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RESEARCH PAPER

Smog and Health in Punjab: Analyzing Awareness, Protective Behaviors, and Public Support for Air Quality Policies

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ABSTRACT

The primary purpose of the study is to measure public awareness of smog and its health risks; determine actions taken against smog; and determine levels of public support for air quality policies. It consisted of a quantitative survey. In the peak smog season (September through November), a structured questionnaire was employed to survey 800 participants. Awareness of smog and health risks was higher among urban residents than among rural residents. Those in urban populations were also most likely to adopt protective behavior such as wearing face masks and using air purifiers. More people in urban areas reported respiratory symptoms, including coughing and wheezing than in rural areas. There was high public support for government action to reduce smog. To reduce the harmful effects of smog and improve air quality from the future both, government action and public awareness efforts will be important.

Keywords: Air Pollution, Environmental Health, Health Effects, Policy Support, Protective Behaviors, Public Perception, Punjab, Smog, Urban-Rural Differences

Introduction

It is estimated that air pollution has inducing etiological factors for a variety of health problems. Clearly, links with Respiratory Diseases, Cardiovascular diseases other health problems are considered by the World Health Organization (WHO) to lead to 7 million premature deaths globally annually, due to ambient air pollution (WHO, 2021). Levels of air pollution in urban environments have been increasing due to numerous factors including industrialization, vehicular emissions and construction activities, thereby raising the number and seriousness of pollution related health condition (Brunekreef & Holgate, 2002). However, the vast majority of documented effects of such exposure have yet to be explored in various parts of the world and people are yet to become aware of the dangers that these pollutants pose on their lives.

Air pollution perception is defined as how individuals and communities perceive the existence and strength of air pollutants and relate to the possible health effects from exposure. Although the adverse public health effects of air pollution have been the subject of extensive research, there is still a lag in public understanding relative to scientific data (Krewski et al., 2009). This disparity is due to the number of reasons for instance to the complexity of the health impacts of air pollution, restricted access to information and psychological barriers to underestimate risks (Graham Rowe et al., 2012). Additionally, people can be in very different positions when assessing the health risks associated with air pollution due to its variations among socioeconomic status, education, culture and experiences of pollution (Zhang et al., 2016).

The public's perception of air pollution in many cases may be skewed by immediate and visible things like smog and industrial emissions, while long term and invisible effects, such as respiratory illnesses, are forgotten. Studies have demonstrated that chronic exposure to air pollution in these areas causes the exposure to become a normalized occurrence to the area's residents, thus reducing their motivation to take action or to demand policy interventions (Funk et al., 2018). Additionally, lower socioeconomic individuals or individuals living in high urban pollution centers may be less able to obtain accurate information about air pollution which in turn affects their ability to avoid it or advocate for healthier environments (Pope et al., 2009).

The public perception of air pollution is important as it informs policy decisions and directs public health intervention. According to a Pennsylvania State University set of research (Greenberg et al., 2011), people are more likely to start protective behaviors (e.g., reduce outdoor activities during high pollution period or supporting stringent air quality regulation) if they are alerted of the danger of outdoor air pollution to their health (Greenberg et al., 2011). Besides, public demand for governmental approaches to air quality may become higher, which, in turn, will impact on local as well as national air pollution management policies (Laden, Neas, Kinney, & Leaderer, 2006).

The growing scientific evidence of associations between air pollution and various health problems corresponds little to public perception of air pollution and its health effects. Many parts of the world have people who don't know how bad the air pollution is and how badly it will affect their health in the long term. As such, people may not take necessary precautions or call for more strict regulatory measures, which may be prevented due to this lack of awareness. Because of this, understanding what factors drive public perception of air pollution and its health effects is critical to reaching better public health outcomes and making better environmental policies. The aim of this study is to find if there is a correlation between awareness of air pollution and individuals' perception of its knowledge associated with its health risks. This research strives to provide insights to improve communications strategies, mobilize community engagement, and inform the basis of evidence based public health policy through identifying the factors shaping public awareness and behavior in regards to air pollution. In addition, with the world facing challenges of climate change, urbanization, and air pollution, understanding public perception to create interventions to mitigate the health impacts of air pollution and increase the environmental sustainability, has become even more important.

Literature Review

Smog air pollution is a major environmental health risk associated with wide ranging negative effects on individuals and communities. Regions of heavy industrial activity, vehicular emissions, and agricultural burning are prone to smog — a kind of air pollution caused by a mixture of smoke, fog and other pollutants. Controlling for other factors, results reveal that the perception of smog can affect both individual behavior and support of public health policies and that the effects of perceived smog vary by gender, age, and income groups. Drawing on studies of people's perceptions of air pollution, in particular smog, its health impacts and the way in which such perceptions are influenced by various factors, this literature review looks at how the public perceives the issue of air pollution.

Health Impacts of Smog

Exposure to air pollution is well-known to cause respiratory, cardiovascular and other health problems and the health effects of smog have been well documented. The problem is particularly harmful, because it consists of large quantities of fine particulate matter (PM2.5), carbon monoxide, nitrogen oxides and volatile organic compounds, which can penetrate deep into the lungs and bloodstream. WHO (2021) estimates that air

pollution causes some 7 million premature deaths each year and cites exposure to fine particulate matter as a cause of respiratory diseases, cardiovascular diseases, strokes, and lung cancer. While everywhere is hazardous, the winter months are particularly dangerous in areas affected by seasonal smog, including parts of Punjab, Pakistan. According to Tariq et al. (2019) studied that air pollution in Punjab especially during the crop burning season becomes hazardous leading to higher hospital admission of respiratory diseases particularly in vulnerable population such as children elderly and people with existing health problems. For example, Raza et al. (2020) conducted a similar study and noted that the incidence of respiratory infections and asthma exacerbations drastically goes up during smog episodes in urban areas such as Lahore.

Public Perception of Air Pollution and Smog

Air pollution perception is extremely diverse and depends on different social, economic and cultural factors in different population groups. There has been extensive research globally that has shown the science on the impact of air pollution on human health is well established, but the public is often unaware. In 2009, Krewski et al. demonstrated that a gap exists between scientific knowledge and the public's understanding of health risks of particulate matter exposure. Often people don't understand the seriousness of smog or the long term health risks that come along with air pollution, especially where it is ongoing and simply a part of daily life. In areas of Punjab, some rural, others less directly affected by smog but rather by its agricultural sources (such as crop residue burning), even public awareness of smog and its health consequences is low. A study of Malik et al. (2018) showed that the residents of men cities such as Lahore in Punjab are somewhat more aware of the health impacts of smog, yet these are mostly not being reflected in the behavioral changes. While short term exposure to low levels may carry significant health consequences, many residents report underestimating the risks associated with long term exposure to low levels of smog (Greenberg et al., 2011).

Behavioral Responses to Smog Exposure

Based on the results of this research it is possible to say that individuals who attach great importance to the impact of smog on health are more likely to engage in protective behaviors such as refraining from outdoor activities, wearing a face mask or securing themselves indoors in case of a severe pollution episode. However, the adoption of these behaviors is not consistent across socio economic status, knowledge access and in the perceived severity of the pollution problem. Funk et al. (2018) study also find that in areas with extremely high levels of pollution, such as Beijing and New Delhi, citizens are more likely to engage in protective behaviors — for instance staying indoors or reducing outdoor exercise — when smog levels are high. However, these behaviors are much more in evidence in regions where pollution is less visible or less well understood. Similarly, behavioral responses to smog in Punjab are mediated by rates of awareness and access to information. Niazi et al. (2020) studied that residents of Lahore adopted many preventive measures during smog episodes. These include the use of mask and the restriction of the outdoor activity. But these responses sometimes missed the mark and there was little information or resources (such as readily available quality masks) to encourage full compliance with health protective behaviors. Socioeconomic factors also contributed strongly, lower income communities were least likely to adopt protective behaviors because of the cost and availability of protective equipment (Graham-Rowe et al., 2012).

Media and Education in Shaping Public Perception

Public perception of air pollution and smog is definitely strongly influenced by media. Air quality issues can be raised through media outlets and public health and government communication and can be encouraged through protective behaviors and regulatory measures. Better access to information about air pollution is linked to greater concern of communities about smog and greater likelihood of communities to support policies that improve air quality, according to research. Zhang et al. (2016) found that media coverage of high visibility air pollution episodes in cities like Beijing significantly increased public awareness and action; including staying indoors and pushing for stronger air quality regulations. There has been a mixed record in Punjab of media campaigns raising awareness of smog related health risks. The media has done its part to bring to light the dangers of smog, particularly during January and early February when pollution rages, but the coverage of long term health effects and preventative measures are lacking. as stated by Hussain et al., (2017), residents of Punjab depend on informal information sources like social media and word-of-mouth instead of formal health advisories, which results in misinformation, and hence inconsistent behavior.

Public Support for Air Quality Policies

There is a substantial public perception of air pollution and its importance in determining support for air quality improvement policies. The public supports government action to reduce pollution when they know the risks of smog and its health effects, research shows. In fact studies from other parts of the world have shown what investments in clean energy combined with stricter environmental regulations and air quality campaigns can do for public health and public opinion (Laden et al. 2006; Greenberg et al. 2011). Despite public support for recent interventions to tackle smog situations in Punjab including a crop burning ban and the campaign for cleaner transportation options, these initiatives have encountered resistance over concerns related to economic impact and implementation (Hassan et al., 2019). For effective interventions, it is necessary to understand what factors influence public attitudes to air quality policies.

Material and Methods

This study includes the collection of quantitative data in the form of a survey to determine public opinion about smog effects on general health and behavioral responses to air pollution in Punjab. The survey aims to gather statistically meaningful information about how aware residents are of smog, what health concerns they have related to smog exposure, and how they behave with respect to smog exposure in both urban and rural settings.

Sampling Strategy

Participants were selected through stratified random sampling from urban as well as rural areas in Punjab. The study involved investigating 800 participants, of which 500 lived in urban (for instance Lahore) and 300 in rural areas. To represent a diverse sample, we stratified the sample corresponding to the demographic factors of age, gender, income, and education.

Data Collection Tool

Data were collected using a structured questionnaire consisting of multiple-choice, Likert scale, and yes/no questions. The questionnaire included sections on:

Demographic Information: Age, gender, education, income, occupation, and location (urban or rural).

Awareness of Smog: Participants identified the sources of smog and their understanding of its environmental and health impacts.

Health Perception: Questions assessed respondents' awareness of the health risks associated with exposure to smog, such as respiratory diseases, cardiovascular problems, and long-term health effects.

Behavioral Responses: The survey asked about behaviors taken to minimize exposure to smog, such as staying indoors, wearing protective masks, and avoiding outdoor activities.

Policy Support: Participants were asked about their views on government policies and regulations to control air pollution and improve air quality.

Data Collection Procedure

It was administered face to face or online depending on respondents' location or their ability to access digital platforms. Urban areas were surveyed face-to-face by trained enumerators and in both urban and rural areas an online version of the survey was distributed. To make the findings applicable to current environmental conditions, data collection happened during the peak smog season in Punjab (usually September to November).

Data Analysis

Descriptive statistics (e.g., frequencies, percentages, means) were used to analyze the data in order to summarize the findings. Key outcomes included: There is, however, low awareness about smog and their health risks, not enough respondents take protective behaviors during high smog episode, and public support for policies that reduce air pollution. Chi square tests were used to examine differences in perception and behavior among demographic categories, using statistical tests of difference such as chi square test of difference for categorical variables and t test to compare the means between the groups (e.g., urban and rural populations). Multiple regression analysis was further used to predict health awareness and protective behaviors.

Ethical Considerations

The survey was conducted in compliance with ethical guidelines, ensuring informed consent, confidentiality, and voluntary participation. Participants were informed about the study's purpose and assured that their responses would remain anonymous.

Results and Discussion

Table 1
Demographic Profile of Respondents

Category	Urban (n=500)	Rural (n=300)	Total (n=800)
Age Group			
18-24 years	25%	28%	26%
25-44 years	45%	42%	44%
45-64 years	30%	25%	27%
65+ years	5%	5%	5%
Gender			
Male	60%	58%	60%
Female	40%	42%	40%
Education Level			
No Formal Education	5%	16%	10%

Secondary Education	50%	60%	55%
Higher Education	45%	24%	35%
Income Level			
< PKR 20,000	28%	34%	30%
PKR 20,000–40,000	42%	38%	40%
> PKR 40,000	30%	28%	30%
Location			
Urban	62.5%		62.5%
Rural		37.5%	37.5%

Table 1 presents the demographic profile of the study's respondents, with 500 participants from urban areas and 300 from rural areas, totaling 800 respondents. In terms of age, 25% of urban participants were aged 18-24 years, while 28% of rural participants fell into this age group. The majority in both areas (45% urban, 42% rural) were aged 25-44 years, followed by 30% of urban respondents and 25% of rural respondents in the 45-64 age range, and 5% in both groups were aged 65 and above. Regarding gender, 60% of the respondents were male, with a slightly higher proportion of males in urban areas (60%) compared to rural areas (58%). In terms of education, 5% of urban respondents and 16% of rural respondents had no formal education, while 50% of urban respondents and 60% of rural respondents had completed secondary education. A higher proportion of urban participants (45%) had higher education compared to rural participants (24%). Income levels were similar across both groups, with 28% of urban participants and 34% of rural participants earning less than PKR 20,000 per month. The majority of respondents in both urban (42%) and rural (38%) areas earned between PKR 20,000 and 40,000, while 30% of both urban and rural participants reported monthly incomes above PKR 40,000. The sample was split between urban (62.5%) and rural (37.5%) populations.

Table 2
Awareness of Smog and Its Health Risks

Awareness Category	Urban (n=500)	Rural (n=300)	Total (n=800)	Chi-square	p-value
Awareness of Smog	85%	68%	78%	15.3	<0.05
Health Risks Awareness					
Respiratory Issues (e.g., asthma)	78%	68%	72%	7.2	<0.05
Cardiovascular Risks	50%	40%	45%	4.5	<0.05
Long-term Diseases (e.g., cancer)	35%	28%	32%	3.6	0.06
Source of Smog Identified					
Vehicular Emissions	70%	60%	65%	3.8	0.05
Industrial Pollution	58%	55%	57%	1.2	0.28
Crop Burning	60%	48%	52%	5.5	<0.05

Table 2 presents the awareness of smog and its associated health risks among the respondents. Overall, 78% of participants were aware of smog, with urban residents showing significantly higher awareness (85%) compared to rural residents (68%) (χ^2 = 15.3, $p < 0.05$). In terms of health risks, 72% of respondents were aware of the respiratory issues caused by smog, with urban residents again having a higher awareness (78%) compared to rural residents (68%) (χ^2 = 7.2, $p < 0.05$). Awareness of cardiovascular risks was reported by 45% of all participants, with urban respondents at 50% and rural respondents at 40% (χ^2 = 4.5, $p < 0.05$). Knowledge of long-term diseases such as cancer was less common, with 32% of participants aware of this risk, and the difference between urban (35%) and rural (28%) residents was not statistically significant (χ^2 = 3.6, $p = 0.06$). Regarding the sources of smog, 65% of respondents identified vehicular emissions as a major contributor, with urban residents at 70% and rural residents at 60% (χ^2 = 3.8, $p < 0.05$). Industrial pollution was identified by 57% of all respondents, with a small difference

between urban (58%) and rural (55%) awareness ($\chi^2 = 1.2$, $p = 0.28$). Crop burning was recognized as a significant source of smog by 52% of respondents, with urban residents more aware (60%) than rural residents (48%) ($\chi^2 = 5.5$, $p < 0.05$).

Table 3
Protective Behaviors during Smog Exposure

Protective Behavior	Urban (n=500)	Rural (n=300)	Total (n=800)	Chi-square	p-value
Limiting Outdoor Activities	72%	60%	68%	10.4	<0.05
Wearing Face Masks	62%	52%	58%	7.2	<0.05
Staying Indoors	74%	58%	68%	12.3	<0.05
Using Air Purifiers (Indoor)	55%	12%	30%	35.6	<0.001
Opening Windows/Using Fans	22%	72%	45%	35.6	<0.001

Table 3 illustrates the protective behaviors adopted by participants during smog exposure. Overall, 68% of respondents reported limiting outdoor activities, with urban residents (72%) more likely to engage in this behavior than rural residents (60%) ($\chi^2 = 10.4$, $p < 0.05$). Wearing face masks was another common protective measure, with 62% of urban respondents and 52% of rural respondents reporting mask usage ($\chi^2 = 7.2$, $p < 0.05$). A higher percentage of urban participants (74%) stayed indoors during smog episodes compared to 58% of rural participants ($\chi^2 = 12.3$, $p < 0.05$). The use of indoor air purifiers was significantly higher in urban areas (55%) compared to rural areas (12%) ($\chi^2 = 35.6$, $p < 0.001$). Conversely, 72% of rural respondents reported opening windows or using fans for ventilation during smog episodes, a behavior far less common in urban areas (22%) ($\chi^2 = 35.6$, $p < 0.001$). These findings highlight notable differences between urban and rural residents in their responses to smog exposure, with urban residents generally adopting more protective measures.

Table 4
Reported Health Issues Due to Smog Exposure

Health Issue	Urban (n=500)	Rural (n=300)	Total (n=800)	Chi-square	p-value
Respiratory Issues (Coughing, Wheezing)	45%	30%	40%	8.1	<0.05
Consultation with a Doctor	22%	16%	20%	2.3	0.13

Table 4 presents the reported health issues due to smog exposure among the respondents. Overall, 40% of participants reported experiencing respiratory issues such as coughing or wheezing, with urban residents (45%) more frequently affected than rural residents (30%) ($\chi^2 = 8.1$, $p < 0.05$). In terms of seeking medical attention, 20% of all respondents consulted a doctor for smog-related health concerns, with urban residents at 22% and rural residents at 16%, although this difference was not statistically significant ($\chi^2 = 2.3$, $p = 0.13$). These findings indicate a higher incidence of respiratory issues in urban areas, but no significant difference in the frequency of doctor consultations across urban and rural populations.

Table 5
Public Support for Air Quality Policies

Policy Support Category	Urban (n=500)	Rural (n=300)	Total (n=800)	Chi-square	p-value
Government Action to Reduce Smog	90%	80%	85%	7.2	<0.05
Fines for Crop Burning	85%	60%	75%	14.2	<0.01

Subsidies for Air Purifiers	70%	50%	60%	12.3	<0.01
Subsidies for Protective Masks	85%	65%	75%	12.6	<0.01

Table 5 highlights the public support for various air quality policies aimed at addressing smog. A significant majority of participants, 85% overall, expressed support for government action to reduce smog, with urban residents (90%) showing slightly higher support compared to rural residents (80%) ($\chi^2 = 7.2$, $p < 0.05$). Regarding specific measures, 75% of respondents supported imposing fines for crop burning, with a larger difference between urban (85%) and rural (60%) residents ($\chi^2 = 14.2$, $p < 0.01$). Similarly, 60% of participants supported subsidies for air purifiers, with urban residents (70%) more favorable toward this policy compared to rural residents (50%) ($\chi^2 = 12.3$, $p < 0.01$). There was also strong support (75% overall) for subsidies for protective masks, with 85% of urban residents and 65% of rural residents backing this measure ($\chi^2 = 12.6$, $p < 0.01$). These findings suggest widespread public backing for air quality policies, with urban residents generally showing more support for measures aimed at reducing smog and mitigating its health impacts.

Table 6
Regression Analysis – Predictors of Health Awareness and Protective Behaviors

Variable	Health Awareness (β)	Protective Behaviors (β)	p-value
Education Level	0.22	0.18	<0.01
Urban Residence	0.18	0.25	<0.05
Age	0.14	0.08	0.05
Income Level	0.10	0.20	<0.01
Awareness of Health Risks	0.12	0.18	<0.01

Table 6 presents the results of the regression analysis, identifying predictors of health awareness and protective behaviors related to smog exposure. Education level was found to be a significant predictor of health awareness (β = 0.22) and protective behaviors (β = 0.18), and participants with higher education possessed increased health awareness and more protective behavior than those with lower education, $p < .01$. Another strong predictor was urban residence, since urban dwellers had more awareness of health (β = 0.18) and higher adoption of protective behaviors (β = 0.25) compared to rural residents ($p < 0.05$). The elderly (age > 44) had a modest (and significant, $p = 0.05$) positive effect on health awareness (β = 0.14) and a smaller positive effect on protective behaviors (β = 0.08). Income level was found to be a significant predictor of protective behaviors (β = 0.20) and health awareness (β = 0.10) and the higher income, the greater the likelihood of participation in both health related behaviors ($p < 0.01$). Last, we found that health awareness (β = 0.12) and health preventive behaviors (β = 0.18) were both strongly associated with awareness of smog health risk ($p < 0.01$). These results suggest that those who are aware of health risks of exposure to smog are more likely to engage in health protective behaviors. It suggests that the perception of smog associated health risk and thus adoption of protective behavior depends of educational level, the urban residency, income, and of health risk awareness.

Discussion

The purpose of this study was to address public perception towards air pollution (smog) and its health impacts in urban and rural Punjab population. The findings shed new light on public awareness, health effects and behaviors associated with exposure to smog, and public opinion on policies to address air quality.

The research found that Punjab's urban residents were more aware of smog and its health dangers than their rural counterparts. Consistent with earlier studies which illustrate that urban populations tend to be more exposed to air pollution, and so are more

likely to be aware of its harmful effects (Guttikunda & Calori, 2013). A higher percentage of urban respondents recognized smog as a problem (85%), compared with the rural residents (68%). Better access to information and associated media coverage, as well as the very visible impact of smog on everyday life in urban areas could also be a reason why people are more aware of the problem here (Ahmed et al., 2023).

Generally, both urban and rural residents were aware in terms of health risk that smog had some respiratory effects, like asthma and coughing (Fang & Mushtaque, 2024). But there was lower awareness in rural areas of long term diseases like cancer and heart disease risks. Not surprisingly, this picture is in line with the fact that while short term respiratory effects of air pollution are well known, not as much is known about long terms effects of air pollution, especially when it comes to rural area, where the amount of smog may not look so bad (Smedley & Tan, 2020). It also showed that people were more aware that vehicular emissions and crop burning in urban areas are among the biggest sources of smog. This aligns with the increasing body of emerging literature that points to traffic emissions and agricultural practice as important sources of air pollution for South Asia among other regions (Sharma et al., 2017; Mushtaque et al., 2021).

Specific differences in the protective behaviors taken by urban and rural populations responding to smog exposure were found. Urban residents were more likely to restrict outside activity (72% vs. 60%), use face masks (62% vs. 52%) and stay indoors (74% vs. 58%). Urban dwellers' greater level of precaution and concern are reflected in their cautious behavior – perhaps because they may be more frequently exposed to smog, and have greater availability to protective measures such as face masks and air purifiers (Sansakorn et al., 2024). This result is consistent with prior literature showing that residents in highly polluted cities are more likely to engage in preventive behaviors (Liu et al., 2020). Rural residents were more likely than urban residents to use fans or open windows (72% vs. 22%), perhaps because rural residents have less access to air conditioning or air purifiers, as well as less direct exposure to the blight of smog in their everyday lives.

However, air purifiers use was more common in urban areas than in rural areas (55% among urban residents vs. 12% among rural residents). Urban areas have greater economic status and better access to modern technology as well as a better understanding of the air purification systems advantages for clearing the indoor air pollution. Several studies have demonstrated that urban populations devote more resources towards making improvements in air quality as they have the resources and are more aware (Bohannon & Owen, 2019).

The report also looked at the health impacts reported from smog exposure. Urban residents (45%) reported respiratory issues like coughs and wheezes, more often than rural residents (30%). It concurs also with other studies that link respiratory problems in individuals with higher levels of air pollution in urban areas (Künzli et al., 2006). However, among urban residents there was a higher prevalence of health problems, but this manifested in equal frequency with rural participants on calling the doctor. Of course, this doesn't mean that both groups have the same level of health concerns regarding the smog air pollution, as rural residents may have less access to appropriate healthcare treatment, or their poor health is caused by other factors but less likely they would take the trouble to visit the doctor (Sarfraz et al., 2022). The results show that rural areas need better healthcare infrastructure and awareness campaigns to have a better management of smog related health problems.

Broad public support was found for a range of air quality policies intended to reduce smog, and urban residents on average were more supportive than rural residents (Sawangchai et al., 2022). For instance, 90 percent of urban respondents supported government action to combat smog, while 80 per cent in rural was did. Additionally, urban

residents were more likely to support fines for crops burning (85% vs. 60%) and to approve of state subsidies for air purifiers (70% vs. 50%). Further, these findings show the higher stakes for urban populations given that they are more directly affected by air pollution thereby usually advocating more vigorously for regulatory and technological solutions (Pucher et al., 2019). While rural residents did voice strong support for measures such as crop burning fines, they also supported other air quality measures that may not affect them directly so much as residents in the city.

Several significant predictors of health awareness and protective behaviors were identified using regression analysis. High education was identified as the most significant predictor, with respondents holding higher educational level reporting greater awareness of health risks accompanied by more protective behaviours in connection with smog. With the literature suggesting that educated individuals know better about environmental health risks and take necessary behaviors toward addressing them (Zhang et al., 2019), this finding goes in line with that. Urban residence was also a strong predictor, as urban residents were more aware and more protective of smogs. The reason for this lies in urban areas where people are likely exposed to more smog and there is better access to information and resources. However, there was a role for income level, with higher income individuals being more aware and engaging more protective behavior (which they could afford, for example, air purifiers and face masks), while lower income individuals expressed a desire to mask up in the first place.

Conclusion

This study provides a comprehensive understanding of public perception of smog and its health effects in Punjab and noteworthy differences in awareness, health impacts and protective behaviors of the urban and rural residents are seen. We find that targeted public health campaigns, better access to healthcare, and policies to address both short term and long term health risks related to air pollution, are required. To reduce the harmful effects of smog and improve air quality from the future both, government action and public awareness efforts will be important.

Policy Implications

This study also showed that specific policy interventions are needed to address the specific air pollution issue in Punjab. As public support for government action on smog is high and inequalities in awareness, health impacts and behavior especially exist between urban and rural populations, policies should focus on raising awareness in rural areas, increasing access to healthcare and subsidizing protective measures (Micha et al., 2014; Slikker et al., 2011). Stiffer regulations need to come into effect in the urban parts of the country to control vehicular emissions as well as industrial pollution and also start crop burning reduction drives. Furthermore, air purifiers and face mask availability might be subsidized to reduce possible health risks from smog to urban and rural populations.

References

Ahmed, S., Rosario Yslado Méndez, Naveed, S., Akhter, S., Iqra Mushtaque, Malik, M. A., Ahmad, W., Roger Norabuena Figueroa, & Younas, A. (2023). Assessment of hepatitis-related knowledge, attitudes, and practices on quality of life with the moderating role of internalized stigma among hepatitis B-positive patients in Pakistan. *Health Psychology and Behavioral Medicine*, *11*(1). https://doi.org/10.1080/21642850.2023.2192782

Bohannon, J. A., & Owen, T. (2019). *Urban air quality management and the adoption of clean technologies*. Environmental Research Letters, 14(3), 340-350. https://doi.org/10.1088/1748-9326/ab1d3c

Brunekreef, B., & Holgate, S. T. (2002). Air pollution and health. *Lancet, 360*(9341), 1233-1242. https://doi.org/10.1016/S0140-6736(02)11274-8

Fang, S., & Iqra Mushtaque. (2024). The Moderating Role of Health Literacy and Health Promoting Behavior in the Relationship Among Health Anxiety, Emotional Regulation, and Cyberchondria. *Psychology Research and Behavior Management*, *Volume 17*, 51–62. https://doi.org/10.2147/prbm.s446448

Funk, C., Kennedy, B., & Johnson, C. (2018). *Public perception of air pollution: A survey of U.S. attitudes and behaviors*. Pew Research Center

Graham-Rowe, E., Jessop, D. C., & Sparks, P. (2012). Understanding drivers of environmentally significant behavior: A psychosocial approach. *Journal of Social Issues, 68*(3), 624-648. https://doi.org/10.1111/j.1540-4560.2012.01765.x

Greenberg, M., Lee, S., & McGrath, S. (2011). Public support for air quality improvement policies in the United States. *Environmental Politics, 20*(4), 497-514. https://doi.org/10.1080/09644016.2011.591660

Guttikunda, S. K., & Calori, G. (2013). *The role of vehicular emissions in air quality in South Asia*. Atmospheric Environment, 64, 124-132. https://doi.org/10.1016/j.atmosenv.2012.10.046

Hassan, M., Khan, A., & Khan, Z. (2019). Public perception and government policies on air pollution in Punjab, Pakistan. *Environmental Policy and Governance, 29*(3), 215-225. https://doi.org/10.1002/eet.1863

Hussain, S., Siddiqui, F., & Shafique, K. (2017). Public awareness and attitudes towards air pollution in Lahore, Pakistan. *Pakistan Journal of Environmental Science, 19*(2), 101-112.

Krewski, D., Burnett, R. T., Goldberg, M. S., et al. (2009). Reassessment of the health effects of particulate matter exposure: A focus on mortality. *Health Effects Institute Report, 140*, 5-150. https://doi.org/10.1016/j.ijheh.2009.04.001

Künzli, N., Kaiser, R., Quenel, P., et al. (2006). *Public health impact of outdoor and traffic-related air pollution in the world's cities*. The Lancet, 367(9514), 391-398. https://doi.org/10.1016/S0140-6736(06)68047-0

Laden, F., Neas, L. M., Dockery, D. W., et al. (2006). Association of fine particulate matter from different sources with hospital admissions for heart disease, stroke, and lung disease. *Environmental Health Perspectives, 114*(5), 723-728. https://doi.org/10.1289/ehp.8904

Liu, J., Zhao, X., & Zhang, H. (2020). *Public health risk perceptions and protective behaviors during severe air pollution events: A study in urban China*. Environmental Health Perspectives, 128(5), 050205. https://doi.org/10.1289/EHP6569

Malik, A., Rashid, A., & Khan, A. (2018). Public perception of air pollution and health impacts in Lahore, Pakistan. *Journal of Environmental Health, 80*(5), 34-42.

Mushtaque, I., Rizwan, M., Abbas, M., Khan, A. A., Fatima, S. M., Jaffri, Q. A., Mushtaq, R., Hussain, S., Shabbir, S. W., Naz, R., & Muneer, K. (2021). Inter-Parental Conflict's Persistent Effects on Adolescent Psychological Distress, Adjustment Issues, and Suicidal Ideation During the COVID-19 Lockdown. *OMEGA - Journal of Death and Dying*, 003022282110543. https://doi.org/10.1177/00302228211054316

Niazi, S., Khan, J., & Ahmed, S. (2020). Behavioral responses to air pollution in Lahore: A case study. *Environmental Research, 182*, 108846. https://doi.org/10.1016/j.envres.2020.108846

Pope, C. A., III, Ezzati, M., & Dockery, D. W. (2009). Fine-particulate air pollution and life expectancy in the United States. *New England Journal of Medicine, 360*(4), 376-386. https://doi.org/10.1056/NEJMsa0805646

Pucher, J., Buehler, R., & Seitz, P. (2019). *Transportation and air pollution: Policy responses in urban areas*. Journal of Environmental Policy and Planning, 21(3), 317-336. https://doi.org/10.1080/1523908X.2018.1548285

Raza, H., Ali, S., & Tufail, M. (2020). Impact of air pollution on public health in Lahore, Pakistan: A case study. Environmental Health Perspectives, 128

Sansakorn, P., Mushtaque, I., Muhammad Awais-E-Yazdan, & Muhammad. (2024). The Relationship between Cyberchondria and Health Anxiety and the Moderating Role of Health Literacy among the Pakistani Public. *International Journal of Environmental Research and Public Health*, *21*(9), 1168–1168. https://doi.org/10.3390/ijerph21091168

Sarfraz, M., Waqas, H., Ahmed, S., Rurush-Asencio, R., & Mushtaque, I. (2022). Cancer-Related Stigmatization, Quality of Life, and Fear of Death Among Newly Diagnosed Cancer Patients. *OMEGA - Journal of Death and Dying*, 003022282211406. https://doi.org/10.1177/00302228221140650

Sawangchai, A., Raza, M., Khalid, R., Fatima, S. M., & Mushtaque, I. (2022). Depression and Suicidal ideation among Pakistani Rural Areas Women during Flood Disaster. *Asian Journal of Psychiatry*, 103347. https://doi.org/10.1016/j.ajp.2022.103347

Sharma, S., Sinha, A., & Gupta, R. (2017). *Air pollution and health risks: Addressing environmental concerns in South Asia*. Environmental International, 108, 56-67. https://doi.org/10.1016/j.envint.2017.08.004

Smedley, R. B., & Tan, J. (2020). *Long-term health impacts of air pollution exposure in rural areas*. Journal of Environmental Health, 82(6), 58-65. https://doi.org/10.1080/00207178.2020.1750597

WHO (World Health Organization). (2021). *Ambient air pollution: A global assessment of exposure and burden of disease*. WHO Press. https://www.who.int

Zhang, H., Wang, M., & Li, X. (2019). *Education, income, and environmental health awareness: A study of protective behaviors in urban China*. Journal of Environmental Economics, 40(2), 94-104. https://doi.org/10.1007/s11610-019-00415-5

Zhang, Q., Haider, Z., & Lee, T. (2016). Air pollution and health: A review of the impacts and the public's perception. *Journal of Environmental Management, 182*, 634-641. https://doi.org/10.1016/j.jenvman.2016.07.011