Article

People's knowledge regarding impacts of air pollution on reproductive health: a self-reported study

Ahmad Kamruzzaman Majumder[*], Romana Afrose Meem, Ariful Hoque, Marufa Gulshan Ara and Abdullah Al Nayeem

Department of Environmental Science, Stamford University Bangladesh

*Corresponding author: Dr. Ahmad Kamruzzaman Majumder, Professor, and Chairman, Department of Environmental Science, Stamford University Bangladesh. Phone: +8801712017725; E-mail: kamrul_sub@hotmail.com

Abstract: Air pollution is a major challenge worldwide, particularly in the developing world. This study aimed to revelation people's perceptions regarding the impacts of air pollution on reproductive health. This study was conducted among107 respondents and a google form was used to create a survey questionnaire. Purposive sampling has been used to select the respondents. A large number of respondents are male and aged less than 30 years. A large number of respondents are from the urban area and depends on Non-Government Job. A satisfactory number of the respondents know about air pollution. Both male and female respondents know smoke inhalation during pregnancy, damage reproductive organs of the male, birth defects due to air pollutions, and delayed brain development of the newborn baby. Most of the respondents gather their knowledge from television and social media.

Keywords: air pollution; reproductive health; contaminants; air quality; Bangladesh

1. Introduction

Human beings are continuously exposed to mixtures of environmental contaminants and a lot of evidence now links exposure to these chemicals with an increased incidence of reproductive and developmental disorders (Woodruff and Walker 2008; Sadeu *et al*., 2010). Episodes of high levels of air pollution experienced by cities in Europe and the United States have enlightened both government agencies and the global community public about the harmful effects of air pollution on human health. Infamous examples include both the Great Smog of London in 1952 and Donora Smog of 1948 that were associated with significantly elevated rates of hospital admissions and mortality (Helfand *et al*., 2001). Similarly, the more recent Bhopal gas disaster should also be remembered. In this tragic example, a methyl isocyanate gas leak killed 2,500 people in 5 days and many more were condemned to long-term morbidity including serious reproductive dysfunctions (Sriramachari, 2005). After these episodes, clean air legislation and other regulatory actions have significantly reduced ambient air pollution in many regions of the world, especially in both North America and Europe (Chen *et al*., 2007). Despite successful regulatory oversight, air pollution in urban centers remains a substantial risk factor to global human health. The respiratory tract is the first system to be in contact with air pollutants. Respiratory and cardiovascular diseases are the most commonly observed effects associated with exposure to low levels of air pollution followed by neoplasia (Schwartz, 2006; Pope *et al*., 2009; Dockery, 2009). Recent studies support that common environmental air pollutants that we contact in our daily life and to which exposures are unavoidable could also affect both reproductive health and fetal development. Exposure to ambient air pollution appears to adversely impact fertility, pregnancy outcomes, and fetal health and development (Maisonet *et al*., 2004; Parker and Woodruff, 2008). Epidemiological studies suggest the association between exposure to air pollution and impairment of reproductive health. However, these studies also recognize and acknowledge many uncertainties

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about this association (Slama *et al.*, 2008). Pollution is defined as the introduction into the environment of substances harmful to humans and other living organisms. Pollutants are harmful solids, liquids, or gases produced in higher than usual concentrations that reduce the quality of our environment. The health of susceptible and sensitive individuals can be impacted even on low air pollution days. Short-term exposure to air pollutants is closely related to COPD (Chronic Obstructive Pulmonary Disease), cough, shortness of breath, wheezing, asthma, respiratory disease, and high rates of hospitalization (a measurement of morbidity). The overall objective of the study was to identify the respondents' perception of the impacts of Air pollution on reproductive health.

2. Materials and Methods

This study took place between 10 August 2020 and 25 August 2020. Due to the COVID19 emergency in Bangladesh, Govt. have restricted the public movement. In this situation, a standardized semi-structured online questionnaire has been designed on Google form data collection. Purposive sampling has been used to select 107 respondents for this survey. The survey has been conducted in both rural and urban areas. To respond to the questionnaire the respondents have available internet facilities. The data from the completed surveys were analyzed by using SPSSv20 and Excelv13.

3. Result

Table 1. Demographical Characteristics of the respondents (N=107).

Respondents	Frequency	Percent (%)
Sex of the Respondents		
Male	94	87.9
Female	13	12.1
Age of the Respondents		
18-30 Years	74	69.1
31-40 Years	26	24.3
41-50 years	3	2.8
51 above	4	3.7
Occupation of the Respondents		
Business	10	9.3
Government Job	8	7.5
House wife	1	0.9
Non-Government Job	65	60.7
Student	13	12.1
Others	10	9.3
Living Area of the Respondents		
Rural area	18	16.8
Urban area	88	82.2

Table 1 shows the demographical characteristics of the respondents. Most of the respondents are male (87.9%) and 69.1% of the respondents are aged between 18 to 30 years. A large number of respondents are from the urban area and depends on Non-Government Job.
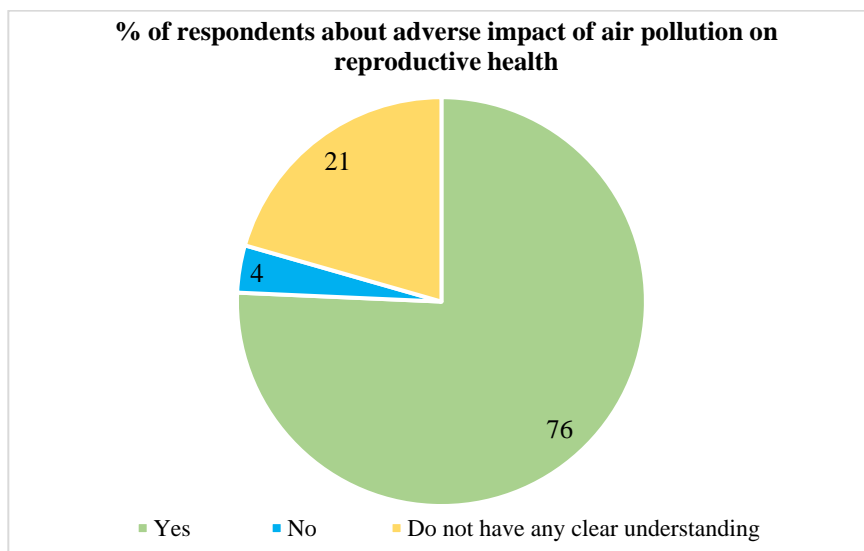
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Figure 1. Respondents' knowledge about the adverse impact of air pollution on reproductive health.

Figure 1 represents the respondent's knowledge of air pollution; 76% of respondents have knowledge of air pollution and 21% of the respondents do not have any clear understanding and 4% of the respondents do not have any knowledge.

Table 2. Knowledge of respondents on impact of air pollution on reproductive health and pregnancy.

Issues	% of the respondents (N=81)		
	Male (N=71)	Female (N=10)	Total (N=81)
During pregnancy, smoke inhalation can create risk for the mother & developing child.	100	70	96
Exposure to air pollution during pregnancy can increase the risk of premature birth	48	30	46
Exposure to air pollution during pregnancy can increase the risk of low birth weight.	44	20	41
Exposure to air pollution can damage the reproductive organs of male	97	70	94
Exposure to air pollution can damage the reproductive organs of the female	31	50	33
Exposure to air pollutions is one of the causes of birth defects.	79	40	74
Delayed brain development of the newborn baby.	96	80	94

Table 2 represents that female respondents have a significant knowledge gap than male respondents. 100%, 97%, 79%, 96% male respondents are concern about the adverse impact of smoke inhalation during pregnancy, damage reproductive organs of the male, birth defects due to air pollutions, and delayed brain development of the newborn baby respectively. On the other hand, 70%, 70%, 40%, 80% of female respondents are concern about the adverse impact of smoke inhalation during pregnancy, damage reproductive organs of the male, birth defects due to air pollutions, and delayed brain development of the newborn baby respectively.

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Table 3. Source of Knowledge of respondents.

Source of Knowledge on the impact of air pollution on reproductive health (Multiple responses)	
Source	**% of respondents**
Television	88
News paper	52
Social Media	84
Family	7
Friend and others	33

Table 3 illustrates that most of the respondents gather their knowledge from television (88%) and social media (84%). 52%, 33%, 7% of respondents have their knowledge through the newspaper. family, friends, and others respectively.

4. Discussion

Air pollution is a widespread environmental contaminant. In a broad sense, air pollution can be defined as a mixture of gaseous, liquid, and solid substances containing many toxic components which include; CO, NO_2, SO_2, O_3, Pb, polycyclic aromatic hydrocarbons (PAH), and particulate matter (PM) (WHO 2005). Expansion of industry and vehicular traffic has had a major impact on the overall air quality in urban areas over the last decades. As defined by Collbeck and Lazaridis (2010), particulate matter (PM) is a complex mixture of solid particles, liquid droplets, and liquid components contained in the solid particles constituted by many different chemical species originating from a wide variety of sources. Particles can be produced by combustion, suspension of soil material, and also from chemical reactions in the atmosphere. Nitrates, sulfates, elemental carbon, organic substances (VOC, PAH), metals (Cd, Pb), and mineral material (Al, Si, Fe, and Ca) are major constituents of airborne PM (Colbeck and Lazaridis, 2010; Heal *et al.*, 2012).

The evidence for harmful effects at realistic urban air concentrations of air pollutants predominantly come from epidemiological studies (Slama *et al.* 2008; Stillerman *et al.*, 2008). In this section, we will present recent reports that indicate that exposures to ambient levels of air pollutants (PM, NO_2 SO_2, and O_3), in addition to the recognized adverse cardiorespiratory effect are associated with negative impacts on reproductive health. Beyond the recognized adverse consequences on pregnancy outcomes, exposure to air pollution is associated with adverse impact on reproductive function including fertility. Furthermore, studies have shown that periods of elevated air pollution were significantly associated with changes in semen quality and damages in sperm DNA (Dejmek *et al.*, 2000; Rubes *et al.*, 2005).

Very few studies have addressed the effects of ambient air pollution on human fertility. Available studies focus on the primary impact on male fertility, probably due to readily accessible semen acquisition and analysis (Sokol *et al.*, 2006). Detrimental changes in various semen parameters such as motility, sperm morphology, and DNA are reported, which may cause reduced fertility in males or miscarriage in females. The impact of SO_2 on fecundability (the probability of conceiving during the menstrual cycle) has been evaluated in the First Unprotected Menstrual Cycle (FUMC) of 2,585 parental pair in a heavily polluted region of Northern Bohemia (Djemek *et al.*, 2000). They found that adjusted odds ratios of conception in the FUMC may be reduced in couples exposed to mean SO_2 levels > 40 pg/m^3 in the second month before conception. Selevan *et al.* (2000) showed that elevated periods of air pollution were significantly correlated with changes in various semen parameters of young Czech men including proportionately fewer motile sperm, less sperm with normal morphology or normal head shape, and proportionately more sperm with abnormal chromatin. Based on these preliminary findings, Rubes *et al.* (2005) monitored semen quality in a cohort of young Teplice residents over longer periods (periods of exposure to both low and high air pollution) and found a significant association between exposure to high levels of air pollution and decreased sperm chromatin integrity. However, a study by Hansen *et al.* (2010) did not support a consistent pattern of association between O_3 and PM2.5. They performed an analysis of several measures of semen quality and found only a statistically significant adverse association between increased PM2.5 averaged over the 0- to 90-day period before semen sampling and an increase in the percentage of sperm with abnormally shaped heads and the percentage of sperm with cytoplasmic droplets. However, after controlling for season and temperature results failed to reach statistical significance. In the study of Sokol *et al.* (2006), there was a significant negative correlation between O_3 levels (70–90 days before

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collection) and average sperm concentration, which was maintained after correction for birth date, age at donation, temperature, and seasonality. These epidemiological results are in line with occupational exposures (Guven *et al.*, 2008) and experimental studies of diesel exhaust inhalation and detrimental effects on sperm (Izawa *et al.*, 2007). There are very limited studies on the impact of air pollution on female fertility. We are aware of only two studies available in the literature on female fertility that were conducted by Perin *et al.* (2010a, b). These studies evaluated the impact of PM exposure during the follicular phase of the menstrual cycle or the preconception period of women undergoing IVF/ET on early pregnancy loss and miscarriage. Both studies support an association between brief exposure to high levels of PM and adverse gestational outcomes. This is an area that would likely benefit from additional studies. Human fertility is declining in different parts of the world for unclear reasons. Many hypotheses have been used to explain this observation. Among the most supported causes of worldwide declining fertility are the delay of childbearing by modern women and other changes in social factors. Nutritional status, obesity, drugs, smoking habits, stress, and increasing exposures to environmental pollutants, such as air pollution, are also plausible factors involved in human reduced fertility that deserve more attention.

5. Conclusions and Recommendations

Air pollution is one of the most crucial concerns to make our world suitable to live in, otherwise, mankind will be on extinction. From the study, we can conclude that most of the people have basic knowledge about air pollution as well as many of the respondents are confused. Whatever it is, y*et al*l have an idea that exposure to air pollution can damage reproductive health. But awareness will not be ensured without proper and clear knowledge. So, it must be ensured and policies should be properly executed. It has been recommended that knowledge dissemination events and awareness programs may arrange to enhance public awareness of air pollution. Television and Social media may play a vital role in the promotion of air pollution awareness programs. Air pollution issues must be included in our school curriculum and law enforcement should be ensured. Phasing out Lead (Pb) from petrol was one of the most successful strategies by the Bangladesh government. This policy must be continued and other sources of lead except for petrol also must be identified to stop emission. The Government of Bangladesh banned the use of two-stroke three-wheelers in Dhaka in 2003 and replaced them with four-stroke three-wheelers CNG taxies. It brought a significant positive impact. This ban should be strictly followed and monitored. More use of bi-cycles and CNG vehicles should be promoted and encouraged. In 2002, rules were proposed to ban buses older than 20 years or trucks older than 25 years from Dhaka city (Department of Environment Government of Bangladesh, October 2012). But the ban has not been enforced and the policy failed. Old vehicles must be banned as they emit more pollutants. Traffic management in urban cities including Dhaka needs to be digital so that less fuel is consumed by vehicles. Urban afforestation program should be promoted in Dhaka City. Smoking and the use of polythene should be banned as it can minimize air pollution. The facilities of a city should be expanded to a rural area so that the population from the city area is decentralized. Last but not the least, proper enforcement of the law must be ensured.

Conflict of Interest

None to declare.

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