EXPLORING THE PUBLIC HEALTH IMPACTS OF AIR POLLUTION ON RESPIRATORY HEALTH IN URBAN POPULATIONS

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ABSTRACT

Dental caries is a leading global child health problem among school-going children that has a significant impact on their health and quality of life in general. The paper explores the dental caries and oral hygiene practices among school children in Coimbatore, India. In this cross-sectional study, 500 children aged 6-12 years in urban and rural schools were used. A questionnaire and clinical dental examination were the instruments used to gather data. The researchers discovered that 38 percent of the children were experiencing dental caries, with a greater percentage reported to be among those children who brushed their teeth less often and were frequent consumers of sugary snacks. The researchers also determined that 42 percent of children had never been to a dentist, and 50 percent of them could not use a toothpaste with fluoride. The results indicate that more oral health education and dental care should be accessible, particularly in rural communities.

Keywords: *Dental Caries, Oral Hygiene Practices, School-Age Children, Tooth Decay, Preventive Dentistry, Oral Health Education, Pediatric Dentistry.*

INTRODUCTION

Industrialization, urbanization, and globalization have uplifted the economic growth of many developing countries, including India [10]. The fast rate of urbanization and industrialization has resulted in the emission of air pollution into the environment, causing serious health issues to most countries [. Air pollution is the occurrence of various toxic elements in the atmosphere at different concentrations, which are harmful to the environment as well as to human health. Human activities release a variety of pollutants into the air, leading to the issue. Air pollution can be divided into two broad categories: ambient air pollution and indoor air pollution, both with their own set of problems and health effects [7-8]. Natural atmospheric

air that is unpolluted by airborne contaminants is known as ambient air quality. Clean air is a balance of several gases, including oxygen and nitrogen, with trace amounts of carbon dioxide, argon, neon, helium, and other gases, according to the body of knowledge about the properties of air in the environment. The earth's atmosphere serves as a barrier that both nurtures life and shields it from other environmental contaminants. Troposphere, stratosphere, mesosphere, and thermosphere are the several classifications for the atmosphere. The lowest part of the atmosphere, known as the troposphere, is where life is found. It extends in altitude after the earth's exterior to around 11 km with an average temperature ranging from 15 degrees at a sea-level to 56 degrees at its upper boundary called the stratosphere. Human activities and natural phenomena release gaseous and particulate matter pollutants into the atmosphere.[2] Pollution in the form of liquid, gaseous, and solid has been present since the beginning of human habitation. Gaseous pollutants released into the environment can be carbon dioxide, nitric oxide, carbon monoxide, nitrogen dioxide, hydrogen sulfide, chlorine, benzene, toluene, and xylene. Air pollution is the main reason for the world's environmental and health problem, and air pollution is among the most critical environmental threats to human health [15, 13]. By lowering the levels of air pollution, nations can avert the burden of different diseases, such as lung cancer, heart disease, stroke, and respiratory conditions like asthma, both in acute and chronic stages [11].

The majority of global air pollution is caused by human activity [16]. Petroleum and petrochemical companies, refineries, mining companies, nuclear power plants, businesses, residences, and street cars are the most well-known sources of air pollution caused by humans [19-20]. Different toxicants are released into the air based on the fuel's origin and the ignition method. Petroleum-based fuel combustion emits a variety of air pollutants such as nitrogen oxides, sulfur dioxide, carbon monoxide, particulate matter, lead, and volatile organic compounds (VOCs), which are responsible for poor air quality and adverse environmental and health effects [3] [21]. Different pollutants are also incorporated into the atmosphere due to woodland consumption, synthetic substances, composts and pesticide, fabrics, and waste burning. These toxicants are called primary pollutants [17]. The primary pollutants are emitted directly from sources like petroleum derivative utilization, volcanic emission, and industrial facilities [18]. The significant primary pollutants are oxides of sulfur, oxides of nitrogen, oxides of carbon, particulate matter, methane, smelling salts, chlorofluorocarbons, harmful metals, and others. Secondary pollutants are created when the original pollutant combines with other elements in the atmosphere. Air quality in cities is measured in terms of concentrations of certain pollutants, such as Ozone (O_3), Particulate Matter (PM_{10}, $PM_{2.5}$), Sulfur Oxides (SO_x), Nitrogen Oxides (NO_x), Carbon Monoxide (CO), and Volatile Organic Compounds (VOCs). Interestingly, ground-level ozone, a toxic pollutant to humans, is not directly emitted into the atmosphere [12]. Rather, it is created when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) combine in a chemical reaction when they are exposed to sunlight. To put it another way, ozone is produced when sunlight combines with pollutants released by power plants, automobiles, and material burning. Smog is created by ozone, which makes breathing harder. Colorless gases called sulfur oxides are present in the lower atmosphere. These gases can be identified by taste and smell, depending on their concentration. [4] Burning sulfur-containing fossil fuels is the primary source of these pollutants. Thermal power plants, especially those fueled by high-sulfur coal, are the leading anthropogenic sources of sulfur dioxide emissions globally. Local ambient concentrations of sulfur dioxide can also be substantially high due to vehicle and residential coal combustion emissions, which contribute to air pollution in nearby areas. Additionally, sulfur oxides and precipitation combine to form sulfuric acid, or acid rain [9].

Objectives

- To determine the respiratory tract infection by air pollution in urban populations [14].
- To identify the public health impacts due to air pollution

Research question

- What are the respiratory infections most commonly occurred by air pollution in urban populations?

Literature review

Due to the continuous population growth, increasing electricity demand is the most fundamental need in everyone's life in this dynamic world. Since the Industrial Revolution, from the global and Indian perspective, fossil fuel (Coal) is one of the leading energy sources for power generation.[5] Globally, it contributes to 35-45% of electricity generation. Coal-based pollution is considered one of the most significant threats to the environment, especially in developing nations like India. Respiratory tract infections (RTIs) involve both upper and lower respiratory tract infections, and consist of a variety of clinical syndromes including rhinitis, bronchitis, common cold, laryngitis, pneumonia, pharyngitis, tracheitis, and tracheobronchitis. Upper respiratory tract infections (URTIs) present with symptoms such as sore throat, fever, rhinorrhoea, cough, and nasal congestion for 7-15 days. URTIs are usually caused by viruses, then bacteria and fungi. Some of the most common respiratory tract infections are acute respiratory distress syndrome (ARDS), chronic obstructive pulmonary disease (COPD), pneumonia, and tuberculosis. ARDS is an extremely inflammatory lung damage with bilateral alveolar opacities, reduced lung compliance, and hypoxemic respiratory failure. COPD, the fourth deadliest disease, affects the lung parenchyma and airways, predominantly by long-term cigarette smoke inhalation (CS) due to either active or passive smoking.. Systemic inflammatory response contributes for the mortality and morbidity due to chronic inflammatory response in the parenchyma. COPD exacerbations may be due to infectious origin; increased incidence may be due to air pollution, smoking or ageing.

As per recommendations, all major COPD patients are indicated for seasonal influenza vaccination. Extrapulmonary conditions include neurological, cardiovascular, and musculoskeletal comorbidities are linked to higher rates of morbidity and mortality. 33 Anxiety and sadness may be linked to COPD patients, which could negatively impact their quality of life and survival rate. Air pollution imposes social cost, which is an additional cost of pollution prevention and mitigation. Apart from the polluter, the society undertakes measures to mitigate the negative impact of air pollution individually and collectively. However, inspite of collective action, society has to incur social and private costs to reduce the impact of air pollution. Therefore, the social cost borne by the individual households and the society have to be estimated. Hence, it is necessary to evolve a detailed framework for analyzing the negative externality caused by urban air pollution in terms of health effects [1].

Methodology

Monitoring, measuring, and controlling both systematic and random errors are the goals of quality assurance and control. Accuracy, precision, and contamination were the quality control characteristics taken into consideration. To determine the accuracy and precision of each batch of analysis, clean triplicate filters were used and determined the PM concentrations. Air samples were taken over a period of 8 hours with a Portable Laser Aerosol Spectrometer, Dust Monitor Model 1.108/1.109, and a polytetrafluoroethylene (PTFE) filter. Three filters were taken at each sampling point, spanning a 24-hour period. The data was taken at one-minute intervals. The mean concentrations of PM10, PM2.5, and PM1 were determined for each site. The flow was calibrated at the beginning of sampling and field blank was also carried to check for any cross contamination at each location of the study area.

Sample size: To determine the sample size for the proposed study with respiratory disorder (URI, Asthma, Bronchitis) as outcome, a nation wise pooled prevalence of these disorders was 2.05% considered, as published in ICMR study.

Study design: By contrasting patients with the condition (cases) with those without the condition (controls/normal), the design is frequently used to identify the factors that contribute to the medical

condition. By comparing the case and control participants in terms of how frequently the factor or trait is present in each group, the link between risk factors is investigated.

Inclusion and exclusion criteria: The male and female patients aged between 18 to 70 years and diagnosed with asthma or chronic upper respiratory infections with repeated episodes despite medication were considered in the study. Pregnant women, patients with a history of IHD were excluded from the study. Age and gender-matched individuals asymptomatic for respiratory illness were included in the study as controls. In this group also, patients with a history of IHD were excluded from the study.
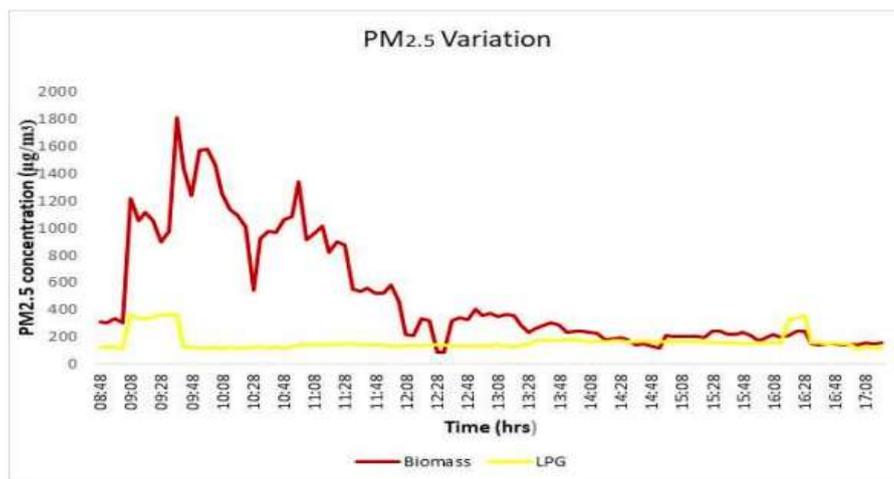

Figure 1: PM variation

Experimental analysis

The impact of environmental changes on human health can be analyzed by adopting two types of strategies. The first strategy is to understand individual behaviour and choice in which environmental quality is one of the important variables. The second strategy is to deal with the environmental changes and its health impact separately.
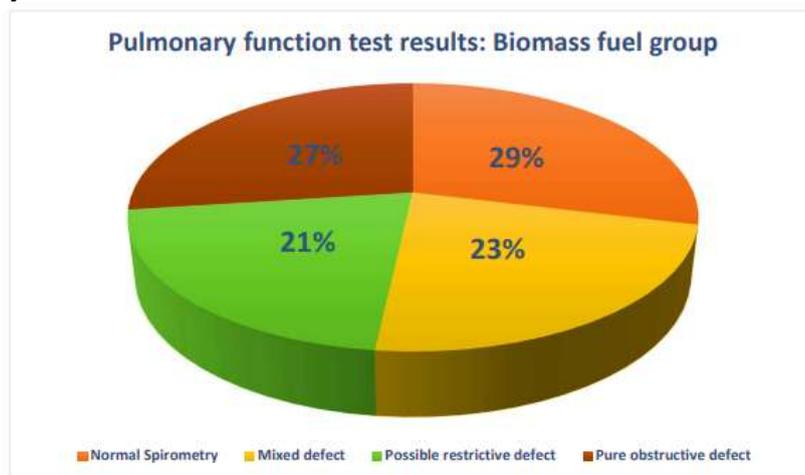

Figure 2: Pulmonary Function test results of study participants in Biomass fuel group

First, the generated forecasts of health change are mixed independently with the economic value of health status changes. Exposure to air pollution throughout early childhood and later in life may raise the risk of developing respiratory conditions, especially asthma.
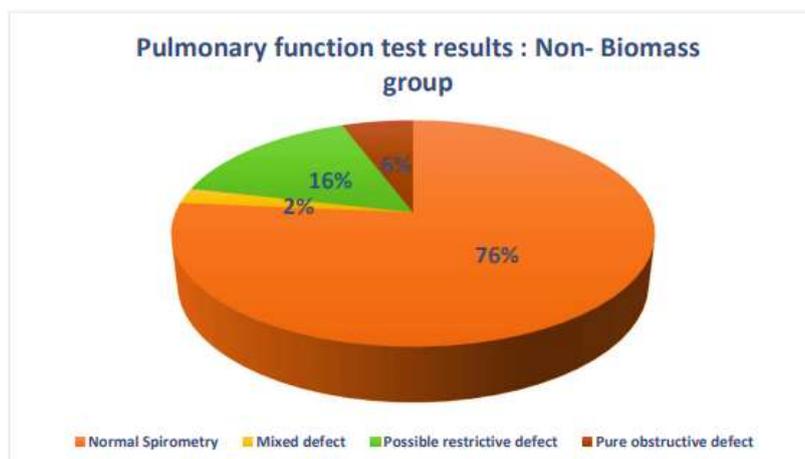

Figure 3: Pulmonary Function test results of study participants in non-biomass fuel group

The major cause of urban air pollution is the extensive use of private cars, especially older diesel vehicles. In addition, solid fuels are used to provide energy for cooking and heating by about half of the world population and are a major cause of air pollution [7].
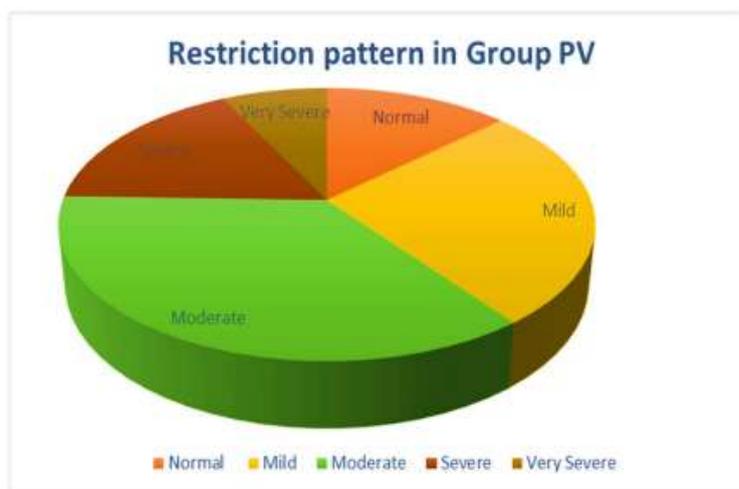

Figure 4: Distribution of Retrictive pattern in group PV (poorly ventilated)

In order to reduce the prevalence of respiratory morbidities in urban and rural villages, the results of the current study could be used to strengthen current policies and implement management strategies pertaining to the switch to cleaner alternative energy sources for cooking and the reduction of air pollution load in these areas. The work's main significance is related to how carbonaceous aerosols and dangerous gasses

from biomass smoke might affect women's lung function by irritating the mucous glands and constricting the smooth muscles of the airways, which causes wheezing and excessive sputum production.

Figure 5: Distribution of Retrictive pattern in group AV (adequately ventilated)

These fuels, which include coal, wood, and charcoal, are burned in inefficient stoves that emit a lot of pollutants that cause climate change and health problems into the surrounding air. Industrialization is also a major source of air pollution in cities, especially in industrial complexes where air quality is famously bad. Industries contribute majorly to emitting dangerous gases as they consume fossil fuels and use chemicals in manufacturing processes. The gases then combine with other atmospheric conditions and react with one another, worsening air pollution and the related health hazards.

Conclusion

To face the challenge of urban air pollution, quantification of its impacts on health is necessary in terms of economics. Economic valuation has a key function in the construction of useful instruments to internalize the external costs of air pollution, ultimately as a guide towards policies that abate its noxious effects. When implemented at the best possible social level, fiscal tools like the establishment of carbon markets or fee systems can effectively encourage lasting results. Global warming and general climate change will be exacerbated by the rise of urban ambient air pollutants such as CO, O3, and air toxicants, which are also greenhouse gases Urban ambient air quality is considered the environmental variable in the health production function to quantify the economic impact of increasing urban air pollution on human health. There is growing evidence that urban air pollution contributes to the environmental burden of disease (EBD). In terms of additional social costs to society, such as direct treatment costs and efficiency losses in the form of a large number of sick days and decreased labor productivity, the EBD places a financial burden or welfare loss on society. Air pollution can create a serious and dangerous hazard for the living environment which affects the natural ecosystem, agriculture, human health and also change the regional and global climate. The rapid expansion of urbanization and industry in urban or semi-urban regions is causing air pollution to progressively become the biggest environmental issue in the globe.

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