

AIR POLLUTION INDUCES RESPIRATORY DISEASES IN BANGLADESH: A PERCEPTION BASED STUDY

Ahmad Kamruzzaman Majumder^{1*}, Marziat Rahman², Md Nasir Ahmmed Patoary³ Muhammad Shamim Hossain Reza⁴, Rasheduzzaman Majumder⁵ and Kaspia Rahman Tanima⁶

¹Professor and Chairman, Department of Environmental Science, Stamford University Bangladesh, Dhaka-1217, Bangladesh and Center for Atmospheric Pollution Studies (CAPS), Dhaka-1217, Bangladesh.

²Scientific Officer, Center for Atmospheric Pollution Studies (CAPS), Dhaka-1217, Bangladesh.

³Lecturer, Department of Environmental Science, Stamford University Bangladesh, Dhaka-1217, Bangladesh.

⁴Post-Graduate Student, Department of Environmental Science, Stamford University Bangladesh, Dhaka-1217, Bangladesh.

⁵Director, Center for Atmospheric Pollution Studies (CAPS), Dhaka-1217, Bangladesh.

⁶Research Associate, Center for Atmospheric Pollution Studies (CAPS), Dhaka-1217, Bangladesh.



***Corresponding Author: Dr. Ahmad Kamruzzaman Majumder**

Professor and Chairman, Department of Environmental Science, Stamford University Bangladesh, Dhaka-1217, Bangladesh and Center for Atmospheric Pollution Studies (CAPS), Dhaka-1217, Bangladesh.

Article Received on 21/07/2024

Article Revised on 11/08/2024

Article Accepted on 01/09/2024

ABSTRACT

Air pollution has an enormous effect on respiratory health problems. This study used carried out using a web platform known as Google Form, total 325 standardized questionnaires were collected to assess individuals' views of respiratory diseases caused by air pollution. The analysis utilized statistical methods, such as descriptive statistics and a Chi-Square test, to evaluate the responses. Among the respondents, 79.4% were male and half of male participants age lies between 31 to 40 years. The urban population consisted of 146 individuals, the majority of whom relied on employment outside of the government sector. The findings indicated that 37% of the participants perceived the ambient air quality as highly detrimental to health, while 26% recognized air pollution as a contributing factor to respiratory illnesses. Significantly, 16% of the individuals had asthma, 3.7% were afflicted with COPD, Additionally, 26% of respondents experience respiratory difficulties when they step outside of their home. A notable 56% voiced apprehension regarding the influence of air pollution on respiratory well-being. Study discovered the combustion of fuel, insecticides, fertilizers, garbage, industrial pollutants, and dust generated from construction activities as the primary causes of pollution. Finally, the study emphasizes the immediate necessity for timely solutions and efficient monitoring to reduce air pollution in Bangladesh.

KEYWORDS: Air pollution, respiratory disease, health impact, people's perception and Bangladesh.

INTRODUCTION

Air pollution is now a severe problem for developing countries, which has a serious toxicological impact on human health and the environment (Majumder et al., 2023). The impact of air pollutants on the respiratory system has been widely and consistently reported in recent years. The immediate consequences encompass impairment of pulmonary function, elevation of inflammatory markers and respiratory symptoms, aggravation of chronic obstructive pulmonary disease (COPD) (Sweileh et al., 2018). Bangladesh is a major developing country with rising levels of air pollution from industrial and traffic emissions coupled with manmade phenomena. Nature of air pollution in Bangladesh is mainly differ from others developing countries in terms of its magnitude (Nayeem et al., 2020;

Rahman et al., 2019). Air pollutant emissions and the resulting health disease have increased annually since revaluation of industrialization and urbanization (Begum et al., 2014). There is increasing evidence that the most common air pollutants (PM, O₃, NO_x and SO₂) adversely affect the respiratory health of human (Colarusso et al., 2019; Bakonyi et al., 2004). There are around 92% of the world's population that are considered to breathe harmful air quality, and it is estimated that it contributes to 7 million early deaths per year (IQAir, 2023; WHO, 2016). In 2017, a total of 1.23 lakh fatalities were attributed to the combined effects of indoor and outdoor air pollution (HEI and IHME., 2019). On the other hand, within 10 % respiratory infections and diseases in Bangladesh occur due to urban air pollution (World bank., 2006). It reduces the Forced Vital Capacity (FVC), Forced Expiratory

Volume (FEV) 1, FEV 1 / FVC%, and Peak Expiratory Flow Rate (PEFR) of people especially children (Akhter, et al., 2012). People who are living in ambient air and indoor air both are affected by air pollution (Nayeem et al., 2020; Nahar et al., 2016). Long-term exposure to vehicle emissions causes Chronic Obstructive Pulmonary Disease (COPD) in traffic policeman (Ahmed et al., 2016). The adverse effects of air pollution is more detrimental to children, since for an adult the effects are more likely to be an inconvenience but to children it is also a matter of their development. In childhood, the lungs keep on developing which is why children breathe more air, and that too rapidly. Thus, the quantity of toxicant children takes in, are far more. Due to air pollution respiratory problems among school children in Dhaka cities are found (Woo et al., 2018). However, some people are exposed to long term and some in the short term. Heavy metals cause severe diseases such as lung cancer, asthma, bronchitis, tuberculosis, kidney damage, high blood pressure, birth defects, etc. because of long persistence in nature and bioaccumulation in the food chain (Rahman et al., 2019; Bhuyan and Islam, 2017 and Shandiz and Talasaz, 2017). On the other side particulate matter effects, the cognitive function of children by changing the brain structure, heavy metal like lead in air increase lead level in blood resulting reduce child brain development (Woo et al., 2018).

MATERIALS AND METHODS

Study Design and Sample Size

The study utilized a cross-sectional design to collect qualitative data through the distribution of questionnaires. All questions were responded to by the participants themselves and administered in English. Before and after pretesting, a group of specialists assessed the questionnaire's content and face validity. The study included a sample size of 325 respondents.

Data Collection

This study took place in 2020. A standardized structured online questionnaire through Google Form designed to meet the objectives of this research was used for data collection. Prior to data collection, respondents' verbal was sought. Respondents were informed about the purpose of the study and were made to understand that participation was voluntary. The study respondents were assured of confidentiality. Personal identifiers were removed after data collection in the summary data to ensure confidentiality. Ethical clearance was obtained from the Ethics Review Committee (ERC) of Department of Environmental Science, Stamford University Bangladesh.

Data Analysis

The data from the completed surveys were analyzed using SPSSv20 and Excelv13. The analysis has two sequential stages: (1) Descriptive statistics, such as frequencies, mean, and standard deviation, were employed to quantify the respondents and their answers to different survey items (2) A chi-square test is used to

determine the associations between the dependent variable of air pollution effects on respiratory health and the independent variables.

RESULTS AND DISCUSSION

The respondent's demographic details are displayed in Table 1. Majority portion (79.4%) of the respondents are male, while females constitute 20.6%. This indicates a significant gender disparity among the respondents. The age range covered was $\leq 11-20$ to ≥ 50 , with the majority (37.2%) falling between 31 and 40 years old. The second largest age group is 41-50 years, comprising 30.9% of the respondents. The age group of 21-30 years constitutes 21.5% of the respondents, whilst the youngest age group (11-20 years) and the oldest age group (51 and beyond) represent lesser numbers, specifically 2.2% and 7.2% respectively. The largest occupational group consists of non-government employees, accounting for 44.9% of the total. They are followed by individuals working in business, making up 16.0%. Additional noteworthy categories consist of housewives, accounting for 11.7% of the total, individuals with undetermined vocations, making up 10.5%, and doctors, representing 7.1%. The sample consists of smaller groups of government job holders (5.2%) and students (4.6%). The demographic distribution of the respondents reveals that most of the group consists of middle-aged males who have different professional backgrounds. Additionally, a large proportion of the respondents are employed in non-governmental positions.

Table 1: Demographical characteristics of the respondents (N=325).

	Frequency	Percent (%)
Gender category of the respondents		
Male	258	79.4
Female	67	20.6
Age category of the respondents		
11-20 Years	7	2.2
21-30 Years	70	21.5
31-40 Years	121	37.2
41-50 years	100	30.9
51 above	23	7.2
Occupation of the respondents		
Business	52	16.0
Doctor	23	7.1
Government Job	17	5.2
Non-Government Job	146	44.9
Housewife	38	11.7
Student	15	4.6
Others	34	10.5

It has been reported that 37% respondents consider that the condition of ambient air pollution has extremely unhealthy where 29% said it's in very unhealthy condition, and 30% opine that it's on unhealthy conditions (Figure 1). Only 4% believe its ambient air is healthier. It is found in figure 2 that 67% respondents said they did not have any respiratory problem; 26%

respondents agree that air pollution induced in respiratory disease. About 90% of deaths due to air pollution in the South Asia region occur in low- and middle-income countries (Sweileh *et al.*, 2018). The table presents the distribution of respiratory diseases among 325 respondents. Most participants, 73.2% (238 individuals), reported no respiratory problems. Of those with respiratory conditions, asthma was the most common, affecting 16.0% (52 individuals) of the sample. Other conditions reported include bronchitis (4.9%, 16 individuals), chronic obstructive pulmonary disease (COPD) (3.7%, 12 individuals), and combinations of asthma with other conditions such as bronchitis (0.6%, 2 individuals), COPD (0.9%, 3 individuals), and lung cancer (0.6%, 2 individuals). Traffic-related air pollutants (TRAP) is mostly associated with the development of asthma everywhere and it has been widely accepted that the acute health effects in individuals with pre-existing COPD may be caused by air pollution (McConnell *et al.*, 2010; Bloemsma *et al.*, 2016). Figure 3 shows that 26% of respondents have breathing difficulties when they go outside from home. 7% people doesn't understand whether they face breathing difficulties and majority of respondent 67% doesn't having breathing difficulties, here as 12%

respondents use sometimes. Almost 65% of respondents don't use it. Figure 4 depicts the respondents' perceptions of the impact of air pollution on respiratory health. Based on the statistics, 56% of participants hold the belief that air pollution has a substantial impact on respiratory problems. By comparison, 29% of participants believe that air pollution could potentially affect their respiratory health, while 15% do not perceive air pollution as a catalyst for their respiratory issues. Figure 5 presents the frequency of medication used among respondents for respiratory and airborne diseases. It indicates that 23% of participants use medication regularly, 29% use it occasionally, and 48% do not use any medication. Figure 6 details the frequency of doctor visits in 2019 related to respiratory and airborne diseases. It shows that 48% of respondents visited a doctor 1-5 times during the year. Additionally, 11% visited 5-10 times, and 1% visited more than ten times. Notably, 40% of individuals with respiratory or airborne illnesses did not visit a doctor at all in 2019. The study also highlights hospitalization trends for respiratory and airborne conditions in 2019. It found that 20% of respondents were hospitalized 1-5 times, while only 1% were hospitalized 5-10 times. The majority, 79%, did not experience hospitalization during the year.



Figure 1: Opinion about the Quality of Air in Bangladesh

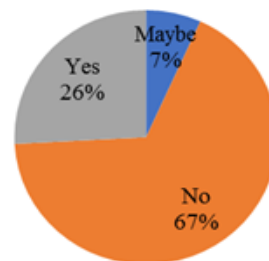


Figure 2: Perception about Respiratory Problems

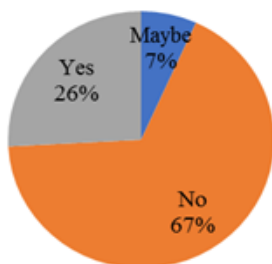


Figure 3: Breathing Difficulties When You Go Outside

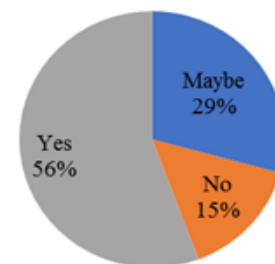


Figure 4: Air Pollution Triggers Your Respiratory Problems

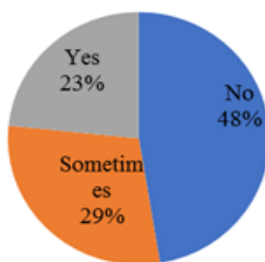


Figure 5: Medicine for Respiratory & Airborne Diseases Regularly

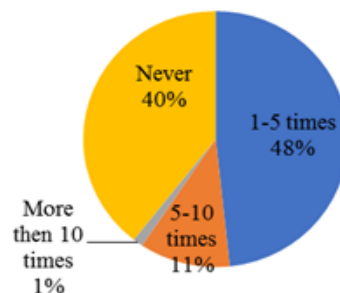


Figure 6: Visit Doctors Due to Respiratory & Airborne Diseases in the Year 2019

Table 2: Types of respiratory problem of respondents

Disease	Frequency	Percent	Cumulative Percent
Asthma	52	16 %	16.0
Asthma, Bronchitis	2	0.6 %	16.6
Asthma, COPD	3	0.9 %	17.5
Asthma, Lung Cancer	2	0.6 %	18.2
Bronchitis	16	4.9 %	23.1
COPD	12	3.7 %	26.8
No problem	238	73.2 %	100.0
Total	325	100.0	

Table 3 demonstrates Chi-Square test. The analysis reveals significant associations between demographic factors and health outcomes related to air quality in Bangladesh. Gender strongly influences opinions on air quality, while age is a significant factor in respiratory health, affecting the occurrence of problems and the use

of inhalers. Although occupation shows a marginal association with opinions on air quality, it does not significantly impact willingness to pay for air pollution mitigation. Overall, demographic factors play a crucial role in shaping experiences and attitudes toward air quality and respiratory health in Bangladesh.

Table 3: Chi-Square test (Hypothesis).

	Vale	df	P value (95% CL)
Opinion about the quality of air in Bangladesh			
Age	6.9	3	0.075
Gender	48.40	18	0.000
Occupation	56	33	0.070
Age			
Respiratory problems	25.68	12	0.012
Types of respiratory problems	136	36	0.000
Breathing difficulties	17.74	12	0.124
Taking inhaler regularly	33.64	12	0.001
Air Pollution trigger up respiratory problems			
Existing respiratory problems	80.67	4	0.000
Willingness to pay to combat air pollution			
Occupation	61.42	55	0.250

Worldwide air pollution is a threat because of its tremendous effects on respiratory (Nayeem *et al.*, 2020). A long period of time if polluted air is absorbed by the human body during inhalation, it slowly affects respiratory system. People who suffer from respiratory disease, in maximum cases can understand at the trimester stages of disease (Manisalidis *et al.*, 2020). Another study found that respondents suffered from respiratory diseases such as, asthma (20%), bronchitis (10%) and others (6%) problems (Tusher *et al.* 2018). Though air pollutants are linked to a range of health issues, including eye irritation, headaches, kidney damage, central nervous system harm, skin cancer, cardiovascular diseases, nausea, asthma, and anemia (Alam *et al.*, 2018). This broad spectrum of health concerns underscores the critical need to address air quality to mitigate its adverse effects. Again, different studies found relationship between particulate matter concentrations (PM_{2.5} and PM₁₀) and peak expiratory flow rate (PEFR) in children, both asthmatic and non-asthmatic (Ahmad *et al.*, 2008). Their study found that increases in PM_{2.5} and PM₁₀ concentrations are associated with significant reductions in PEFR, with variations observed between morning and afternoon measurements and between dry and wet seasons. This

highlights the impact of air pollution on lung function and the variability in effects based on environmental conditions. Different studies emphasize that air pollution's health effects extend beyond respiratory symptoms to include associations with preterm birth, infant mortality, impaired lung growth, and potentially the development of asthma (Ali *et al.* 2006). About 4.5 million deaths worldwide were connected to outdoor air pollution exposures and another 2.2 million deaths were caused by indoor air pollution (State of Global Air, 2019). Particulate matter is a mixture of particles and droplets in the air, consisting of a variety of components such as organic compounds, metals, acids, soil, and dust (Ciencewicki *et al.*, 2007). Particulate Matter (PM), particles of variable but very small diameter, penetrate the respiratory system via inhalation, causing respiratory disease and may lead to death (Manisalidis *et al.*, 2020). Particulate matter (PM_{2.5}) is a lung-damaging tiny particle. According to WHO, the safe limit of PM_{2.5} is 15 micrograms per cubic meter for outdoor air. From substantial evidence it has been found that PM_{2.5} is independently implicated in respiratory diseases, and cancer and considering its ability it can reach terminal bronchioles and alveolar structures. (Siddiqui *et al.*, 2020). Many studies have discussed the effects of air

pollution on the respiratory system. Almost all studies focused on indoor and outdoor air pollution and its severity in human health. Chronic obstructive pulmonary disease (also known as COPD), asthma, bronchiolitis, and lung cancer are all instances of severe respiratory disorders that may occur as the consequence of exposure to air pollution. According to data from the Directorate General of Health Services (DGHS), an alarming number of patients paint a picture of a country's poisoned air. National Institute of Disease of Chest and Hospital (NIDCH) claims that about 7 million people in Bangladesh are affected by asthma and half of them are children (Shakeel *et al.*, 2017). In 2014, the World Health Organization (WHO) reported that lung cancer deaths reached 9,660 in Bangladesh, which is a staggering 1.3% of the total deaths in Bangladesh for the previous year. The present study found that the respondent said 16% respondent were faced asthma (Table 2). Air pollution is responsible for death estimated about 2.7 to 3.0 million people every year in the whole world, and 6% of all annual deaths. About 9 deaths out of 10 people due to air pollution take place in the developing countries, where about 80% of all people live (Shakeel *et al.*, 2017).

CONCLUSION AND RECOMMENDATION

Air pollution has become the second leading risk factor for death worldwide, contributing to 8.1 million deaths in 2021 (HEI and IHME., 2024). This study focuses on a critical problem of contemporary issue that, how air pollution affects respiratory functions. Among the respondents, 26% acknowledged that air pollution causes respiratory diseases. Specifically, 16% (52 individuals) reported having asthma, while 3.7% were discovered to be suffering from COPD. A significant majority of 73.2% of the respondents were not familiar with any respiratory condition. The survey revealed that 26% of participants had respiratory challenges while venturing outside of their residences their annual income for the same purpose. Only 0.6% of respondents are willing to allocate more than 25% of their annual salary towards mitigating air pollution. A study has revealed that 48% of the respondents were admitted to the hospital 1-5 times in 2019 because of respiratory and airborne infections. There is a substantial correlation between the basic concept of air pollution in Bangladesh and the respondent's age, gender, and occupation. Furthermore, the age of the respondent significantly influences their perception of the respiratory health effects of air pollution. To effectively bring pollution under control, it will be necessary to implement measures such as the effective enforcement of laws, the reduction of political influence during mobile court operations, the establishment of efficient government monitoring cells, and the raising of public awareness. Educate individuals on how to reduce their exposure to air pollution and raise awareness among the general public; this initiative can begin in a specific region and eventually spread across the entire nation. Everyone needs to be aware of this issue and its detrimental effects on both our health and

environment. We should avoid using vehicles that emit black smoke and instead opt for cycling. We should plant more and more trees for a greener environment. The most necessary steps are public awareness and government investment in this particular area to reduce air and dust pollution. Strong rules and regulations will eventually emerge, and their implementation has the potential to reduce pollution to a level that is sustainable. Human sincerity, motivation, planting, minimizing unplanned urbanization, and strictly shutting down defective vehicles and industries will all play a crucial role.

ACKNOWLEDGEMENTS

The authors are very much thankful to the Center for Atmospheric Pollution Studies (CAPS) and Department of Environmental Science, Stamford University Bangladesh for the technical and others support.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

1. Ahmad SA, Sayed MH, Khan MH, Karim N, Hossain Z, Yasmin N, Hossain M. Assessment of Impact of Air Pollution Among School Children in Selected Schools of Dhaka City, Bangladesh. Male Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effect for South Asia, 2008.
2. Ahmed S, Shamima Q, Eva H, Bhowmik M. Effect of Air Pollution on FVC, FEV1 and FEV1/FVC% of the Traffic Policemen in Dhaka city. *J Bangladesh Soc Physiol*, 2016; 11(2): 39-42.
3. Alam MZ, Armin E, Haque M, Halsey J, Kayesh E, Qayum A. Air Pollutants and Their Possible Health Effects at Different Locations in Dhaka City. *Int J Environ Sci Nat Res.*, 2018; 9(4): 1-11.
4. Ali T, Hossain MA, Bennoor KS. Air Pollution and Chest Diseases—a Review. *Bangladesh J Physiol Pharmacol*, 2006; 22(112): 25-28.
5. Bakonyi SM, Danni-Oliveira IM, Martins LC, Braga AL. Air Pollution and Respiratory Diseases among Children In Brazil. *Rev Saude Publica*, 2004; 38(5).
6. Begum BA, Nasiruddin M, Randal S, Sivertsen B, Hopke PK. Identification and Apportionment of Sources from Air Particulate Matter at Urban Environments in Bangladesh. *Br J Appl Sci Technol*, 2014; 4(27): 3930-3955.
7. Bhuyan MS, Islam MS. A Critical Review of Heavy Metal Pollution and Its Effects in Bangladesh. *Sci J Energy Eng.*, 2017; 5(4): 95-108.
8. Bloemsma LD, Hoek G, Smit LA. Panel studies of air pollution in patients with COPD: systematic review and meta-analysis. *Environ Res.*, 2016; 151: 458-468.
9. Ciencewicki J, Jaspers I. Air pollution and respiratory viral infection. DOI: 10.1080/08958370701665434.
10. Colarusso C, Falco GD, Terlizzi M, *et al.* The

- Inhibition of Caspase-1 Does Not Revert Particulate Matter (PM)-Induced Lung Immunosuppression in Mice. *Front Immunol*, 2019; 10: 13-29.
11. Global Burden of Disease Collaborative Network. *Global Burden of Disease Study 2019 (GBD 2019) Results*.
 12. Institute for Health Metrics and Evaluation (IHME); 2020. Available at: <https://vizhub.healthdata.org/gbd-results/>. Accessed April 29, 2023.
 13. Health Effects Institute. *State of Global Air 2019. Special Report*. Boston, MA: Health Effects Institute; 2019.
 14. Health Effects Institute. *State of Global Air 2024. Special Report*. Boston, MA: Health Effects Institute; 2024.
 15. IQAir. *World Air Quality Report Region & City PM_{2.5} Ranking*; 2023.
 16. Majumder AK, Rahman M, Patoary MNA. A bibliometrics of air pollution studies in Bangladesh from 1995-2020. *World Journal of Advanced Engineering Technology and Sciences*, 2023; 9(1): 228-239. doi:10.30574/wjaets.2023.9.1.0110
 17. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and Health Impacts of Air Pollution: A Review. DOI: 10.3389/fpubh.2020.00014.
 18. McConnell R, Islam T, Shankardass K, et al. Childhood incident asthma and traffic-related air pollution at home and school. *Environ Health Perspect*, 2010; 118(7): 1021-1026.
 19. Nahar M, Khan MH, Ahmad SA. Indoor Air Pollutants and Respiratory Problems Among Dhaka City Dwellers. *Arch Community Med Public Health*, 2016; 2(2): 032-036.
 20. Nayeem AA, Hossain MS, Majumder AK. Characterization of Inhalable Ground-Level Ambient Particulate Matter in Dhaka City, Bangladesh. *J Sci Res.*, 2020; 12(4): 701-712.
 21. Nayeem AA, Majumder AK, Hossain MS, Carter WS. The Impact of Air Pollution on Lung Function: A Case Study on the Rickshaw Pullers in Dhaka City, Bangladesh. *J Hum Environ Health Promot*. DOI: 10.29252/jhehp.6.2.1.
 22. Rahman MS, Khan MDH, Jolly YN, et al. Assessing Risk to Human Health for Heavy Metal Contamination through Street Dust in the Southeast Asian Megacity: Dhaka, Bangladesh. *Sci Total Environ*, 2019; 660: 1610-1622.
 23. Shakeel AIM. Air pollution kills 15,000 Bangladeshis each year: The role of public administration and government integrity. *J Public Adm Policy Res.*, 2011; 3(4): 129-140.
 24. Shandiz F, Talasaz ZH. The Relationship between Breast Cancer and Air Pollution: Review Article. *Rev Clin Med.*, 2017; 4(3): 136-139.
 25. Siddiqui SA, Jakaria M, Amin MN, et al. Chronic air pollution and health burden in Dhaka city. *Eur Respir J.*, 2020; 56: 2000689. doi: 10.1183/13993003.00689-2020.
 26. Sweileh WM, Al-Jabi SW, Zyoud SH, Sawalha AF. Outdoor air pollution and respiratory health: a bibliometric analysis of publications in peer-reviewed journals (1900-2017). *Multidiscip Respir Med.*, 2018; 13: 15.
 27. Tusher TR, Ashraf Z, Akter S. Health Effects of Brick Kiln Operations: A Study on Largest Brick Kiln Cluster in Bangladesh. *South East Asia J Public Health*, 2018; 8(1): 32-36.
 28. Woo MK, Young ES, Mostofa MG, et al. Lead in Air in Bangladesh: Exposure in a Rural Community with Elevated Blood Lead Concentrations among Young Children. *Int J Environ Res Public Health*, 2018; 15: 1947.
 29. World Bank. *Country Environmental Analysis Bangladesh Development Series Paper No: 12; 2006*. www.worldbank.org.bd/bds.2006.
 30. The Daily Star. Respiratory diseases skyrocketing in Bangladesh. *The Daily Star*. <https://www.thedailystar.net/health/respiratory-diseases-skyrocketing-bangladesh-1565779>. Published April 21, 2018.
 31. World Health Organization (WHO). WHO releases country estimates on air pollution exposure and health impact. Published September 27, 2016.