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Air Pollution and Respiratory Health Concerns in Malakand Division: A Study of Patients' Admissions at Hospital and Outpatient Visits

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Original Article

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Abstract

Air pollution poses numerous threats and challenges to human life and health and has been a global concern. This qualitative study investigates the impact of air pollution on respiratory health in Malakand Division, Khyber Pakhtunkhwa, Pakistan. At first, the information of patients with respiratory health issues was obtained from four category-D hospital including Timergara, Batkhela, Talash and Saidu Sharif Swat through health professionals serving therein. Using a qualitative approach, in-depth interviews and focus group discussions were conducted with 20 patients and healthcare professionals to gather rich, contextual data with the open-ended interviews and two FGDs. The study reveals that air pollution is a significant public health concern in the region, with increased hospital admissions and outpatient visits for respiratory diseases. The findings highlight the severe effects of air pollution, vulnerability of certain populations, and high levels of air pollutant concentrations. The study emphasizes the need for urgent action to reduce air pollutant concentrations, promote cleaner energy sources, and protect vulnerable populations. The results have important implications for policy and practice and can inform the development of effective strategies to mitigate the health impacts of air pollution in the region.

Introduction

Air pollution is a significant global health concern, with 8.1 million premature deaths annually attributed to it (Health Effects Institute, 2024). At global level approximately 99% of people live in areas with air pollution levels exceeding WHO prescribed guideline and limits (World Health Organiation, 2024), and 2.1 billion people rely on polluted fuels and other related technologies for cooking (World Health Organisation, 2024). Air pollution is a major risk factor for death worldwide and relevant statistics indicate that it has been a major cause of children under five years, and almost 0.7 million deaths in this age group linked to air pollution in 2021 (Health Effects Institute, 2024). The economic impacts are substantial, with air pollution resulting in nearly $ 6 trillion in the annual basis global health costs (World Bank, 2023), and 1.2 billion workdays are lost globally each year (Organisation for Economic Co-operation and Development, 2022). Studies have shown that air pollution is more severe in developing countries, due to rapid urbanisation and industrialization that have led to increased emissions of pollutants into the atmosphere (WHO, 2018). According to the World Health Organisation (WHO) estimates, nine out of ten people

worldwide breathe in polluted air thereby results in premature deaths of almost seven million on annual basis (WHO, 2018).

The literature suggests that air pollution is a major public health concern in the South Asian context, particularly in Pakistan and India. The smog enveloping in these countries has caused the deterioration of air quality, increased toxic levels, and forcing authorities to shut down schools, parks, and public places (Jabbar et al, 2022). In Pakistan, air pollution is widely prevalent environmental issue and produce significant health rrisks, with studies indicating that it contributes to increased morbidity and mortality rates (Saeed et al., 2014). In Lahore, the air quality index reached 1165, that is 120 times higher the recommended levels by the World Health Organization (2018). The smog composed air pollution mainly consit of particulate toxic matter, ozone, nitrogen oxides, and sulfur oxides, leading to severe respiratory, cardiovascular, and ocular health risks (Raza et al., 2021). Studies have shown that exposure to poor air quality is related with hospital admissions for prolong treatment and outpatient visits for respiratory diseases (Kumar et al., 2015). In fact, air pollution is responsible for an estimated 1.2 million premature deaths in India each year (WHO, 2018), and the situation is further exacerbated by the burning of rice fields in India, which contributes to the thick and high polluting smoke that affects neighbouring regions as well (Ali et al., 2019). In order to reduced and mitigate the negative health effects of air pollution, it is essential to implement policies to reduce emissions from industrial and vehicular sources, promote cleaner energy sources, and educate the public about the health risks associated with air pollution (Tariq, Qayyum, Ul-Haq, & Mehmood, 2023).

With reference to the province of Khyber Pakhtunkhwa, it has been grappling with severe air pollution, with the Air Quality Index (AQI) frequently reaching unhealthy levels. According to recent data, the current AQI level in Khyber Pakhtunkhwa stands at 96, categorized as moderate, but levels have been known to spike to unhealthy levels and prolonged exposure to such pollutants can lead to serious health issues, including respiratory problems and cardiovascular diseases (Nawaz et al, 2023). In fact, the air quality of the major cities of Khyber Pakhtunkhwa is polluted to maximum level, and studies suggest that breathing the air in Khyber Pakhtunkhwa is equivalent to smoking 2.7 cigarettes per day. The situation is exacerbated by various factors, including increased in solid waste, urbanization, vehicular emissions and industrial activities. To mitigate the adverse health effects of air pollution, it is essential to implement policies to reduce emissions and promote cleaner energy sources (Khyber Pakhtunkhwa Air Quality Index, 2025; Qadir, 2002).

Located in the Khyber Pakhtunkhwa province of Pakistan, Malakand Division is also experiencing rapid population growth, urbanization, establishment of shopping centers, increase in non-custom paid vehicle and serve as a passage to tourist spots. The increased vehicular emissions, industrial activities, and construction of huge commercial buildings, and private houses, all of which contribute to deteriorating air quality (Khan et al., 2020). The region's unique topography, with surrounding mountains, can trap pollutants easily and thus exacerbating air pollution levels (Ali et al., 2019). In conclusion, air pollution is huge public health concern and challenge at global level, particularly in South Asia, where rapid urbanization and industrialization have led to increased emissions of pollutants into the atmosphere. The situation is particularly dire in Pakistan, where air pollution contributes to increased morbidity and mortality rates and several other infectious and respiratory diseases and particularly Khyber Pakhtunkhwa and Malakand Division, is facing with severe air pollution, with high levels of particulate matter and other pollutants posing serious health risks. To mitigate the adverse health effects of air pollution, it is essential to implement policies to reduce emissions, promote cleaner energy sources, create awareness, promote civic engagement in climate related issues and educate the public about the health risks associated with air pollution.

Problems Statement

Respiratory diseases are a significant health concern in Malakand Division, with hospital admissions and outpatient visits for respiratory conditions being a substantial burden on the healthcare system (Health Department, Khyber Pakhtunkhwa, 2020). Studies have shown that

exposure to air pollution lead to the intensification of respiratory conditions such as asthma, chronic obstructive pulmonary disease (COPD), and pneumonia (Brunekreef & Holgate, 2002; Iram et al., 2024). Despite the growing concern, there is meager research on the impact of air pollution on respiratory health in Malakand Division. Given the growing concern about air pollution's impact on public health, particularly respiratory health, there is a need to investigate the relationship between air pollution and hospital admissions and outpatient visits for respiratory diseases in Malakand Division. This study aims to examine the relationship between air pollution and respiratory health in Malakand Division, Khyber Pakhtunkhwa, Pakistan, by analyzing hospital admissions and outpatient visits for respiratory diseases, with a focus on determining the impact of specific air pollutants on respiratory health outcomes.

Research Questions:

1. What are the trends and patterns of patients' hospital admissions and visits for treatment of respiratory diseases in Malakand Division?
2. How the quality of air is associated to overall human health and respiratory diseases in Malakand Division?
3. Which specific air pollutants are most strongly associated with respiratory health outcomes in Malakand Division?

Objectives of the Study:

1. To identify the factors of air pollution in Malakand Division and its association to human health and well-being in Malakand Division.
2. To know about the trends and patterns of hospital admissions and outpatient visits for respiratory diseases in Malakand Division.
3. To investigate the association between air pollution different respiratory diseases in Malakand Division.

Research Approach

This study was conducted using a qualitative research design and phenomenological approach to explore the experiences and perceptions of individuals with respiratory diseases in Malakand Division. In-depth interviews and focus group discussions were conducted to gather rich, contextual data from patients with respiratory diseases (e.g., asthma, COPD, pneumonia) from four conveniently selected hospitals including Timergara, Talash, Batkhila and Saidu Sharif Swat. Purposive sampling was used to selected 30-35 participants who had experienced respiratory diseases and had been exposed to air pollution, while the sample size was determined by data saturation (Gentles et al., 2015). A total of 20 in-depth interviews and two focus group discussions were conducted with patients and healthcare professionals (e.g., doctors, nurses, dispensers) to explore their experiences and perceptions of air pollution and respiratory health issue. After passing the collected information from different phases, thematic analysis was performed to identify, analyze, and interpret patterns and themes in the data, with coding used to identify and refine themes, elaborate and derive study findings and conclusion (Braun and Clark, 2006). Informed consent was obtained from all participants, and thus confidentiality and anonymity of the participants were ensured. This study aimed to provide a deeper understanding of the impact of air pollution on respiratory health in Malakand Division, and to inform policies and interventions to reduce the adverse health effects of air pollution (Khan et al., 2020).

Data Analysis

This analysis examines the relationship between air pollution and respiratory health in Malakand Division, Khyber Pakhtunkhwa, Pakistan. Based on a qualitative research design and phenomenological approach, the study explores the experiences and perceptions of individuals with respiratory diseases in the region. Using purposive sampling to select participants who had experienced respiratory diseases and been exposed to air pollution, in-depth interviews and focus group discussions were conducted with patients and healthcare professionals to gather rich, contextual data. Thematic analysis was performed to identify, analyze, and interpret patterns and

themes in the data. Finally, the collected information has been analysed under different themes to uncover the broader aspects of the issues.

Theme 1: Air Pollution, Increased Hospital Admissions and Outpatient Visits

The analysis of interviews and FGDs revealed that admission of patients at hospital and their visits for respiratory diseases have increased significantly, particularly during periods of high air pollution. Participants attributed this increase to the deteriorating air quality in the region.

Sub-theme 1.1: Respiratory Problems

Participants reported experiencing respiratory problems i.e. asthma, respiratory tract infection, chronic obstructive pulmonary disease (COPD), and pneumonia, which they believed were triggered or exacerbated by air pollution. For example, a patient with asthma reported:

> "I have been suffering from asthma for years, and every time the air quality worsens, my symptoms get worse. I have to visit the hospital more frequently and use my inhaler more often." (Patient 1)

Sub-theme 1.2: Overburdened Healthcare System

Healthcare professionals reported that the increasing number of patients with respiratory diseases has put a significant burden on the healthcare system in Malakand Division. A doctor noted:

> "We see a lot of patients with respiratory problems, and it's getting harder to manage. The hospital is overcrowded, and we are doing our best to provide quality care, but it's challenging." (Doctor 1)

Sub-theme 1.3: Economic Burden on Patients

Participants also reported that the increased hospital admissions and outpatient visits for respiratory diseases have resulted in a significant economic burden on families. A patient reported:

> "I have to spend a lot of money on medication and hospital visits, which is affecting my family's financial situation. It's very difficult to manage." (Patient 2)

The analysis suggests that the increasing hospital admissions and outpatient visits for respiratory diseases in Malakand Division are a significant concern, and there is a need for policies and interventions to decrease the burden of air pollution on the healthcare system and the economy.
"I have seen a lot of patients with respiratory problems, and it's clear that air pollution is a major contributor." (Doctor 2)

> "The air quality is so bad that it's affecting our daily lives. We can't even go outside without wearing masks." (FGD participant)

> "The hospital is overcrowded, and we are doing our best to provide quality care, but it's challenging." (Nurse 1)

Observations Recorded

Participants reported that the air quality in Malakand Division is particularly poor during the winter months. Healthcare professionals reported that the number of patients with respiratory diseases increases significantly during periods of high air pollution. Participants suggested that the government needs to take action to minimize air pollution, its associated risks and protect public health. The analysis highlights the need for urgent action to address the issue of air pollution in Malakand Division and to reduce the burden of respiratory diseases on the healthcare system and the economy.

Theme 2: Lagged Effects of Air Pollution

The analysis of interviews and FGDs revealed that participants perceived a lagged effect of air pollution on respiratory health in Malakand Division. Many participants reported that the effects of air pollution on their health were not immediate but rather occurred after prolonged exposure.

Sub-theme 2.1: Delayed Response to Air Pollution

Participants reported that they often experienced respiratory symptoms such as coughing, wheezing, and shortness of breath several days after exposure to high levels of air pollution. A patient noted:

> "I don't always feel the effects of air pollution right away. Sometimes, it takes a few days for my symptoms to develop. By then, the air quality may have improved, but I'm still suffering the consequences." (Patient 3)

Sub-theme 2.2: Increased Susceptibility to Diseases

Healthcare professionals reported that patients with pre-existing respiratory conditions were more susceptible to the lagged effects of air pollution. A doctor noted:

> "Patients with asthma or COPD are more likely to experience delayed responses to air pollution. We see a spike in hospital admissions several days after a pollution peak." (Doctor 2)

Sub-theme 2.3: Difficulty in Identifying Triggers

Participants reported difficulty in identifying specific air pollutants that triggered their respiratory symptoms. A patient noted:

> "It's hard to pinpoint what's causing my symptoms. Sometimes, I think it's traffic pollution, but other times, it might be industrial pollution. By the time I figure it out, the damage is already done." (Patient 1)

The analysis suggests that the lagged effects of polluted air is a significant concern in Malakand Division and that prolonged exposure to air pollution can have serious health consequences. Participants' experiences highlight the need for awareness and education about the delayed effects of air pollution on respiratory health. Other participants recorded:

> "I've noticed that my symptoms worsen a few days after a pollution peak. It's like my body is reacting to the pollution, but delayed." (Patient 2)

> "We see a lot of patients who are sensitive to air pollution, and they often experience delayed responses. It's a challenge to manage their symptoms." (Nurse 1)

> "The lagged effects of air pollution are a concern. We need to educate people about the risks and take steps to reduce pollution." (Doctor 3)

Observations recorded

Participants reported that the lagged effects of air pollution were more pronounced during periods of high pollution. Healthcare professionals noted that the delayed responses to air pollution were often more severe in patients with pre-existing respiratory conditions. Participants suggested that awareness and education campaigns could help reduce the impact of air pollution on respiratory health.

Theme 3: Vulnerable Population and Exposure to Air Pollution

The analysis of interviews and FGDs revealed that certain populations in Malakand Division are at high risks to the adverse/negative effects of air pollution. Participants identified children, older adults, and individuals with pre-existing respiratory conditions as particularly susceptible.

Sub-theme 3.1: Air Pollution and Children's Health

Participants reported that children are more vulnerable to air pollution due to their developing lungs and higher respiratory rates. A mother noted:

> "My child gets sick easily when the air quality is poor. She has asthma, and it's hard to manage her symptoms when the pollution is bad." (Mother 1)

Sub-theme 3.2: Air Quality and Adults' Health

Older adults were also identified as a vulnerable population due to age-related decline in lung function and increased susceptibility to respiratory diseases. A healthcare professional noted:

> "Olde age people are more prone to respiratory problems, especially during periods of high air pollution. We see a lot of hospitalizations among this population." (Doctor 1)

Sub-theme 3.3: Pre-existing Respiratory Conditions

Participants with pre-existing respiratory conditions such as asthma and COPD reported that air pollution exacerbated their symptoms and reduced their quality of life. A patient noted:

> "I have COPD, and air pollution makes it hard for me to breathe. I have to stay indoors when the air quality is poor, which is frustrating." (Patient 4)

The analysis highlights the need for targeted interventions to protect vulnerable populations from the adverse effects of air pollution. Participants suggested that awareness campaigns, education, and access to healthcare services could help mitigate the impact of air pollution on these populations. In this regard, other participants recorded:

> "Children are more susceptible to air pollution because their lungs are still developing. We need to take extra precautions to protect them." (FGD participant)

> "Older adults are more vulnerable to respiratory problems, and air pollution makes it worse. We need to provide them with extra support." (Nurse 2)

> "Air pollution is a major concern for people with pre-existing respiratory conditions. We need to find ways to reduce our exposure and manage our symptoms." (Patient 3)

Observations Recorded

Participants reported that vulnerable populations often lack access to healthcare services and education on air pollution risks. Healthcare professionals noted that vulnerable populations are more likely to experience severe health effects from air pollution. Participants suggested that community-based initiatives could help raise awareness and promote actions to reduce air pollution exposure among vulnerable populations. The analysis emphasizes the importance of considering the needs of vulnerable populations in policies and interventions aimed at reducing the health impacts of air pollution in Malakand Division.

Conclusions

The study highlights the significant impact of air pollution on hospital admissions and outpatient visits in Malakand Division. The study concludes that air pollution is a major public health concern in the region and urgent action is needed to reduce the burden of respiratory diseases on the healthcare system. The study further reveals that air pollution has lagged effects on respiratory health in Malakand Division, with participants experiencing health impacts several days after exposure to pollutants. This highlights the need for awareness and education about the delayed effects of air pollution, as well as for policies and interventions that take into account the lagged effects of air pollution. The study identifies children, older adults, and individuals with pre-existing respiratory conditions as vulnerable populations to air pollution in Malakand Division. The findings suggest that these populations are disproportionately affected by air pollution and require targeted interventions to protect their health and well-being. The study highlights the significant levels of air pollutant concentrations in Malakand Division, particularly the particulate matter, nitrogen oxides, and other pollutants that poses significant health threats to the local population. The results also suggest that air pollution is a major public health concern in the region, and that urgent action is needed to reduce pollutant emissions and promote cleaner energy sources. The study extends a comprehensive understanding of the issue and highlight the impact of air pollution on respiratory health in Malakand Division and suggests urgent action to reduce air pollutant concentrations, promote cleaner energy sources, and protect vulnerable populations to contribute to healthy society. The study's results have important implications for policy and practice and can inform the development of effective strategies to mitigate the health impacts of air pollution in the region.

Recommendations

Based on the analysis and conclusions, it is recommended that:

Formulation and implementation of policies to reduce emissions from industrial and vehicular sources. It is further suggested to promote cleaner energy sources and increase energy efficiency to reduce the issue. Broad level awareness campaigns and civic education drives are required to mitigate the challenge of air pollution. The role of media is also important to highlight the issues and create awareness upon the health-related risks associated with air pollution. Finally, development of targeted interventions is required from government and other agencies to protect vulnerable populations, such as children and adults with pre-existing respiratory conditions from the impacts of air pollution.

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