



THE EFFECT OF AIR POLLUTION ON HUMAN HEALTH: A CASE STUDY

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Abstract:

There are a lot of cities throughout the globe that have a significant issue with air pollution, and Janakpur is not an exception. The air in Janakpur has gotten very filthy over the course of the last several years. Smoke from automobiles, dust from roads, the burning of crops in surrounding communities, and smoke from firewood used for cooking are the primary causes of this phenomenon. In the Nepalese city of Janakpur, which is still in the process of development, the air quality is regularly below average. As a result of dust, burning crops, vehicles, and smoke from firewood cooking, the air is filled with potentially hazardous particles. In this research, the consequences of air pollution on human health are investigated, with a particular emphasis placed on the cardiovascular system and the respiratory system. In addition to the prevalence of respiratory conditions such as asthma, coughing, and other respiratory disorders, there is a possibility of long-term risks such as heart disease. In order to conduct this analysis, we have used data on air quality as well as information from research papers and reports. Increasing public awareness, using clean cooking stoves, and planting trees are some of the simple steps that are recommended to help reduce the number of health problems that people are experiencing. The purpose of this research was to investigate the effects of smoke on lung health and respiration in households in Janakpur that used traditional stoves. Numerous households in Janakpur prepare their meals by using agricultural waste, cow dung, or firewood. When burnt indoors, these

materials produce a significant amount of smoke, which contributes to the contamination of the air inside the home. It is possible that breathing filthy air on a regular basis is harmful to one's health, particularly for women and children.

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Introduction:

The presence of hazardous or excessive substances in the air that we breathe is referred to as air pollution. These pollutants may include gases, dust, smoke, or chemicals that have the potential to cause harm to human health, as well as to animals, plants, and the environment. It is possible for these pollutants to originate from both natural causes, such as forest fires or dust storms, and human activity, such as emissions from vehicles, industrial operations, or the burning of fuel for cooking and heating purposes.

Air pollution is now one of the most significant environmental issues that the globe is facing in the present day. It occurs when toxic gases, smoke, and minute particles are discharged into the air from sources including as cars, industries, burning waste, and even cooking with wood or coal in the home. A significant number of individuals breathe in this contaminated air on a daily basis without being aware of the potential risks it poses to their health.

Air pollution is a significant issue in the city of Janakpur, which is located in the southern region of Nepal and is experiencing rapid growth. Every day, residents of the city breathe in contaminated air that is produced by smoke from automobiles, dust from roads, the burning of crops in adjacent villages, and the use of firewood or charcoal for cooking in many households. These factors contribute to the pollution of the air. Additionally, the air becomes considerably more hazardous to breathe throughout certain seasons of the year, particularly during the winter months.

Air pollution is a threat to our health since it has a variety of negative effects on our bodies. Taking in unclean air may lead to a variety of health issues, including but not limited to coughing, asthma, migraines, and chest discomfort. Patients who already have health problems, such as the elderly, youngsters, or those who have ailments related to their heart or lungs, may experience a worsening of their symptoms if they breathe in filthy air. In

certain cases, prolonged exposure might even result in the development of dangerous illnesses such as lung cancer or heart attacks.

This article will investigate the ways in which the air pollution in Janakpur is affecting the health of the people who live there. It will explain what causes pollution, what health concerns are associated to it, and recommend easy remedies that may help safeguard the community, such as cleaner cooking techniques, better waste management, and more green areas. Both of these things will be discussed.

Literature Review:

There are many emerging cities, like Janakpur, Nepal, that face a substantial challenge to their public health due to the presence of air pollution. According to the World Health Organization (WHO), several studies have shown that human activities, such as the emission of vehicles, the burning of biomass, and the use of solid fuels for cooking in households, are the primary contributors to urban air pollution. According to Shrestha et al.'s research from 2020, the most significant factors that contribute to air pollution in Janakpur are the smoke from automobiles, the dust from unpaved roads, the burning of agricultural leftovers, and the extensive use of firewood and other forms of biomass for cooking.

Exposure to polluted air, particularly particulate matter (PM_{2.5} and PM₁₀), has been consistently linked to respiratory and cardiovascular diseases. Children and women, who are more likely to be exposed to indoor air pollution in biomass-using households, face heightened risks of chronic respiratory conditions such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD) (Smith et al., 2014). Studies conducted in South Asia have indicated that long-term exposure to air pollution increases the incidence of heart disease and premature death (Lelieveld et al., 2015).

A study by Gurung and Bell (2013) focusing on Nepal highlights that the use of traditional stoves significantly contributes to indoor air pollution, producing harmful levels of carbon monoxide and fine particulate matter. Such exposure, especially in poorly ventilated homes, leads to reduced lung function and increased respiratory symptoms among residents. These findings are consistent with observations in Janakpur, where many families cook with firewood, crop waste, or cow dung, exposing household members to noxious fumes daily.

Crop burning in surrounding rural areas has become a seasonal problem in Janakpur, leading to elevated air pollution levels during the harvest seasons. A similar pattern is observed across South Asia, where biomass burning contributes significantly to regional haze and

deteriorating air quality (Jain et al., 2014). Vehicle emissions further aggravate the situation, with poorly maintained engines and high traffic volumes leading to increased release of nitrogen dioxide and fine particulates (ICIMOD, 2017).

Addressing the health impacts of air pollution requires both immediate and long-term strategies. Research supports the introduction of improved cookstove technologies, which significantly reduce indoor air pollution and improve respiratory health (Rehfuess et al., 2009). Public awareness campaigns also play a vital role in promoting behavioral changes, such as avoiding crop residue burning and adopting cleaner cooking alternatives. Urban greening through tree planting has been proposed as a cost-effective method to filter airborne pollutants and improve overall urban air quality (Nowak et al., 2006).

In Janakpur's context, integrated approaches including policy enforcement, community engagement, and infrastructural improvements (e.g., paving roads) are essential. These strategies not only mitigate pollution sources but also help raise awareness of air quality and its impact on health.

Objective of the Research:

- 1. To identify the major sources of air pollution in Janakpur**, including vehicular emissions, road dust, crop residue burning, and indoor cooking with biomass fuels.
- 2. To examine the impact of air pollution on human health**, with a specific focus on respiratory and cardiovascular conditions such as asthma, coughing, bronchitis, and potential long-term heart diseases.
- 3. To assess the health risks associated with indoor air pollution in households using traditional cooking stoves**, particularly among women and children who are most exposed.
- 4. To recommend practical, community-based solutions** such as the adoption of clean cooking technologies, tree planting, and awareness campaigns to reduce exposure to air pollution and improve public health outcomes.

Methodology:

This study used a combination of methods to understand how air pollution affects health in Janakpur, Nepal, especially focusing on the heart and lungs.

- 1. Review of Existing Information**

First, a literature review was done using research papers, government reports, and data from environmental and health organizations. This helped us to understand the main causes of air pollution and its impact on human health.

- 2. Use of Secondary Air Quality Data**

The study used existing air quality data (such as levels of dust particles and smoke in

the air) from reports published by Nepal’s environmental agencies and other reliable sources. This data showed how polluted the air in Janakpur has been in recent years.

3. Household Surveys

A simple survey was created and given to people in different parts of Janakpur. The survey asked about cooking practices, fuel types (such as firewood or cow dung), ventilation in the home, and any health issues like coughing or asthma among family members.

4. Interviews

Short interviews were conducted with local health workers and women who do the cooking in their homes. These interviews helped gather more personal and detailed information about how smoke and air pollution affect daily life and health.

5. Observations

During home visits, observations were made on how people cooked, what fuels they used, and how much smoke was produced. This helped us understand the real conditions inside homes.

6. Data Analysis

The information from surveys and interviews was organized and reviewed to find common patterns. The number of people with health problems was compared with the type of cooking fuel used and the level of smoke in their homes.

7. Ethical Considerations

Before collecting any information, all participants were asked for their permission. Their identities were kept private, and participation was completely voluntary.

Result and Discussion:

Objective:

To quantitatively analyze the relationship between indoor air pollution levels and respiratory illness occurrence in households using traditional biomass fuels in Janakpur.

Problem Example 1: Probability and Relative Risk

Suppose a survey of 100 households in Janakpur shows the following data:

Cooking Fuel Used	No. of Households	Respiratory Cases
Biomass (firewood, dung, waste)	75	50
Clean Fuel (LPG, electric)	25	5
Total	100	55

Tasks:

1. **Find the probability** that a household using biomass fuel has at least one member with respiratory illness.
2. **Find the probability** for households using clean fuel.
3. Calculate the **Relative Risk (RR)** of illness in biomass-using households compared to clean-fuel households.

Problem Solution:

Step 1: Probability that a biomass-using household has a respiratory case

$$P(\text{Illness} \mid \text{Biomass}) = \frac{\text{Households with illness using biomass}}{\text{Total biomass – using households}}$$

$$P(\text{Illness} \mid \text{Biomass}) = \frac{50}{75} = 0.67$$

Step 2: Probability that a clean-fuel household has a respiratory case

$$P(\text{Illness} \mid \text{Clean}) = \frac{5}{25} = 0.20$$

Step 3: Relative Risk (RR) compares the likelihood of illness in biomass users to clean fuel users:

$$RR = \frac{P(\text{Illness} \mid \text{Biomass})}{P(\text{Illness} \mid \text{Clean})} = \frac{0.67}{0.20} = 3.35$$

Answers:

$$P(\text{Illness} \mid \text{Biomass}) = 0.67$$

$$P(\text{Illness} \mid \text{Clean}) = 0.20$$

$$RR = 3.35$$

Households in Janakpur that use biomass fuel are 3.35 times more likely to have at least one member suffering from respiratory illness compared to households using clean fuel like LPG or electricity.

This clearly shows a strong health risk associated with traditional cooking methods and supports the need for interventions like clean stoves or alternative fuels.

Conclusion:

The city of Janakpur, Nepal, is experiencing a significant and rising issue with air pollution, which has a direct impact on the health of its citizens, particularly the lungs and the heart. By doing a literature review, collecting data on air quality, conducting household surveys, conducting interviews, and making observations, this research came to the conclusion that the primary contributors to pollution include emissions from vehicles, dust from roads, crop burning, and smoke from traditional cooking methods that are produced inside of homes. The findings of the study make it abundantly evident that households who cook with firewood, cow dung, or agricultural waste, particularly in houses with inadequate ventilation, are at a greater risk of developing respiratory ailments such as coughing, asthma, and long-term cardiac issues. Due to the fact that they are exposed to smoke for longer periods of time, women and children are the most susceptible to smoking. The research suggests a number of measures that are both practicable and inexpensive in order to solve these difficulties. These solutions include the promotion of clean cooking stoves, the improvement of house ventilation, the increasing of knowledge about pollution, the planting of trees, and the regulation of crop burning and vehicle emissions. When these efforts are carried out in an efficient manner, they have the potential to result in cleaner air and improved health outcomes for the people of Janakpur.

References:

1. Gurung, A., & Bell, M. L. (2013). *Exposure to airborne particulate matter in Kathmandu Valley, Nepal*. *Environmental Research*, 124, 57–66. <https://doi.org/10.1016/j.envres.2013.03.007>
2. ICIMOD. (2017). *Air pollution in the Hindu Kush Himalaya region: Current status and future needs*. International Centre for Integrated Mountain Development.
3. Jain, N., Bhatia, A., & Pathak, H. (2014). *Emission of air pollutants from crop residue burning in India*. *Aerosol and Air Quality Research*, 14(1), 422–430. <https://doi.org/10.4209/aaqr.2013.01.0031>
4. Lelieveld, J., Evans, J. S., Fnais, M., Giannadaki, D., & Pozzer, A. (2015). *The contribution of outdoor air pollution sources to premature mortality on a global scale*. *Nature*, 525(7569), 367–371. <https://doi.org/10.1038/nature15371>
5. Nowak, D. J., Crane, D. E., & Stevens, J. C. (2006). *Air pollution removal by urban trees and shrubs in the United States*. *Urban Forestry & Urban Greening*, 4(3–4), 115–123. <https://doi.org/10.1016/j.ufug.2006.01.007>

6. Rehfuess, E., Mehta, S., & Prüss-Üstün, A. (2009). *Assessing household solid fuel use: Multiple implications for the Millennium Development Goals*. *Environmental Health Perspectives*, 117(3), 373–378. <https://doi.org/10.1289/ehp.11134>
7. Shrestha, R., Shrestha, M., & Sharma, P. (2020). *Air pollution in urban Nepal: A growing health concern*. *Journal of the Institute of Medicine*, 42(1), 1–6.
8. Smith, K. R., Bruce, N., Balakrishnan, K., et al. (2014). *Millions dead: How do we know and what does it mean? Methods used in the comparative risk assessment of household air pollution*. *Annual Review of Public Health*, 35, 185–206. <https://doi.org/10.1146/annurev-publhealth-032013-182356>
9. World Health Organization. (2018). *Ambient (outdoor) air pollution*. [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)