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Assessment of knowledge, attitude and practices against inhaled particulate matter among urban residents in Dhaka, Bangladesh

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Abstract

Purpose – In order to reduce the health impacts of air pollution effectively, developing strategies that involves individual or community level is crucial. The purpose of this paper is to assess people's protective practices for inhalable particulate matter and its significant determinants such as general characteristics, knowledge and attitude among residents of an urban residential area, Dhaka, Bangladesh.
Design/methodology/approach – This cross-sectional study was conducted by systematic random sampling. A total of 424 people, who lived in that area for not less than two years before the survey, were interviewed using a structured questionnaire. χ^2 and Fisher's exact test were used to analyze the data.
Findings – Only a small proportion of respondents had high practice level. In addition, a little more than half has high level of knowledge about inhalable particulate matter, its adverse health effects and protective practices and almost 70 percent had high level of attitude toward air pollution. The protective practices for small inhalable particulate matter was significantly associated with age, educational level, occupation, knowledge and attitude toward small inhalable particulate matter, its adverse health effects and protective measures.
Originality/value – A good level of knowledge about the prevailing air pollution and related health risks can be crucial to develop more focused attempt at changing the current situation with public participation. The environmental experts and health volunteer should disseminate precise and adequate information about long-term health hazards of particulate matter and measures of exposure prevention to improve the protective practices.

Keywords Air pollution, Particulate matter, Protective practices, Bangladesh
Paper type Research paper

Introduction

Rapid economic and industrial growth in developing countries has resulted in increased air pollution[1–3]. Globally, there are an estimated 3m premature deaths annually due to outdoor air pollution in both urban and rural areas[4]. In sum, 90 percent of these deaths occur in low and middle-income countries and two out of three occur in the Western Pacific

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and South-East Asian regions[4]. In Bangladesh, an estimated 15,000 people die each year due to air pollution[5]. The estimated health care cost and reduced productivity due to this is equivalent to around US$500m per year[6].

Bangladesh is densely populated with more than one-third of its population living in cities. Recent air quality data suggests that particulate matter $< 10\,\mu$m in aerodynamic diameter (PM_{10}) is the most worrying air pollutant in urban areas of Bangladesh, and most prominently, in Dhaka[7]. During 2013–2015, the levels of PM_{10} and $PM_{2.5}$ in Dhaka exceeded both annual ($50\,\mu gm/m^3$) and daily ($150\,\mu gm/m^3$) national standards[8]. The main source of particulate matter emission is brick kiln (58 percent), mainly operated during the winter season. Motorized vehicular emissions (10 percent), re-suspension of dust from unpaved roads and soil (17 percent), and refuse burning by slum dwellers are noteworthy among other sources[9, 10]. The Bangladeshi government has banned traditional brick making industries and enforced cleaner technologies and launched a roadside vehicular emission testing program to solve this problem[8]. These solutions require a large amount of funding and time. A recent study suggested that air pollution-related health problems could be reduced using strategies at the individual and community level[11]. However, the successful development of such strategies requires an understanding of the knowledge, attitude, and practice regarding air pollution at the individual and community level. A cross-sectional study reported that 75 percent of people in the community do not know what to do about air pollution even though they were concerned about it[12]. A study in Canada revealed that even though 60 percent of people knew of the Air Quality Health Index (AQHI), only 20 percent practiced the suggested protective measures based on the AQHI due to lack of knowledge on best practice[13].

Therefore, this study aimed to determine knowledge, attitude and practices regarding air pollution among subjects in urban Dhaka, Bangladesh, and the factors associated with this in order to inform air pollution lowering programs and factors to pass on at the individual and community level.

Methodology

Study design and recruitment of participants

This study used a cross-sectional data collection from a sample of 424 participants living in the Mohammadpur residential area of Dhaka, the capital city of Bangladesh. A systematic random sampling technique was used to recruit the participants. A standard formula ($n = (z^2_{\alpha/2}p(1-p)/d^2)$) was used to reach a universal sampling size. Here, n is the estimated sample size, p is the estimated proportion of the population (0.5), $z_{\alpha/2}$ is the value from normal distribution associated with 95% confidence level (1.96), and d is the allowable error which is 10 percent of p (0.05). An additional 10 percent was added to adjust for missing data; thus, the desired sample size reached 424 at a 95% confidence interval.

After informing participants of the study goals, informed consent was obtained from all participants prior to the beginning of the face-to-face interview. People who lived in the study area for at least 2 years, aged between 18 and 60 years and were of sound mental health were included in this study based on their willingness to participate.

Data collection

The study was conducted during April 2017. The study area consisted of five wards with 85 subjects chosen from each ward. Two representatives from each household were chosen as subjects. The response rate was 94.2 percent (424 out of 450).

Research instrument

A pre-tested questionnaire was used as the research instrument. The validity of the questionnaire was checked through content and expert advice. A pre-test was done; the

reliability of knowledge (0.626) and attitude (0.51) outcomes was tested by Cronbach's α. Following phase 3 of the PRECEDE-PROCEED model[14], enabling and reinforcing factors were also included in the question to find supportive information about the predisposing factors. Experiences about air pollution were recorded for the same purpose.

The questionnaire had five parts:

(1) Predisposing factors:

- General characteristics including age, gender, educational status, household monthly income, occupation.
- Experience of the current air pollution situation including health effects, control measures and the situation of air pollution overseas.
- In gauging knowledge levels, nine statements were used about particulate matter exposure related to sources of inhalable particulate matter and its adverse health effects, Air Quality Index (AQI) and prevention measures. Each statement had "Yes" as the correct answer and "No" and "Don't know" as incorrect answers. Each correct answer scored 1 and each incorrect answer scored 0.
- To measure attitude levels, six positive statements toward particulate matter exposure in the same relevant subjects as knowledge were used. Each statement was evaluated on a three-point Likert scale from 0 to 2, the subjects having to choose the answer that suits best.

(2) Enabling factors: the participants were questioned about the availability of equipment and information about protective practices against inhalable particulate matter. They had to choose answers in five multiple choice questions, which were examined by descriptive analysis.

(3) Reinforcing factors: the participants were questioned about the support they get from family, friends, neighbors, environmental experts and health volunteers in terms of information on inhalable particulate matter, its health effects and advice on protective measures for particulate matter air pollution. Statements regarding reinforcing factors were positive and answers were examined according to the frequencies of performing these.

(4) Protective practices: participants were questioned about their protective practices against particulate matter exposure. This section consisted of five positive statements with possible responses as "usually," "occasionally" and "never." Each statement was evaluated on a three-point Likert scale from 0 to 2, the subjects having to choose the answer that suits best.

(5) Additional information: this part questioned the respondents about government policy and people's participation, which were examined by descriptive analysis.

Statistical analysis

All analyses were conducted using SPSS statistical software version 18.0 (SPSS, version 18.0, IBM, Armonk, NY). Descriptive analysis of variables, means, standard deviations (SDs) and percentages was considered. χ^2 test and Fisher's exact test were performed to find the association between variables. Statistical significance for all analyses was set at a $p < 0.05$ for two-tailed tests. For the convenience of analyses, total scores for protective practices, knowledge, attitude and reinforcing factors were calculated, and then divided into three levels as follows: > 80 percent of the total score was a good level; 60–80 percent of the total score was moderate; and < 60 percent of the total score was a poor level score.

Ethical consideration

The Ethical Review Committee for Human Research at the Mahidol University of Thailand granted ethical approval (COA. No. MUPH 2017-087) for this study. The confidentiality of the person and the information was maintained.

Results

Of the 424 respondents, 55.7 percent were males and 44.3 percent were females; respondents' mean age was 35.66 (ranging from 21 to 58) years old with an SD of 9.87. About 63.9 percent were educated to university level or above; 43.9 percent were in service work, which was the highest in frequency among all occupation groups. However, a significant proportion of respondents (41.0 percent) were unemployed. More than half (53.3 percent) belonged to families with an average monthly family income ranging from 28,001 to 56,000 BDT (US$1 = 80.54 BDT) and the average monthly income in families was around 40,000 BDT (US$1 = 80.54 BDT).

Overall, the respondents had moderate to good levels of attitude, which is coherent with the level of knowledge. Surprisingly, overall levels of practice were poor, inconsistent with the level of knowledge and attitude.

Table I, overall knowledge regarding the source of pollutants, health effects and prevention measures was higher than 70 percent except for AQI, which was known to only 0.5 percent of the respondents.

Respondents' knowledge in the same relevant subjects was consistent with their attitudes (Tables I–II), especially the ones related to AQI, personal protective equipment and exposure sources. However, people chose not to follow their knowledge and attitudes as shown in

Statements	Correct answer Frequency	Percent
Air pollution can come from man-made sources	375	88.4
Younger and older people are more vulnerable to the harmful effects of air pollution	370	87.3
Smaller inhalable dust (PM 10 and PM 2.5) can go deeper into your lung	303	71.5
Health problems caused by small inhalable dust can be a reason for premature death	297	70.0
People who have heart and/or lung disease are more prone to be affected by small inhalable dust	290	68.4
Air quality index is divided into six levels	2	0.5
Covering face and mouth can protect people from air pollution	360	84.9
Motorized vehicles can produce small inhalable dust	328	77.4
Outdoor air is more polluted in Dhaka	355	83.7

Note: $n = 424$

Table I. Knowledge about inhalable particulate matter, its health effects and preventive measures

Statements	Percent level of response Agree	Uncertain	Disagree
Brick Kilns are mostly responsible for the air pollution problem in Dhaka	66.0	17.2	16.7
AQI is a good warning parameter to let people know about air quality	0.5	99.5	0
Cotton masks can protect exposure to air pollutants	80.7	2.6	16.7
The faster you drive motor vehicles, the higher the rate of small inhalable dust is emitted	60.1	18.9	21.0
When air pollution in Dhaka is severe, staying indoors can protect you from its harmful effects	50	24.1	25.9
Traffic jams can make you more prone to small inhalable dust	70.8	20.0	9.2

Note: $n = 424$

Table II. Attitude toward inhalable particulate matter and preventive measures

Table III when they were questioned about protective practices. For instance, more than 80 percent recognized that outdoor air pollution is more prominent in Dhaka, but up to 50 percent of the respondents never avoided outdoor activities and only 30 percent of respondents regularly reduced window opening time to air the room. In addition, up to 40 percent never avoided busy roads even though harmful health effects from motorized vehicles were recognized. Interestingly, although more than 80 percent of the respondents recognized and agreed that covering their nose and mouth and using protective equipment can protect themselves from air pollution, only half of them wore facemasks on a regular basis.

χ^2 test and the Fischer Exact test were performed to test the association between predisposing factors including socio-demographic characteristics, knowledge groups, attitude groups and protective practices. As Table IV shows, age, educational level and occupation had significant associations with protective practices for small inhalable particulate matter. Similarly, the level of knowledge and attitude was significantly associated with protective practices.

Almost 90 percent of respondents did not get social support as reinforcing factors. Only a few respondents got information about the adverse health impacts of inhalable particulate matter and protective practices from experts. The less availability of demonstrable information and protective practices the respondents had, the poorer were their own practices ($p < 0.001$) and reduced knowledge levels ($p = 0.016$) (Table V).

While exploring the enabling factors, almost all of the respondents agreed on the affordability and accessibility of the facemasks. In addition, newspaper and television came out as the most used media for gathering information as in Table VI.

Discussion

This study clearly showed that the protective behaviors of people in Dhaka against air pollution were low in contrast to a similar study of residents in Ningbo, China[15] in which 66.77 percent of the respondents had high practicing behaviors. This deviation may have occurred due to different air quality episodes in different places. Although Dhaka's air quality is worse than other major cities in Bangladesh and is deteriorating gradually, the majority of the respondents are not yet aware of the worsening air quality of the community they lived in evidenced by this survey result where half the respondents believed the air quality to be the same as last year.

Watching the AQI regularly and planning daily activities accordingly, wearing a face mask, reducing outdoor activities, spending more time indoors, avoiding busy roads and highways are suggested protective measures to reduce particle exposure[16–18]. However, only one among 424 respondents reported watching AQI levels as a protective practice that is consistent with their lack of knowledge and attitude. In addition, the practice is low regarding the use of facemasks even though everyone indicated the affordability and accessibility of facemasks. Clearly, poor support from family, friends and neighbors indicated that people are overly concerned about their appearance wearing a facemask. When asked, some mentioned that wearing a mask made it difficult to breathe. This study

Table III.
Protective practices against inhalable particulate matter

Statements	Percent of levels of protective practices		
	Usually	Occasionally	Never
You watch the Air Quality Index	0.2	0	99.8
You wear a face mask when you go outside on bad air quality days	40.6	49.3	10.1
You have reduced time opening windows to air the room	27.8	51.7	20.5
You have reduced outdoor activities to avoid small inhalable dust	13.2	33.7	53.1
You avoid busy roads and highways for everyday travel	17.9	43.4	38.7

Note: $n = 424$

Independent variables	Levels of protective practices: High Frequency	High Percent	Moderate Frequency	Moderate Percent	Low Frequency	Low Percent	*p*-value
Age (years)							0.030[a]
21–30	57	37.0	76	49.4	21	13.6	
31–40	66	48.5	58	42.6	12	8.8	
41–50	47	58.0	31	38.3	3	3.7	
51–60	27	50.9	23	43.4	3	5.7	
Gender							0.386[a]
Male	104	44.1	107	45.3	25	10.6	
Female	93	49.5	81	43.1	14	7.4	
Educational level							< 0.001[a]
Primary level	26	60.5	14	32.6	3	7.0	
High school	14	41.2	19	55.9	1	2.9	
College	50	65.8	24	31.6	2	2.6	
⩾University	107	39.5	131	48.3	33	12.2	
Average monthly income							0.258[a]
< 28,000 BDT	64	49.2	57	43.8	9	6.9	
28,001–56,000 BDT	103	45.6	104	46.0	19	8.4	
> 56,000 BDT	30	44.1	27	39.7	11	16.2	
Occupation							0.018[b]
Unemployed	77	44.3	88	50.6	9	5.2	
Manual worker	4	44.4	3	33.3	2	22.2	
Service holder	86	46.2	74	39.8	26	14.0	
Business	30	54.5	23	41.8	2	3.6	
Knowledge level							< 0.001[a]
Low knowledge	35	52.2	31	46.3	1	1.5	
Average knowledge	42	30.2	72	51.8	25	18.0	
High knowledge	120	55.0	85	39.0	13	6.0	
Attitude level							0.002[b]
Low attitude	3	30.0	7	70.0	0	0	
Average attitude	39	33.1	68	57.6	11	9.3	
High attitude	155	52.4	113	38.2	28	9.5	

Notes: $n = 424$. [a]*p*-value calculated by χ^2; [b]*p*-value calculated by Fisher's exact test. Significance level $\alpha = 0.05$

Table IV. The association between general characteristics, knowledge, attitude and protective practices for small inhalable particulate matter

also found that those who did wear face masks when going outdoors on bad air quality days were mostly using cotton made a mask. They did not do it for its effectiveness in protecting particulate matter, but rather used it simply to cover their face and mouth with whatever mask is easily available even though using a simple cotton mask that is not sealed properly does not render any help. It is obvious that participants lack adequate information about appropriate masks to reduce particulate matter exposure, as well as social support, which may act as contributing factors for them to not use facemasks on a regular basis. Similarly, only a small proportion of people had reduced their window opening times, outdoor activities or taking busy roads and highways for everyday travel. Some participants believed reducing window opening times or outdoor exercise would not prevent inhalable particles exposure since they have to go outside for daily activities anyway.

In addition to the aforementioned barriers to practice some protective behaviors for inhalable particulate matter, most participants lack the right knowledge about the health effects of inhalable particulate matter and standard practices for exposure prevention. Community health volunteers rarely disseminate information about healthy protection against inhalable particles since the health system has not yet incorporated the prevention of environmental pollution exposure into its activities. Similarly, projects launched by the Bangladeshi Government are currently monitoring the air pollution situation, but they are

yet to develop policies to control the extent of pollution and its exposure. Thus, a collaboration between the department of environment and public health may become effective in training health volunteers to educate people and disseminate information related to the adverse health impacts of small inhalable particulate matter.

A study in the UK suggests that social support plays a significant positive role in developing perceptions of air pollution, which greatly influences people's protective behavior[19]. Most participants in this study did not get any support from their neighbors or friends because this issue was neglected during their chats or discussions. Thus, they lacked social support for information, which explains part of the reasons behind their lack of clear understanding about the prevailing air pollution in the surrounding area. Furthermore, this lack ultimately affects their protective practices evidenced by the finding that respondents who got social support from family, neighbors, friends, environmental experts and health volunteers practiced safe protective methods. Evidently, social support from family, friends and neighbors should be further promoted as this creates a positive impact.

It is inspiring to see that the majority believed that the government should prioritize small inhalable dust control systems and that every individual should be responsible for improving air quality. This demonstrates the strong interest of people to engage, support and participate in controlling particulate matter pollution and preventing adverse health impacts. While people are more inclined to use the internet, newspapers and watching TV

Table V.
Availability of social support for information about protective practices and information about inhalable particulate matter and its health effects

Statements	Subject responses			
	Usually	Sometimes	Rarely	Never
My family tells me about small inhalable dust and its health effects	25	34.9	24.5	15.6
My neighbors and friends tell me about small inhalable dust and its health effects	7.3	9.9	29.7	53.1
My family suggests protective behaviors to me	32.8	26.7	23.8	16.7
My friends and family suggest protective behaviors to me	6.8	10.8	37.0	45.3
I get information about small inhalable dust, its health hazards and protective practices from environmental experts	4.9	9.2	8.7	77.1
Health volunteers advise me about air pollution and protective practices	5.9	4.2	6.1	83.7

Note: $n = 424$

Table VI.
Enabling factors

Statements	Frequency	Percent
Can afford to buy a protective mask	424	100
Can buy a protective mask in a nearby shop	396	93.4
Where a person does not have a protective mask		
Do not use	277	65.3
Borrow	58	13.7
Buy	89	21
Sources of information		
Television	284	67
Newspaper	293	69.1
Leaflet	14	3.3
Internet	230	54.2
Digital billboards	8	1.9
Received any training program	23	5.4

Note: $n = 424$

were evidently the more common sources of information in this survey. These findings suggest that campaigns by the government involving local media, the health system (e.g. community health volunteers) and advice from environmental experts can be utilized to improve the level of people's practice in terms of inhalable particulate matter.

It is obvious that almost no respondents in this study know about AQI; thus, the government, particularly the Department of Environment, should focus on circulating information about the AQI. The air quality status of major cities and vulnerable places could be published in print media and television on a daily basis. In observation, people are concerned about their external appearance when wearing a mask. Therefore, it is necessary to convince people about the benefits of wearing a mask in terms of protection from inhalable particulate matter and create more social support regarding this topic. Furthermore, information about the appropriate mask should be conveyed. Many people do not know about the long term health effects of small inhalable particulate matter, such as chronic lung disease and heart diseases and, therefore, training health volunteers is crucial to reinforce people's knowledge. Furthermore, a collaboration between the departments of environment and public health is necessary.

Although the majority of respondents were aware of the harmful effects of inhalable particulate matter, many still indulged in high-risk behaviors that may lead to more exposure to polluted air. Besides, knowledge levels amongst different age groups, different income levels and occupation groups are still very poor. This information may help policy makers to make targeted interventions, develop advocacy and guidance schemes to help people understand particulate matter pollution and related health risks.

Conclusion

The level of air pollution in major cities in Bangladesh is over the WHO recommended level. Although a majority of respondents in this study were aware of the harmful effects of inhalable particulate matter, many still indulged in high-risk behaviors that may lead to more exposure to polluted air. In addition, a comparison of knowledge levels among different age groups, different income levels and occupation groups revealed poor levels of knowledge regarding air pollution. A long-lasting improvement in air pollution levels requires changes in individual practices, not only regarding the decision about transportation options but also regarding the measures to minimize the exposure to pollutants. The results of this study may help policy makers to understand the need for education programs aimed at making residents in local neighborhoods aware of sources of air pollution and related health risks. The environmental management authorities need to invest direct efforts on risk communication strategies to motivate personal direct perception or awareness of an environmental problem such as air pollution. This approach enhances the individual's understanding of the importance of environmental policy measures, which makes such measures easier to accept by residents in each community, and enhances personal responses to reducing exposure to pollutants. There is also a need for further research on community perceptions to help understand factors shaping people's practices. This information may help policy makers to make targeted interventions, advocacy and guidance to help people understand particulate matter pollution and related health risks.

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