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Original Article

Information and Safety Precautions on Air Pollution for Adult Respiratory Patients in Tertiary Hospital

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Abstract:

Background: Bangladesh faces escalating air pollution due to urbanization, industrialization, deforestation, and rising energy consumption. This jeopardizes public health, leading to respiratory problems and heightened risks of infections, causing a surge in hospital admissions, deaths, and associated economic burdens.

Method: This was a cross-sectional study to assess the level of knowledge and protective practices regarding air pollution among adult respiratory disease patients who attended the medicine OPD of the National Institute of Diseases of the Chest & Hospital (NIDCH) from January 1, 2023, to December 31, 2023.

Result: The mean age of the 361 respondents was 37.90±13.77 years and more than half (53.5%) of them were in the age group 21-40 years. About one-third (32.1%) received higher secondary and above education. Almost one-fourth (23.5%) of respondents' income was between 15000, and personal monthly income was not applicable for more than (56.5%) of respondents. About three-fourths (73.7%) of patients were married, two-thirds (67.3%) belonged to a nuclear family and about half (54.6%) of participants belonged to a member of 1-4 persons. The majority (95.3%) of respondents were Muslim and about two-thirds (67.3%) belonged to the nuclear family. About two-thirds (67%) of patients had poor knowledge and one-third (33%) had average knowledge regarding air pollution. All the respondents had poor protective practices against air pollution.

Conclusion: The study's insights will guide future efforts to raise awareness among adult respiratory patients about air pollution risks, respiratory health effects, and protective measures. Empowering these patients not only safeguards their health but also promotes environmental responsibility for cleaner air in the community.

Key words: Air Pollution Knowledge, Protective Practice, Adult Respiratory Disease Patients.

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Introduction:

Environmental health relies on the interaction of physical, social, cultural, and technical factors, incorporating perspectives from science, economics, ethics, and politics in the human-environment relationship.[1]

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Political decisions impact the environment, but global challenges like clean air needto go

beyond borders. Urban areas, with diverse pollution sources, disrupt life's balance across domains.[2]Global laws regulate pollutants to safeguard human health.[3] The European Commission sets guidelines to monitor and reduce air pollution.[4]Various methods monitor lead, ozone (O_3), nitrogen oxides (NOx), sulfur dioxide (SO_2), and particulate matter (PM) levels.[5] Urban areas face challenges with around 200 hazardous air contaminants, impacting atmospheric concentrations from various sources, challenging sustainability and health.[4] Global atmospheric contaminant concentrations fluctuate across time and space.[6] Human activity alters Earth's atmosphere over time.[7] Alterations like high concentrations of air pollutants harm ecosystems, crops, and human health.[3,7,8] Urban and industrial air pollution manifests as haze, smog, and acid rain.[9] PM_{10} harms both the environment and human health, elevating rates of respiratory and cardiovascular diseases.[9,10] Carbon monoxide (CO) exposure causes fatigue, headaches, dizziness, unconsciousness, and potential death.[11] SO_2 and NOx impair lung function, suppress the immune system, exacerbate asthma and chronic respiratory conditions, and elevate the risk of cardiovascular disease.[3,11]

Human activities categorize different types of air pollution.[3] Emissions come from home fuel, industry, power plants, and vehicular traffic.[3,10,12] Road traffic, especially from poorly maintained vehicles, older cars, and two-stroke engines, is a significant air pollution source.[3,8] Over a decade ago, the World Health Organization (WHO), the European Union (EU), and the United States Environment Protection Agency (US-EPA) issued recommendations for developing an Ambient Quality Index (AQI). Khanna, for instance, devised an AQI considering welfare losses from pollution exposure damage.[13]

Southeast France, including Dhaka city, is heavily impacted by atmospheric pollution.[14] Dhaka city's population has been rapidly increasing.[3]Reducing air pollution in Bangladesh could save lives, prevent respiratory illnesses, cut healthcare costs by $500 million, and boost production.[15] Vehicular and industrial emissions are key sources of air pollution in Bangladesh.[16] Ozone, crucial for UV protection, turns harmful when present in the air. Earth's atmosphere, mainly oxygen, nitrogen, water vapor, carbon dioxide, and trace gases, is held by gravity, with layers like the troposphere, stratosphere, and ionosphere. Non-gaseous substances like aerosols and particulate matter are dispersed throughout. Biological activities release particles like dust, soot, smoke, and salt, contributing to air pollution.[1]

Pollution, rooted in the 19th-century industrial revolution, now surpasses contemporary nuclear concerns due to technology's impact on the economy and lifestyle. Prioritizing environmental protection is crucial for global economic growth and human well-being.[3]Global pollution, influenced by population growth and technology, encompasses land, water, and air pollution, affecting health. Air pollution, with main, secondary, and natural pollutants from combustion and industry, releases CO, HC, particulates, SO_2, and NO_X. Historical records recognize natural and man-made pollutants.[1]Air pollution stems from industrial combustion, home fossil fuel use, and vehicle emissions.[17,18] Fossil fuels, the main energy source, cause air pollution with health risks (pneumonia, bronchitis) and contribute to CO_2 emissions, amplifying global warming.[15] Vehicle emissions (Pb, PM, CO, organic compounds, NO_X) alter atmospheric composition, posing a threat to organisms. Rapidly escalating air pollution affects urban and rural areas in developing world megacities.[19]Air pollutants harm health and impact the environment, wildlife, flora, buildings, and weather. Studies on health effects trace back to events like the 1952 London disaster and the 1930 Meuse Valley fog disaster, revealing the deadly consequences of high concentrations of sulfur compounds, fluoride gases, and PM.[20] Deadly haze in London, in December 1952, due to temperature inversion and coal burning, led to additional deaths over three weeks. The 1952 London fog incident led to prolonged elevated mortality, and long-term health effects, with approximately 12,000 additional deaths in the year afterward.[21] Developed nations' cities meet air quality criteria, but many Asian cities fail WHO and

US-EPA standards, facing some of the world's worst air pollution.[22] Established in 1998 by the National Environment Protection Council (NEPC), the Ambient Air Quality National Environment Protection Measure (AAQ NEPM) sets federal air quality standards applicable nationwide. Covering six typical pollutants Pb, CO, O_3, SO_2, and PM_{10} the NEPM provides a framework for monitoring and reporting these pollutants on a national level.[23]WHO reports air pollution causing 4.6 million lost life years and 800,000 fatalities annually.[24] In Asia, developing countries account for up to two-thirds of global deaths and lost life years due to air pollution.[25]
U.S. air quality standards prioritize vulnerable populations, adjusting based on data for higher risks in susceptible subpopulations. Pollution reduction aims to protect these groups, considering complex interactions of pollutants and biological reactions. Those with preexisting conditions or genetic predispositions are disproportionately affected. While public health measures benefit the entire population, the need for extra protection for certain individuals is unclear.[26]Not just elderly or sick people are vulnerable to the harmful effects of air pollution on their health.[27]Bangladesh faces an unbalanced environmental situation with severe air, water, and noise pollution posing risks to ecosystems, population, and economic development. Air quality deterioration is attributed to population growth, fossil fuel burning, industrialization, motorization, urbanization, and economic expansion.[28] Human health is seriously threatened by declining air quality. Additionally, it harms the environment, damages ecosystems, interferes with photosynthesis, contributes to climate change, depletes biodiversity, and more.[29]Low ambient air quality adversely impacts human health, agricultural productivity, and material integrity in developed and developing countries, resulting in a noticeable rise in respiratory diseases,[30,31] various types of allergies, circulatory problems,[32] disturbances of the central nervous system (sleeplessness, headaches), and a greater incidence of cancer.[31,33,34]The economic loss due to health issues related to air pollution in the surveyed city ranges from $60 million to $270 million annually, constituting 1.7% to 7.5% of the city's gross product.[35] WHO surveys assessing global city air quality revealed improvements in wealthy nations like Japan and the United States, while megacities in developing nations experienced the worst levels of air pollution.[16] Developing countries with serious air pollution issues, such as China and India, are beginning to build their environmental management systems.[36]

The Air Quality Performance Index urges immediate action against Dhaka's air pollution. Key sources are factories, brick kilns, road dust, and faulty diesel vehicles. Gasoline engines emit CO, HC, NOx, and SO_2. Dhaka's dry season sees the world's highest PM density, surpassing WHO limits. A BAEC study found 50 tons of lead annually, peaking in the dry season. Bangladesh's DoE seeks proposals for an "Air Pollution Reduction Policy" aligned with the Male Declaration. Ambient air quality guidelines in Bangladesh started with the Environmental Conservation Regulations (ECR) 1997. The Air Quality Management Initiative (AQMP) from 2000 to 2007, supported by the World Bank, played a crucial role in managing air quality. Goals included reducing vehicle emissions, establishing standards, implementing cleaner technology, and monitoring. Subsequent efforts, like the Clean and Sustainable Environment (CASE) Project, Implementation of the Male Declaration, and Bangladesh Air Pollution Management (BAPMAN) Project, aimed at reducing air pollution and promoting energy-efficient technologies in specific industries. The analysis covers historical, current, and future states of ambient air quality in Dhaka, along with relevant regulations and initiatives. Major urban areas, including Dhaka, Chittagong, and Khulna, experience significant air pollution attributed to unplanned industrial growth and vehicle exhaust. Rural areas, lacking industries and powered transportation, are less concerned about air pollution. A comparison between WHO and US air quality standards with Bangladesh's standards is illustrated in Table 1.[37]

Table 1. Ambient air quality standards in Bangladesh from July 2005 and their comparison with WHO and US standards

Pollutant	Pollutant (observation realized)	Bangladesh Standard (μgm^{-3})	WHO guideline (μgm^{-3})	US Standard (μgm^{-3})
CO	8 hr	10000	10000	10000
	1 hr	40000	30000	40000
Pb	Annual	0.5	0.5	0.15
NOx	Annual	100	-	-
SPM	8 hr	200	-	-
PM_{10}	Annual	50	20	-
	24 hr	150	50	150
$PM_{2.5}$	Annual	15	10	15
	24 hr	65	25	35
O_3	1 hr	235	-	235
	8 hr	157	100	157
SO_2	24 hr	80	-	78

Bangladesh faces significant air pollution challenges, particularly from irregular brick kilns emitting PM, SO_2, and VOCs. Dhaka was ranked the second-worst city to live in for two consecutive years, considering factors like infrastructure, stability, culture, environment, healthcare, and education, based on thirty variables in the Economist Intelligence Unit's (EIU) study[37].Air pollution leads to respiratory ailments, particularly affecting those with pre-existing conditions. Lack of awareness exacerbates the problem, necessitating a campaign for public awareness.

Materials and Methods:

Study design and settings

This was a cross-sectional study to assess the level of knowledge and protective practices regarding air pollution among adult respiratory disease patients who attended the medicine OPD of the National Institute of Diseases of the Chest & Hospital (NIDCH) from January 1, 2023, to December 31, 2023.

Sample selection

Three hundred sixty-one adult respiratory disease patients were selected conveniently who attended the medicine OPD of NIDCH.

Data collection procedure

The studied adult respiratory disease patients were interviewed by a pretested semi-structured questionnaire through the face-to-face interview. The questionnaire consists of questions on socio-demographic characteristics and questions related to knowledge and protective practice.

Statistical analysis

The data were analyzed into IBM SPSS v27. Descriptive statistics such as mean, standard deviation and percent were computed for continuous variables of the participants. Level of knowledge and protective practice variable scoring was done and categorized into three groups according to Sarker et al., 2018. In that literature, scoring was done from 0 to 126. In this study, these 126 points converted into 22 points as the highest mark of awareness was 22 and then ranging was done as (0-8.73= poor, 8.74-17.46= average, 17.47-22= good). The results were presented in tables and charts.

Ethical approval

Informed written consent was obtained from each participant. Ethical approval was obtained from the Institutional Review Board (IRB) of the National Institute of Preventive and Social Medicine (NIPSOM), Dhaka 1212, Bangladesh. (NIPSOM/IRB/2023/06).

Results:

Particulars		Frequency (n)	Percent (%)
Age group (Years)	20 and less	33	9.1
	21-40	193	53.5
	41-60	107	29.6
	61 and more	28	7.8
	Mean±SD	37.90±13.77	
Educational Qualification	No formal education	78	21.6
	Primary	63	17.5
	Secondary	104	28.8
	Higher secondary and above	116	32.1
Monthly income (In BDT)	1-15000	85	23.5
	15001-30000	51	14.1
	30001-45000	13	3.6
	More than 45000	8	2.2
	Mean±SD	10072.02 ± 25094.82	
Marital status	Single	95	26.3
	Married	266	73.7
Religion	Islam	344	95.3
	Hindu	13	3.6
	Christian	4	1.1
Family type	Nuclear	243	67.3
	Joint	118	32.7
Family member	1-4	197	54.6
	5 and more	164	45.4

Table 2 depicts the particulars of the adult respiratory disease patients. The mean age of the 361 respondents of the National Institute of Diseases of the Chest & Hospital was 37.90±13.77 years and more than half (53.5%) of them were in the age group 21-40 years. About one-third (32.1%) received higher secondary and above education. Almost one-fourth (23.5%) of respondents' income was between 15000, and personal monthly income was not applicable for more than (56.5%) of respondents. About three-fourths (73.7%) of patients were married, two-thirds (67.3%) belonged to a nuclear family and about half (54.6%) of participants belonged to a member of 1-4 persons. The majority (95.3%) of respondents were Muslim and about two-thirds (67.3%) belonged to the nuclear family.

Figure 1 shows almost half (49.03%) of the patients were female and another half (50.97%) were male among all participants.

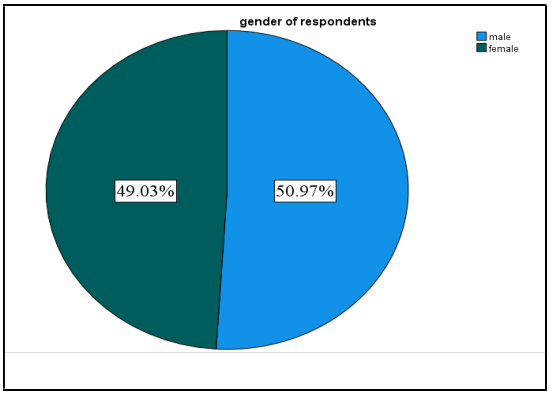

Figure 1:Distribution of the respondents by gender (n=361)

Figure 2 portrays almost two-thirds (58%) resided in Dhaka and almost more than one-third resided outside Dhaka among all respondents.

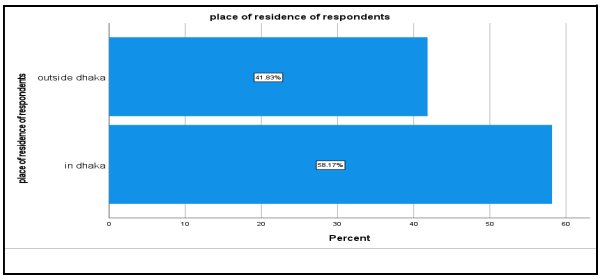

Figure 2: Distribution of the respondents by residential area(n=361)

Table 3: Level of knowledge regardingair pollution(n=361)

Particulars		Frequency (n)	Percent (%)
A significant concern for respiratory health	True False	334 27	92.5 7.5
Air pollution exposure causes shortness of breath in respiratory patients	True False	324 37	89.8 10.2
Air pollution primarily affects the respiratory system	True False	306 55	84.8 15.2
Respiratory patients can safely ignore air quality warnings on high-pollution days	True False	270 91	74.8 25.2
Using air purifiers can help mitigate the effects of indoor air pollution on respiratory health	True False	72 289	19.9 80.1
Air pollution originates from industrial emissions	True False	239 122	66.2 33.8
Air pollution levels remain consistent throughout the year regardless of seasons	True False	229 132	63.4 36.6
Being aware of local air quality levels is crucial for managing respiratory health	True False	315 46	87.3 12.7
Weather conditions can influence the impact of air pollution on respiratory health	True False	278 83	77 23
Regular physical activity outdoors can help counteract the adverse effects of air pollution	True False	118 243	32.7 67.3
Air quality index (AQI) provides a reliable measure of daily air pollution levels	True False	42 319	11.6 88.4
Local and national regulations effectively control and reduce air pollution levels	True False	171 190	47.4 52.6

Table 4: Knowledge category regardingair pollution (n=361)

Level of knowledge	Frequency (n)	Percent (%)
Poor	242	67
Average	119	33
Good	0	0

Table 4 demonstrates about two-thirds (67%) of patients had poor knowledge and one-third (33%) had average knowledge regarding air pollution.

Table 5: Protective practice againstair pollution (n=361)

Particulars		Frequency (n)	Percent (%)
Checking the daily air quality index (AQI) to monitor air pollution levels in their area	Yes No	0 361	0 100
Wearing mask when going outside on days with poor air quality	Yes No	303 58	83.9 16.1
Changing to their daily routines to reduce exposure to outdoor air pollution	Yes No	131 230	36.3 63.7
Using air purifiers with HEPA filters in their home to improve indoor air quality	Yes No	2 359	0.6 99.4
Aware of common indoor air pollutants that can affect respiratory health	Yes No	181 180	50.1 49.9
Engaging in physical activities or exercises indoors when outdoor air quality is poor	Yes No	114 247	31.6 68.4
Discussing air pollution effects with healthcare provider	Yes No	214 147	59.3 40.7
Taking prescribed medications or inhalers as recommended by their healthcare provider	Yes No	233 128	64.5 35.5
Participating in any local or community efforts aimed at reducing air pollution	Yes No	121 240	33.5 66.5
Aware oflocal and national regulations related to air pollution control and reduction	Yes No	274 87	75.9 24.1

Table 6: Protective practice category regarding air pollution (n=361)

Protective practice	Frequency (n)	Percent (%)
Poor	361	100
Average	0	0
Good	0	0

Table 6 interprets all the respondents had poor protective practices against air pollution.

Discussion:

This study in a tertiary hospital assessed sociodemographic traits, protective practices, and air pollution knowledge in 361 adult respiratory disease patients, using a semi-structured questionnaire via convenience sampling. Participants were diagnosed as patients aged 18 and above.

The survey included participants aged 18 to 65, with a mean age of 37.90 years. A significant proportion of the361 individuals fell within the age range of 21 to 40 years. Another study by Sarker *et al*. indicated that the majority of participants were aged 50 or below.[38] The consistency between the two surveys is noteworthy. Within the scope of this investigation, a total of 361 individuals participated in the survey, with about half of them being male and the others being female. According to the findings of a study that was conducted by Qian *et al*., more than half of the participants were female.[39] Therefore, it differs slightly from this study.

One-third completed secondary school, over one-third attained higher education or above, nearly one-fifth finished primary school, and more than one-fifth had no formal education, as per the study. A similar study by Mondol *et al*. found a majority in the higher secondary and above category.[16] It is consistent with this study.

The study shows that over half of the respondents belonged to groups of one to four people, and 45.4% were in groups of five or more. A similar study by Mondol *et al*. found that the majority of individuals were part of families with five to seven members.[17] This study contrasts with the mentioned studies.

The level of awareness in this study is influenced by the permanent residence of

respondents. Over half were from Dhaka, and 41.8% were located outside the city. A similar survey in Poland by Zielonka found the majority living in Warsaw, aligning with the study's conclusions.[40]

In table 3, in this study, the majority of respondents showed significant concern for their respiratory health. In contrast, a study by Zielonka in Poland found that 46% of patients reported air pollution's significant impact on their health.[40]

Only a small percentage of participants in this study used HEPA filter-equipped air purifiers to improve indoor air quality. Zielonka's study revealed that one-third of the surveyed patients had air purifiers with HEPA filters in their homes.[40] It does not align with the study, as there is insufficient knowledge and practice regarding the use of air purifiers with HEPA filters.

A notable portion of the participants in this study wore masks when leaving their homes. According to the findings of another study by Qian *et al*., that is similar to this one, nearly half of the participants in another study used masks when going outside.[39]

All survey participants acknowledged not checking the daily Air Quality Index (AQI) to monitor air pollution levels in their geographical area. However, a study by Qian et al. found that the majority of respondents expressed concern about the AQI.[39] This finding contradicts the current study, as participants are unfamiliar with the AQI.

During the research, almost three-quarters of participants reported did not engage in indoor physical activities or exercises when the outside air quality was poor. Qian *et al*. found that nearly three-quarters of participants engaged in indoor physical activities or exercises during poor outdoor air quality, not aligning with the current study's findings.[39] In other words, the findings are not consistent.

Throughout the research, every participant demonstrated insufficient protection measures against air pollution. According to Qian *et al*., two-thirds of participants took protective practices seriously.[39]

This study differs as two-thirds of respondents lacked sufficient understanding of air pollution, contrasting with one-third having an average awareness level in the survey.

In this study, most respondents had a medium level of knowledge, a small percentage had a low level, and the rest had a high level of knowledge. Zielonka's study in Poland found a high percentage of patients were aware of the connection between air pollution and their health.[40] It contrasts with the study findings as the knowledge about air pollution and preventive practices against air pollution are lower.

Conclusion:

Air pollution is a persistent problem in densely populated Bangladesh, particularly in cities like Dhaka. Major sources include construction sites, high-sulfur fuel in vehicles, and brick kilns. It is crucial to raise awareness among respiratory patients (asthma, COPD, RTI) due to their heightened vulnerability. Knowledge of pollution sources aids patients in minimizing exposure and fostering a better quality of life. Increased awareness can drive behavioral changes, such as using masks or air purifiers, contributing to environmental responsibility and a healthier future.

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Competing interests:

All the authors declared no competing interest.

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