Research Article

Public Awareness, Perception and Attitude Towards Air Pollution; A Cross-Sectional Study Conducted in Punjab, Pakistan

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Abstract

Background: Atmospheric pollution, or smog, poses a significant public health threat. Pakistan, particularly Lahore, faces severe air pollution challenges due to rapid urbanization . Despite efforts by the Pakistan Environmental Protection Agency, particulate matter levels remain alarmingly high, posing health risks to inhabitants. Effective measures are crucial to mitigate the adverse impacts of smog on human health.

Objectives: To investigated smog perceptions and behaviour.

Method: Within 3 months, 96 volunteers were recruited using non-probability sampling. Data were collected through a pre-designed questionnaire and analysed using SPSS version 25. Demographics, perceptions, awareness, and behaviours were assessed. Frequencies, percentages, and Chi-square tests were used to compare outcomes. Stratification for confounders like education, gender, age, and diabetes was performed. p-value of <0.05 was considered significant. The study aimed to understand smog's impact on human health.

Results: The study included 96 participants with diverse demographics. All participants reported awareness of smog, with 94.8% identifying its causes and 95.8% recognizing its health effects. A significant portion expressed concern about its seriousness, with 60.4% considering it a very serious issue. 88.5% supported government regulations to control smog. Participants demonstrated a proactive approach, with 70.8% planning to use public transport and 81.3% intending to adopt energy-efficient appliances to mitigate smog. Statistical analysis revealed significant relationships between demographics and understanding of smog

Conclusion: The study highlights the importance of education and awareness campaigns in enhancing smog literacy. The findings support that there is need for targeted interventions, including government regulations, individual actions, and community engagement, to reduce smog.

Keywords: smog, public awareness, air pollution

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Introduction

Atmospheric pollution suspended in humid air is popularly known as 'smog'.[1] Air pollution is a grave risk to human health that affects nearly everyone in the world and nearly every organ in the body.[2] Fortunately, it is largely a preventable risk. Reducing pollution at its source can have a rapid and substantial impact on health.[2] According to the World Health Organization (WHO), outdoor air pollution has severe negative short-term and long-term impacts on human health, which causes acute disease such as asthma and chronic respiratory diseases.[3] Air pollution has been a persistent concern all over the world. It seems to be an

unavoidable environmental problem during the process of urbanization and industrialization worldwide.[4] Smog can cause serious damages to both economy and human health. For example, due to the dense smog caused by heavy coal combustion, thousands of London citizens lost their lives in 1952; during the 1940 s and 1950 s, photochemical smog shrouded Los Angeles, resulting in thousands of premature deaths and traffic accidents.[4] In 2005, the economic costs of suspended particulates and ozone in China were estimated to be US$112 billion (Matus, et al., 2012), which was about 5% of the country's GDP. Since air pollution can affect many aspects of a society, such as human health, agriculture and industry, the accurate economic loss will be much higher.[4] Fine particulate matter referred to as PM2.5 caused the frequent, severe smog and haze episodes in recent years in China.[5]

Pakistan is the most urbanized country in South Asia,[5] and its second-largest city Lahore, growing at a rate of 4% annually,[7] is regarded as the most polluted city in Pakistan. Urban settlements are frequently plagued by smog in Asia, and Lahore is no exception. Following the pattern of last year, Lahore has once again been engulfed by a disturbingly heavy blanket of smog, shrouding the entire city and taking a toll on people's lives. The exorbitant rise in automobiles, unchecked deforestation, expeditious urbanization, and unabated growth of industries[5-6] have contributed to this alarming situation over the years.

Smog accounts for a rapid sprout in fatal health problems, including exacerbation of asthma, allergies, eye infections, respiratory tract infections, and cardiac pathologies leading to premature death. Sughis et al. reported a concerning finding related to this situation, observing significantly higher levels of systolic and diastolic blood pressure in the school children of Lahore, exposed to high levels of air pollution.[8] This worrisome observation helps highlight the long-term deleterious effects on the health of the public.

The Pakistan Environmental Protection Agency (Pak-EPA) and the provincial EPAs are in charge of monitoring air pollution in Pakistan. In 2010, the Pak-EPA drafted the National Air Quality Standard (NEQS) for ambient air quality.[7] However, the proposed annual mean levels for the ambient particulate matter, PM2.5 and PM10, were higher than the stricter World Health Organization (WHO) guidelines, which are $10 \, \mu g/m^3$ and $20 \, \mu g/m^3$ respectively.[7] According to data, the levels of the ambient particulate matter reported in Lahore far exceed the recommended values of both WHO guidelines and NEQS guidelines.[7,9] A study conducted in Lahore over a period of 5 years, aiming to compare the level of fine particles with the aforementioned guidelines, concluded that the annual average PM2.5 of the areas studied was 136.5±34.1

$\mu g/m^3$[9], which is roughly 14 folds higher than the WHO guidelines. This study also mentions that this level of particulate matter was comparable to one of the most polluted megacities of the world, Delhi.

The main effects of sulfur dioxide gas and sulfuric acid mist inhaled in this way were an increase in airway resistance and appearance of rales, with rhinorrhea and lacrimation.[10] It is toxic even to plants, irritating to the eye, and (in liquid form) very explosive[11]. Smog reduces the visibility on roads and results in road accidents and cancellation of flights.[12] The decision-making process can be vulnerable to environmental stressors.[13] Furthermore, it was not gaseous pollutants like oxides of nitrate, sulfur, carbon mono-oxide or ozone but the particulate matter or PM, of fine or coarse size (PM 2.5 and PM10) which was linearly associated with mortality.[14] The NOx level can obviously affect the OH concentration and volatility distribution of gas-phase oxidation products and thus O3 and SOA formation.[15]

Furthermore, these toxicants are responsible for the development of metabolic disorders, teratogenicity, insulin resistance, infertility, and carcinogenicity of endocrine glands[16]. The hidden social welfare loss caused by air pollution may still be underestimated, even though short-term avoidance costs are included in the evaluation of pollution impacts[17]. The smog episodes and fine particulate have bigger and more detrimental impacts on rural residents, especially for those living close to big and polluted cities.[18] Wildfire smog could be induced respiratory pathway inflammation and easily collapsible respiratory airways.[19]

The public needs to be made aware of the possible health issues that can be encountered during this environmental hazard and educated on ways they can protect themselves and prevent exacerbations of pre-existing medical conditions.[10] Public service messages on television, radio, and the Internet, along with the distribution of educational pamphlets and brochures can be a few of the effective steps for ensuring this.[20]

Methods

This cross-sectional analysis was conducted across Lahore, Punjab, Pakistan. It was completed within 3 months of synopsis approval. Non-probability convenient sampling was utilized and 96 volunteering respondents were included in study. Informed consent was obtained, and data were collected through pre-designed questionnaire distributed among eligible participants. The questionnaire included sections on demographics, perceptions, awareness, attitudes, and behaviours regarding smog. The gathered data were entered into SPSS version 25 for analysis. Frequencies and percentages for categorical variables such as gender, family income, and

education were reported. The Chi-square test was used to compare outcomes between exposed and non-exposed groups, with significance set at $P<0.05$. Stratification for confounders such as education, gender, age, and diabetes was performed, and a post-stratification Chi-square test was applied with a significance level of $P<0.05$.

Results

In this study, 96 people of different age, gender, occupation, education level took part.

Informed written consent was taken from the participants after which Questionnaire was filled in online google form. The collected data was entered in BM SPSS V25 for analysis. Frequencies and percentages were computed to characterize the studying population, chi- square test was computed to see the overall associations of the independent variables with the dependent variables.

According to demographic statistic result, 31 percent of the women were between the ages 18 and 20, 57 percent of women were between 21 and 23 while 12 percent of women were above 23. 62.5 percent were Male, and 37.5 percent participants were female. 86% participants were undergraduated as compared to 10 percent with completion of masters. Mostly participants (9%) were doctors and were studying

Table 3: *Comparison of Predictive Values (Bishop Score vs. Cervical Length)*

Questions	Fre-quencies	Percen-tages
Have you heard about smog?		
Yes	100	100.0%
No		
Do you know the effect of smog on health?		
Yes	92	95.8%
No	4	4.2%
Do you know the cause of smog?		
Yes	91	94.8%
No	5	5.2%
Do you think that individuals can make difference in reducing smog?		
Yes	89	92.7%
No	7	7.3%
Do you have plan to use public transport to reduce smog?		
Yes	68	70.8%
No	28	29.2%
Do you have plan to use energy efficient appliances to reduce smog?		
Yes	78	81.3%
No	18	18.8%
Do you plan to support government organizations to reduce smog?		
Yes	89	81.3%
No	7	18.8%

MBBS while 7 percent participants were unemployed. 85% of them were residents of urban areas while 15% were residents of rural areas.

It was found that all the participants have heard about smog. There was no one among them who had not heard about smog. 94.5% people said that they know the cause of smog while 5.2 % people said that they do not know the cause of smog. 95.8 % people know the effect of smog on health while 4.2 % participants do not know the effect of smog on health. 92.7 % people think that individuals can make difference in reducing smog while 7.3 % people do not think that individuals can make difference in reducing smog. 70.8% people have plan to use public transport to reduce smog while 29 % people do not have such plan.

81.3 % people have plan to use energy efficient appliances to reduce smog in comparison to 18.8% people who do not have plan to use energy efficient appliances to reduce smog. 92.7% people have plan to support organizations while 7% people do not have plan to support organizations.

On inquiring, it was found that 43.75 % people were having good understanding of smog, 28.125% people were having fair understanding of smog, 2.08% people were having very poor understanding of smog while 23.9% people were having very good understanding of smog as shown in figure 1. It indicates that majority of people in Lahore have good understanding of smog. When their concerns about smog were asked about then it was found that 44.9% people were having concern about smog to some extent, while 34% participants were very much concerned about smog as shown in figure 1. This study also revealed that 60.4% people think that smog is very much serious issue while 4% people think that it is a average issue. This shows that majority of people know about the bad effects and hazards of smog.
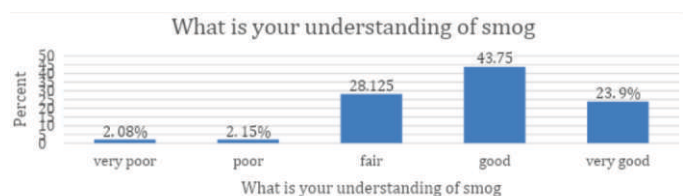

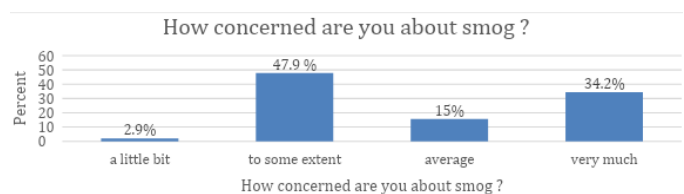**Figure 1.** *Bar chart showing public understanding of smog*

Figure 2. *Bar charts showing the knowledge and concerns of people about smog.*

It was identified that 22.9 % people got information about smog from news, 38.5% people got information from social media, 24% people got information from educational insti-

tutes, 5.2% people got information from friends while 9.4% people used browsing as major source of information about smog as shown in figure 2. It reveals that social media is the most common source in order to get information about smog. 42.7 % people think that these resources are very reliable, 23.9% people think that these resources are moderately reliable while 5.2 percent people think that these are somewhat reliable resources.
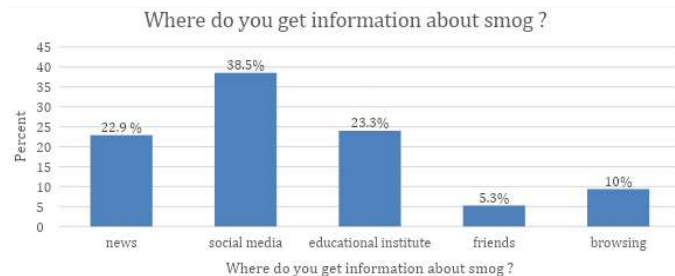

Figure 3: *Showing sources from which people get information*

The second objective of our study was to analyze the effect of age, gender, education, occupation, and residence upon awareness of smog among people. For that purpose, we performed chi-square tests in which independent variables were age, gender, education, occupation and residence. The dependent variables were understanding of smog and from which source they got information about smog.

Figure 3 reveals the relationship between age and understanding of smog. As p value is less than 5 which means that there is a significant relationship between age and understanding of smog. People having age between 21-23 (26.04%) had good understanding of smog while people of age above 23 (7.29%) had very good understanding of smog.

Mostly undergraduates (41.67%) were having good understanding of smog, people who were done with their masters (7.29%) were having very good understanding of smog while most of the intermediate students (1.04%) had fair understanding of smog. As p value is less than .05 which indicates that there is a significant relationship between education level and understanding of smog.

Then relationship between gender, occupation, residence and understanding of smog was found which revealed that there is not a significant relationship between gender and understanding of smog, residence and understanding of smog, and between occupation and understanding of smog.

Males and females were equally having good understanding of smog. Mostly doctors (12.5%) were having good understanding of smog while researchers (1.04%) were having very good information about smog. People who were living in urban areas had better understanding of smog as compared to people who were living in rural areas.

Chi square test was applied to find the relationship between age and source from where they get information about smog, gender and source of information and between residence, occupation, education level and source from they get information about smog. There was a non-significant relationship between age ad source of information. Participants of all ages (38%) mostly were getting information from social media and were using news as second major source of information.

Figure 5 reveals the relationship between gender and source of information. P value is greater than .05 which indicates that source of information does not depend upon gender. All the participants including males (27.08%) and females (11.46%) were using social media as major source of information. They equally got information from both news and educational institutes

The study also revealed that most of the undergraduates (35.42%) were getting information from social media, people with master (5.21%) were getting information from educational institutes and intermediate students were getting information from news. P value was greater than .05 which showed non-significant relationship between them. It was found that mostly doctors (10.42%) among 23% got information about smog from educational institutes, most of the students (12.5%) got information from social media and 4.17%) were using news as a major source of information about smog. People of both urban and rural areas were getting information from social media which indicates that there is non-significant relationship between residence and source of Information.

Discussion

The current cross-sectional study examines the knowledge and perception of smog among the residents of Lahore, Pakistan, a city that experiences frequent air pollution, especially during the winter season. The study brings forward significant findings that are crucial for public health authorities and policymakers. One key point is the widespread awareness of the term "smog," with all participants reporting familiarity with the word. This suggests that previous public awareness efforts have had some success in introducing the concept. However, despite this general awareness, the study uncovers notable gaps in understanding, particularly concerning the causes and effects of smog. Although 94.8% and 95.8% of respondents understood the causes and impacts of smog, these numbers indicate that a segment of the population still lacks a thorough comprehension of how smog forms and its repercussions on health, the environment, and daily life. This limited understanding could undermine public participation in efforts to reduce smog.

The findings of this study align with trends observed globally. For example, Wang (2016) found a strong link between age and smog comprehension. Similarly, this study revealed that older participants were more knowledgeable about the sources, causes, and impacts of smog compared to younger respondents. This highlights the need for targeted education initiatives, particularly for younger demographics. Future programs could benefit from engaging younger audiences through innovative means like school programs, interactive content, and youth-focused campaigns to bridge this knowledge gap.

Furthermore, this research supports conclusions made by Yang and Shi (2017), who found a strong correlation between educational levels and understanding of smog. Participants with higher educational attainment demonstrated better knowledge of both the causes and consequences of smog. This insight is essential for designing effective public health campaigns, suggesting that individuals with lower education levels may require simpler, more accessible information. Environmental science can be complex, and public awareness campaigns must find ways to make the information easier to understand for the general population. Simplified educational content, public service announcements, and visual aids may help make the information more digestible for this group.

The significance of this study lies in its focus on Lahore, a megacity often in the spotlight due to its recurring air pollution issues. Smog in Lahore is a major public health challenge, and the insights from this study hold important implications for local authorities and national policymakers. One key takeaway is the need for a comprehensive approach that not only raises awareness but also deepens public understanding across different demographics. While current awareness campaigns have successfully introduced the term "smog" to the public, much more needs to be done to ensure that residents fully grasp the actions needed to mitigate its impact and understand their role in combating smog.

The findings also emphasize the shared responsibility between the government and citizens in tackling the smog issue. Government measures, such as enforcing stricter environmental regulations, controlling industrial emissions, and promoting clean energy, are crucial. At the same time, individual actions like reducing vehicle emissions, avoiding the burning of waste, and adopting eco-friendly habits are equally important. A collaborative, multi-sector strategy involving industries, government agencies, local communities, and individuals is vital to effectively lower smog levels.

Moreover, this study suggests that community-based initiatives can play an important role in addressing smog. Such programs could not only raise awareness but also encourage active participation in reducing smog. Examples of community involvement include local tree-planting campaigns, neighbourhood pollution monitoring, and encouraging the use of public transport over private cars. Policymakers should consider incorporating more participatory strategies into their plans, as grassroots efforts often lead to greater public involvement and long-term commitment to change.

The study also stresses the importance of educational programs that go beyond raising awareness and work towards enhancing the public's understanding of smog. By focusing on groups with lower education levels or younger individuals, future initiatives can close the knowledge gap and empower citizens to take action. Effective coordination between government policies and individual actions will be key to addressing this issue, and only through joint efforts can real progress be made in reducing the harmful effects of smog on public health and the environment.

However, the study's limitations should be considered. The cross-sectional design does not allow for causal conclusions, and there may be biases in self-reported data. Future research should focus on developing educational programs that promote both knowledge of smog and environmentally friendly behaviors. Long-term studies could also explore the cause-and-effect relationship between knowledge, attitudes, and behaviors related to smog.

Overall, this study highlights the need to address the knowledge gaps related to smog's causes and effects. Educational initiatives and awareness campaigns can play a crucial role in improving public knowledge and promoting positive environmental actions. Policymakers and public health officials should implement multi-faceted strategies, combining both governmental regulations and individual actions, to effectively reduce smog and minimize its adverse health impacts.

Conclusion

The study highlights the importance of education and awareness campaigns in enhancing smog literacy and promoting environmental behaviors. The findings support that there is need for targeted interventions, including government regulations, individual actions, and community engagement, to reduce smog pollution in Lahore.

Ethical Approval

Approval from Institutional Review Board (IRB) was obtained.

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Conflict of Interests:

The authors declare no conflict of Interest.

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