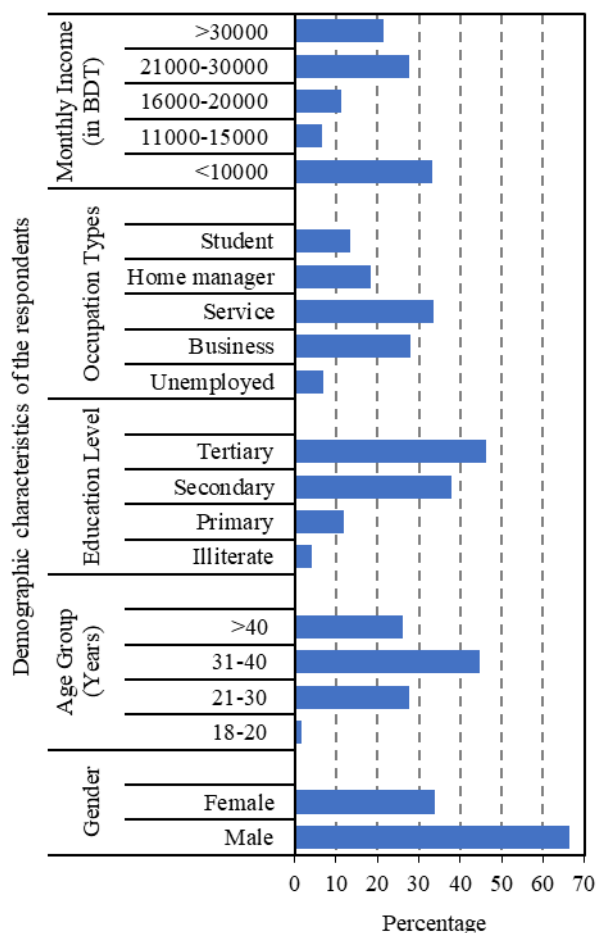

Figure 2. Demographic information of the respondents in the study area

3.2. Environmental pollution-induced diseases of the respondents

Dhaka City dwellers suffer from various diseases all year long. Air pollution is one of the dominant environmental issues for people living in this city. Approximately 90% of the respondents were affected by air pollution-related diseases, about 60% experienced water pollution-related illness, and

55% mentioned noise pollution-related sickness. Only 2% talked about soil pollution-related diseases (Figure 3).
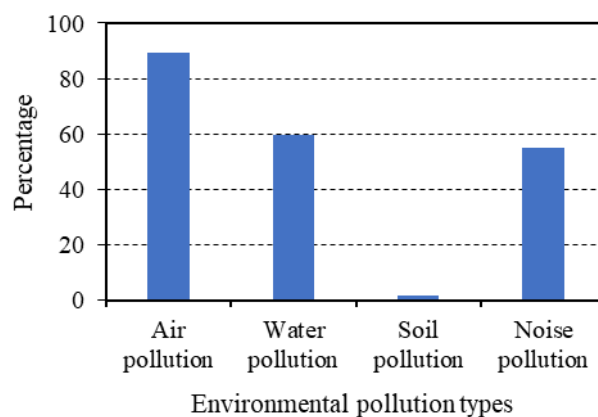

Figure 3. The percentage of respondents' illnesses affected by major environmental pollution (multiple responses)

Due to air pollutants, city dwellers suffer from different diseases. The study findings summarized in Figure 4 revealed that headache is a common problem among most respondents (46.2%) living with polluted air. Around 22% of them were affected by asthma, sinus, irritation to the eye/nose, and throats due to air pollution. More than 14% of people talked about breathlessness, chest pain, and respiratory diseases. Only a few of them think air pollution causes depression (11%) and cancer (2%).
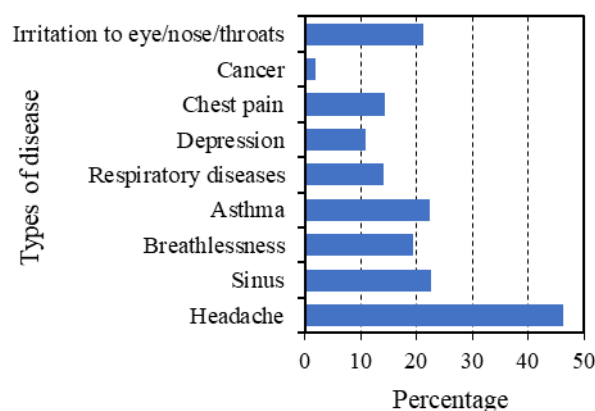

Figure 4. Respondents suffering from various diseases caused by air pollution (Multiple responses)

The current research also demonstrated that diarrhea is a common disease in the study area, suffered by 38.7% of respondents. Around 29% of them suffered from diseases like allergies, cold/cough, and fever by drinking contaminated water. More than 20% of people talked about dysentery and skin diseases. The rest mentioned jaundice (12.2%), typhoid (9.7%), and other diseases (Figure 5).
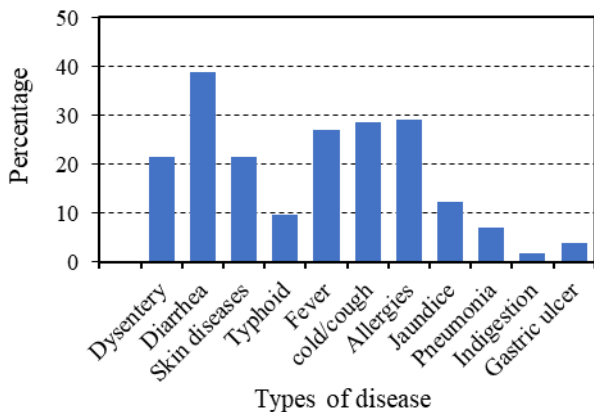
Figure 5. Respondents suffering from various diseases caused by water pollution (Multiple responses)

Soil pollution indirectly affects the food chain and drinking water sources and harms human health. Figure 6 shows that 83% of respondents opined that skin rash is caused by soil pollution. Approximately 33% of respondents mentioned eye irritation problems. A few of them (17%) thought that pollutants in the soil cause cancer and gastrointestinal infections.
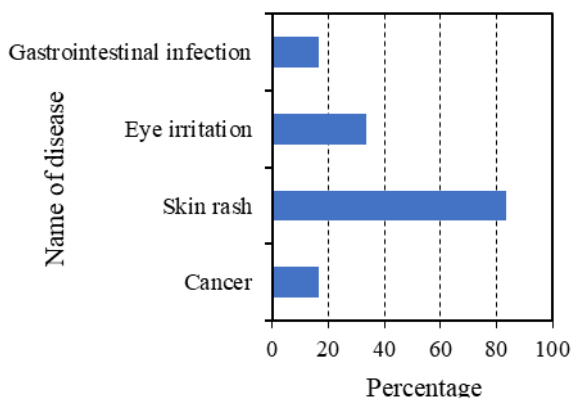

Figure 6. Respondents suffering from various diseases caused by soil pollution (Multiple responses)

Noise pollution is one of the daily hazards faced by the inhabitants in the study area. Excessive sound levels are responsible for physical and psychological damage. The study also highlighted that 67% of people suffered from headaches from high sound levels. Respondents suffered from mental stress (26%), high blood pressure (25%), and insomnia (21%). Moreover, noise pollution causes tiredness, lousy temperament, hypertension, vision problems, and hearing loss in the respondents (Figure 7).
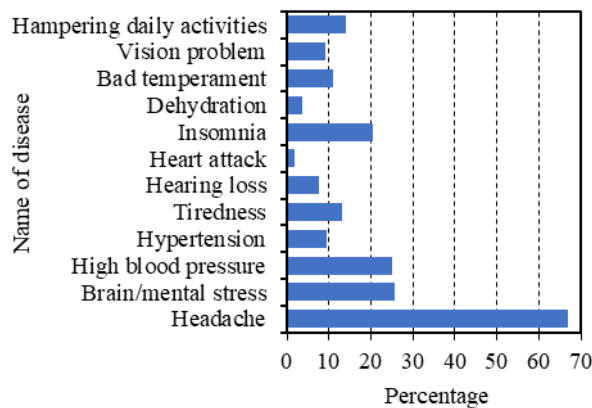

Figure 7. Respondents suffering from various diseases caused by noise pollution (Multiple responses)

3.3. Demographic characteristics affected diseases by the respondents

The study tried to assess the number of affected people based on their gender and age group. Males are more affected by pollution than female respondents (Figure 8). About 53.8% of men are affected by air pollution-related diseases than women (35.8%). Approximately 33% of males suffered from noise-related diseases, whereas 22.3% of females were affected. Similarly, males suffered more than females from soil pollution-related diseases. In contrast, women (31%) are more affected by waterborne diseases than men (29%).
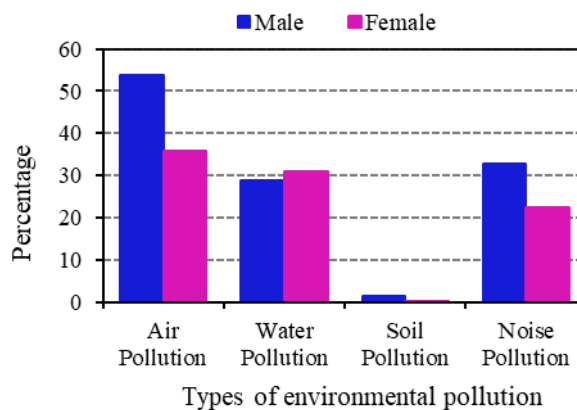

Figure 8. Gender-wise health of respondents affected by different pollution

People in all age groups were affected by air, water, and noise pollution (Figure 9). The age group of 31 to 40 years old claimed that they suffered more than other age groups from diseases caused by poor air quality (26.3%), sound pollution (18.3%), contaminated water (11.8%), and dirt (0.3%) since they work outside almost every day and spend much time outside. Similarly, the age group of 21-30 also experienced the same diseases caused by air, noise, water, and soil pollution. People above 40 and below 18 years old suffer from different air, noise, and water pollution-related diseases.
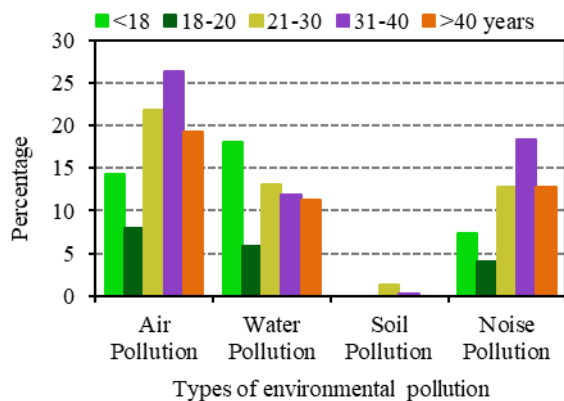
Figure 9. Age-wise health of respondents affected by different pollution

3.4. Suffering frequency and duration of affected diseases of the respondents

During the survey, all respondents were asked about the frequency and duration of diseases affected by different types of pollution (Table 1 and Table 2). Diseases related to air pollution were more prevalent in the study area than other diseases. Nearly 70% of people suffered from diseases in less than one year, and 11.3% said that they experienced diseases for more than four years. Approximately 48% of people reported experiencing diseases from air pollution 1 to 5 times a year, while 26% indicated they are affected by air pollutants throughout the year. Above 50% of people claim that suffering from waterborne diseases lasted less than one year, and they suffer from these diseases 1 to 5 times a year. In the case of noise pollution, 39% experienced diseases caused by excessive sound that lasted below 01 year, and 15% said that diseases lasted more than 04 years. Around 28% said they suffered from noise pollution-related diseases all year, and 23% reported that diseases occurred to them 1 to 5 times a year.

Table 1. Suffering frequency in a year of various diseases caused by significant pollution

Environmental pollution types	Frequency of attacks in a year (times)			
	1-10	11-20	>20	All
Air pollution	51.1	5.8	6.5	26.3
Water pollution	50.8	0	4.0	5.0
Soil pollution	1.0	0	0.0	0.5
Noise pollution	23.8	2.8	1.0	27.5

Table 2. Suffering duration of various diseases caused by significant pollution

Environmental pollution types	Duration of suffering diseases (Year)			
	<1 year	1-2 years	3-4 years	>4 years
Air pollution	70.0	7.8	0.5	11.3
Water pollution	52.5	0.5	0	6.8
Soil pollution	1.3	0	0	0.3
Noise pollution	39.0	0	1.5	14.5

During the survey, respondents were asked about the seasonal occurrence of pollution-related diseases (Figure 10), and more than 90% of respondents noticed that the dry season is more responsible for air, soil, and noise pollution-related diseases than the wet season. Water pollution-related diseases are prevalent in the wet season compared to the dry season, as 76.7% of city dwellers claimed.
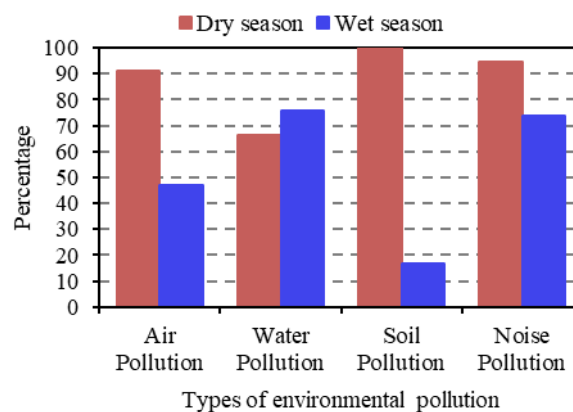

Figure 10. Season-wise respondents suffered from various diseases caused by significant pollution (multiple responses)

The present study reveals that city dwellers notice different health issues caused by environmental pollution. Most city dwellers (90%) identify air pollution. The presence of air pollutants causes various diseases among residents, with headaches being the most reported issue, affecting 46.2% of those living in polluted areas. Another study exposed that air pollution has become a severe environmental concern among the residents of Dhaka City [23]. Regarding water-related diseases, diarrhea is dominant, as 38.7% of respondents suffered in the study area. Globally, 80% of diseases and 50% of child deaths are related to poor water quality, which causes more than 50 kinds of diseases (diarrhea, skin diseases, malnutrition, cancer, etc.). The most common disease caused by water pollution is diarrhea, particularly among young children in low-income countries [32]. According to a WHO report [7], more than 45,000 children aged under five die each year in Bangladesh from diarrhea caused by polluted water [33]. Approximately 67% of individuals experience headaches due to high noise levels in their neighborhoods and workplaces. People in the study area also suffered from diseases like mental stress (26%), high blood pressure (25%), and insomnia (21%). Other studies also claim that noise pollution is responsible for causing headaches and other adverse effects on mood [26]. It is also responsible for diseases like changes in mood, headache, anxiety, hearing loss, sleep disturbances, and more [34].

The findings of the current study display a resemblance with other research. Studies indicate that environmental pollution has a long-term impact on

public health, which is related to demographic characteristics such as age group and gender, as well as the duration of exposure to pollution. [35]. The current study also exposed that males are found to be more affected by diseases related to air, soil, and noise pollution than female respondents, as they spend their whole day outside of the home. On the contrary, women (31%) are more affected by water contamination-related diseases than men (29%). The study also found that 53.8% of men are at a higher risk of diseases caused by air pollution, while only 35.8% of women are affected. This discrepancy is likely because women in the study area primarily use gas for cooking, which does not produce smoke, and they tend to stay home longer than men. However, men are more exposed to outdoor air pollution due to occupational hazards, which can lead to respiratory and cardiovascular diseases [35]. In some studies, females are more vulnerable than males to the effects of air pollution [36]; [37]; [38]. Particularly in developing countries, women experience more exposure to indoor air pollution than men when cooking and heating solid fuels [35]. Similarly, males (33%) suffered more than females (22.3%) from noise pollution-related diseases.

The study findings also emphasized that people aged 31-40 years and 21-30 years suffer more from diseases from air, water, noise, and soil pollution than other age groups due to spending too much time for work and other purposes. The age group of 31 to 40 years old suffers more than other age groups from diseases caused by air pollution (26.3%), sound pollution (18.3%), and water pollution (11.8%). Both long-term and short-term exposure to air pollutants is closely related to causes of public health emergencies like chronic respiratory disease [39]. The primary environmental contaminant that causes premature deaths worldwide in older age groups is air pollution, while water pollution is the cause of newborn mortality. One of the main factors influencing the number of years lost to sickness in infancy and childhood is soil and air pollution [40]. Other studies suggest children are more susceptible to noise-induced hearing impairment than adults [34]. Air Pollution and noise pollution-related diseases were found to be more dominant in the study area than other types in terms of their suffering time, duration in a year, and seasonal occurrence. Respondents experienced more airborne diseases during the dry season compared to the wet season, while waterborne diseases were more prevalent among respondents in the wet season.

4. Conclusion

Every nation strives for a better environment, employing various efforts to educate and raise awareness among people about environmental issues while managing the misuse of resources to maintain a pollution-free environment. The present study tried to show the impacts of environmental pollution on public health based on the duration, frequency, and seasonal variation of different pollutants. The study also attempted to show the effects of environmental pollution on public health by considering all age groups and genders, the names of the suffering diseases, and the suffering scenario of the respondents in the study area. Significant environmental pollution is responsible for causing many fatal and physiological diseases to city dwellers. The study's findings strongly emphasize the need for further analysis of this issue to mitigate the impacts of pollution, aiming to create a safer and healthier environment for the residents of Dhaka City. Measures should also be taken to control environmental pollution and reduce health hazards. The results of this study will help develop initiatives required to improve the dwellers' quality of life and the environment of Dhaka in the future.

References

[1] P. J. Landrigan et al., "The Lancet Commission on pollution and health," The Lancet, vol. 391, no. 10119, pp. 462-512, 2018.

[2] World Health Organization, "Public health and environment," 2012. [Online]. Available: https://www.who.int/data/gho/data/themes/public-health-and-environment

[3] World Health Organization, "The health risks of household air pollution are strongly correlated with poverty," 2024. [Online]. Available: https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/equity-impacts

[4] State of Global Air (SoGA), "Health Impacts of Air Pollution," 2024. [Online]. Available: https://www.stateofglobalair.org/hap#:~:text=Air%20pollution%20accounts%20for%20more,1%20year%20and%208%20months

[5] UNICEF, "Air pollution accounted for 8.1 million deaths globally in 2021 becoming second leading risk," 2024. [Online]. Available: https://www.unicef.org/press-releases/air-pollution-accounted-81-million-deaths-globally-2021-becoming-second-leading-risk

[6]. M. M. Rahman, F. Tasnim, M. A. Quader, M. N. U. I. Bhuiyan, M. S. Sakib, R. Tabassum, I. A. Shobuj, L. Hasan, M. A. Chisty, F. Rahman, and E. Alam, "Perceived noise pollution and self-reported

health status among the adult population of Bangladesh," Int. J. Env. Res. Public Health, vol. 19, no. 4, p. 2394, 2022.

[7] World Health Organization, "UN-Water Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS) 2017 Report: Financing Universal Water, Sanitation, and Hygiene under the Sustainable," Geneva, 2017. [Online]. Available: www.who.int/water_sanitation_health/publicatio ns/glaas-report-2017/en/

[8] U.S. Environmental Protection Agency (EPA), "EPA's Collaboration with the World Health Organization (WHO)," 2023. [Online]. Available: https://www.epa.gov/international-cooperation/epas-collaboration-world-health-organization-who#:~:text=In%20fact%2C%20a%20WHO%20 Study,deaths%20among%20children%20under% 20five.

[9] W. A. Raza and I. Mahmud, "In Bangladesh, an urgent call for clean air," 2022. [Online]. Available: https://blogs.worldbank.org/en/endpovertyinsout hasia/bangladesh-urgent-call-clean-air

[10] World Bank, "Addressing Environmental Pollution is Critical for Bangladesh's Growth and Development," 2024. [Online]. Available: https://www.worldbank.org/en/news/press-release/2024/03/28/addressing-environmental-pollution-is-critical-for-bangladesh-s-growth-and-development

[11] World Health Organization, Air Pollution Monitoring Report, 2014. [Online]. Available: http://www.who.int/phe/health_topics/outdoorair/ databases/cities/en/

[12] BRAC Institute of Governance and Development (BIGD), The State of Cities: Solid Waste Management of Dhaka City – Towards Decentralised Governance, BRAC University, Dhaka, 2015. [Online]. Available: https://www.bufbd.org/images/selectedreports/20 15/state-of-cities-2015.pdf

[13] M. R. Kabir, "Municipal solid waste management system: a study on Dhaka north and South City corporations," J. Bangladesh Inst. Plan., vol. 8, pp. 35-48, 2015.

[14] United News of Bangladesh (UNB), "Dhaka's air most polluted in the world this morning," 2024. [Online]. Available: https://unb.com.bd/category/Environment/dhakas -air-most-polluted-in-the-world-this-morning/144937

[15] M. A. Rahaman, A. Kalam, and M. Al-Mamun, "Unplanned urbanization and health risks of

Dhaka City in Bangladesh: uncovering the associations between urban environment and public health," Front. Public Health, vol. 11, p. 1269362, 2023.

[16] J. N. Halder and M. N. Islam, "Water pollution and its impact on the human health," J. Env. Hum., vol. 2, no. 1, pp. 36-46, 2015. doi:10.15764/EH.2015.01005.

[17] S. M. M. H. Khan, "Environmental Education and Awareness," Bangladesh National Conservation Strategy, Government of the People's Republic of Bangladesh, 2016.

[18] A. Rahman, A. Rahman, and B. K. Dey, "Attitude of the community people towards health and environmental hazards of tanneries in Dhaka," Int. J. Indian Psychol., vol. 3, pp. 175-184, 2016.

[19] K. S. Akter, K. Kurisu, and K. Hanaki, "Water use and pollution recognition from the viewpoint of local residents in Dhaka, Bangladesh," Water, vol. 9, p. 331, pp. 2-14, 2017. doi:10.3390/w9050331.

[20] M. Z. Alam, E. Armin, M. Haque, J. H. E. Kayesh, and A. Qayum, "Air pollutants and their possible health effects at different locations in Dhaka City," Int. J. Environ. Sci. Nat. Resour., vol. 9, no. 4, p. 555768, 2018. doi:10.19080/IJESNR.2018.09.555768.

[21] N. Nahar, S. Mahiuddin, and Z. Hossain, "The severity of environmental pollution in developing countries and its remedial measures," Earth, vol. 2, no. 1, pp. 124-139, 2021.

[22] M. A. Nahian, T. Ahmad, I. Jahan, N. Chakraborty, Q. Nahar, and P. K. Streatfield, "Air pollution and pregnancy outcomes in Dhaka, Bangladesh," J. Clim. Change Health, vol. 9, p. 100187, 2023.

[23] B. A. Begum and P. K. Hopke, "Ambient air quality in Dhaka Bangladesh over two decades: Policy impacts on air quality," Aerosol Air Qual. Res., vol. 18, no. 7, pp. 1910-1920, 2018.

[24] M. R. S. Pavel, S. U. Zaman, F. Jeba, M. S. Islam, and A. Salam, "Long-term (2003–2019) air quality, climate variables, and human health consequences in Dhaka, Bangladesh," Front. Sustainable Cities, vol. 3, p. 681759, 2021.

[25] M. A. Molla, "Air pollution: Dhaka 5th worst city in the world," The Daily Star, 2022. [Online]. Available: https://www.thedailystar.net/environment/pollution/ air-pollution/news/air-pollution-dhaka-5th-worst-city-the-world-3096571

[26] M. M. Razzaque, S. C. Chowdhury, M. M. Helali, and H. Bodén, "On the impacts of noise pollution in Dhaka," in Proc. 17th Int. Congr. Sound Vibr., Cairo, Egypt, Jul. 18–22, 2010, pp. 3068-3074.

[27] Dibya, T. B., Proma, A. Y., and Dewan, S. M. R.,

"Poor Respiratory Health is a Consequence of Dhaka's Polluted Air: A Bangladeshi Perspective," Environ. Health Insights, vol. 17, pp. 1-9, Oct. 2023, doi: 10.1177/11786302231206126.

[28] M. S. Alam, M. M. Siraz, J. AM, S. C. Das, D. A. Bradley, M. U. Khandaker, S. Tokonami, A. Shelley, and S. Yeasmin, "A study measuring the 222Rn in the Buriganga River and the megacity Dhaka tap water," Plos One, vol. 18, no. 5, p. e0286267, 2023.

[29] Bangladesh Bureau of Statistics (BBS), Bangladesh Population and Housing Census 2011, National Report: Volume-3, Urban Area Report, Statistics and Informatics Division (SID), Ministry of Planning, Government of The People's Republic of Bangladesh, 2011.

[30] N. Nahar, Z. Hossain, and S. Mahiuddin, "Assessment of the environmental perceptions, attitudes, and awareness of city dwellers regarding sustainable urban environmental management: a case study of Dhaka, Bangladesh," Environ. Dev. Sustain., vol. 25, pp. 7503–7531, 2023, doi: 10.1007/s10668-022-02354-y.

[31] W. G. Cochran, Sampling Techniques, New York, NY, USA: Wiley, 1963.

[32] Lin, L., Yang, H., & Xu, X., "Effects of water pollution on human health and disease heterogeneity: A review," Front. Environ. Sci., vol. 10, Article 880246, 2022. doi:10.3389/fenvs.2022.880246.

[33] M. K. Hasan, A. Shahriar, and K. U. Jim, "Water pollution in Bangladesh and its impact on public health," Heliyon, vol. 5, no. 8, 2019.

doi:10.1016/j.heliyon.2019.e02145.

[34] Jariwala, H. J., Syed, H. S., Pandya, M. J., & Gajera, Y. M., "Noise pollution & human health: A review," in Proc. NAP 2017 Conf., 2017.

[35] Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E., "Environmental and health impacts of air pollution: A review," Front. Public Health, vol. 8, p. 14, 2020. doi:10.3389/fpubh.2020.00014.

[36] J. E. Clougherty, "A growing role for gender analysis in air pollution epidemiology," Environ. Health Perspect., vol. 118, pp. 167–176, 2010. doi:10.1289/ehp.0900994.

[37] M. S. Oliveira, A. P. Leon, I. E. Mattos, and S. Koifman, "Differential susceptibility according to gender in the association between air pollution and mortality from respiratory diseases," Cad. Saude Publica., vol. 27, pp. 1827–1836, 2011. doi:10.1590/S0102-311X2011000900016.

[38] H. K. Al-Shidi, A. K. Ambusaidi, and H. Sulaiman, "Public awareness, perceptions and attitudes on air pollution and its health effects in Muscat, Oman," J. Air Waste Manage. Assoc., vol. 71, no. 9, pp. 1159-1174, 2021.

[39] Xu, H., Jia, Y., Sun, Z., Su, J., Liu, Q. S., Zhou, Q., & Jiang, G., "Environmental pollution, a hidden culprit for health issues," Eco-Environ. Health, vol. 1, no. 1, pp. 31-45, 2022. doi:10.1016/j.eehl.2022.04.003.

[40] Münzel, T., Hahad, O., Daiber, A., & Landrigan, P. J., "Soil and water pollution and human health: What should cardiologists worry about?" Cardiovasc. Res., vol. 119, no. 2, pp. 440–449, 2023. doi:10.1093/cvr/cvac082.