



Managing Impacts of Air Pollution on Public Health in Australia

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Abstract. The Australian Environment Protection Agency identifies air pollution as a cause and contributor to respiratory and cardiovascular diseases. The World Health Organisation highlights the need for a public health approach in continued research, education, and policy programs to mitigate the health impacts of health pollution. This study aims to analyze evidence from previous literature on the health impacts of air pollution and propose mitigation programs. It also explores the risk factors posed by air pollutants to climate change, and the potential impacts beyond physical medical conditions. The effects of air pollution on public health are increased mortality and morbidity, which in turn burden the health system and cause substantial monetary consequences. The lack of effective policies to address air pollution also increases pollutant emissions and jeopardizes public health. The Australian government has developed several mitigation measures to address air pollution-related health risks. These measures include compliance with regulations aimed at improving air quality and incentives to encourage efficient and sustainable energy innovations. Public health workers should create awareness of health risks associated with climate change and should communicate with stakeholders about human-induced emissions that pose health risks. EPA works to protect human health and the environment by developing mitigation measures, funding environmental projects, and informing people about environmental issues. Mitigation measures can help governments reduce the impacts associated with air pollution and also reduce the negative consequences of air pollution on people's health.

Keywords: air pollution · public health

1 Introduction

1.1 Background

The Australian Environmental Protection Agency has identified air pollution as a cause of respiratory and cardiovascular disease. According to data from the World Health Organisation (WHO), one out of every nine deaths is directly or indirectly attributed to the health impacts of air pollutants. Global consensus on the health risks posed by various pollutants ranging from Greenhouse gas (GHG) emissions to deposits of harmful substances such as lead and mercury requires management through well-defined health

policies and statutory provisions. The range of emissions sources from households, industries, to physical activities highlights the need for a public health approach in continued research, education, and policy programs to mitigate the health impacts of health pollution.

From a public health perspective, the management of the health problems caused by air pollutants should be centered on understanding the sources of the pollutants [1]. Medical studies should be conducted to identify specific pollutants as the cause or contributor of certain diseases so that pollution factors can be linked to direct and indirect health effects.

The Committee, in their inquiry report, also highlighted the need for a stakeholder approach in identifying and analyzing the health impacts of air pollution to promote a collaborative, communal effort toward mitigation programs [1]. Recent research on the health impacts of air pollution related to contemporary issues focuses on vulnerable groups. The study by the United States Environment Protection Agency (EPA) highlights that the health effects of air pollution as a priority public health concern were influenced by socioeconomic disparities and vulnerable groups [14]. The causes and effects of climate change on air quality are another area of concern, particularly the reduction of the ozone layer will cause harmful airborne particles to remain in the atmosphere for longer periods of time [6]. The evolving impact of air pollutants on public health influenced by changing environmental conditions, human activities, and physical conditions warrant continued research in this area, the monitoring of air standards, and communal implementation of mitigation programs.

1.2 Research Objective

Air quality is a component of particulate matter (PM) composition and gas concentration that has an impact on public health. The composition of PM as influenced by harmful chemicals and gaseous concentration is medically proven to have adverse health effects [1]. Air pollutants originating from household activities, industrial operations, and natural phenomena pose health impacts through respiration in the lungs and airways. Harmful components of PM, such as Sulphur, lead, mercury, and carbon, among others, are regarded as causative or contributing agents to respiratory, cardiovascular, and cancerous ailments [5]. Changes in air concentrations particularly increase in the composition of hazardous air pollutants, are associated with increased hospitalizations and mortality from respiratory and cardiovascular diseases.

This study aims to analyze evidence from previous literature on the health impacts of air pollution and apply public health concepts to propose solutions and mitigation programs. Other areas addressed in this study include research on the varied health impacts of air pollution as influenced by socioeconomic disparities, geographical locations, and vulnerable groups to inform multi-policy mitigation measures depending on the target group and other risk factors. This study builds on the public health concepts of community awareness to identify the sources of harmful air pollutants and establish a link between the components of the pollutants and medical conditions. Contemporary areas explored in the study include the risk factors air pollutants pose to climate change and the potential impacts beyond physical medical conditions. Poor air quality contributes to

other social determinants of health such as diet and stress levels, and these are potential predisposing or aggravating risk factors for chronic diseases.

2 Sources of Air Pollutants

A report by the Australian Community Affairs Committee in 2013 notes that despite a significant improvement in the air quality that there is a reduction in carbon dioxide, ammonia, and other harmful concentrations, air pollution is still a significant health risk in the country [1]. As defined by Commonwealth research, sources of air pollution are not limited to anthropogenic and chemical processes influencing the composition of inhaled or physically exposed particulate matter. Respirable particulate matter (PM), which consists of chemicals and gases, is influenced by household activities, industrial processes, and emissions from natural phenomena. The Australian report identifies emissions from automobiles, burning fuel, industrial chemical processes and mining activities as the leading sources of air pollutants. Emissions from automobiles, burning fuel, industrial chemical processes and mining activities as the leading sources of air pollutants.

3 Health Impacts of Air Pollutants

The health impacts of air pollutants are related to PM concentration, which is affected by geographic location, natural phenomena, and the duration of people's exposure to them. Other risk factors include predisposing conditions among vulnerable groups and socioeconomic disparities [6]. Low-income households are at higher risk of air pollutant-related health effects due to their location near industrial areas or lack of access to health services. Evidence from epidemiological studies shows that the prevalence of air pollution-related diseases is higher among urban residents, especially those living near industrial areas and those working in chemical processing and mining industries [5].

Surgical research also provides evidence of the correlation between the size of PM components and respiratory conditions such as difficulties in breathing, pulmonary disease, and clogging of airwaves. PM inhaled resides in a particular section of the respiratory system, especially smaller particles posing more significant risks of penetrating deep into sensitive organs such as the lungs and heart. A medical correlation has also been established between the sizes of PM and the severity of the resulting condition. PM penetrating the heart is linked to cardiovascular diseases, high mortality and low life expectancy rates [1]. The Senate Committee cited medical evidence referring to emissions from burning fuel such as wood as more detrimental to health than cigarette smoke in the report.

4 Vulnerable Groups

A report by the USA EPA identifies that health risks posed by air pollutants affect different populations variedly [6]. The report's findings are consistent with the classification of vulnerable groups such as pregnant women, children, the elderly and people with pre-existing medical conditions in the Australian Senate Commission on Community

Affairs report [1]. Geographic location is also considered a risk factor influenced by PM concentrations. Regional variations in air quality are caused by the scale of human activity, industrial processes and physical phenomena. People inhabiting industrial locations are at a greater risk of air pollutant-related medical conditions. Emphasis on compliance with workplace safety standards, particularly inhalation of hazardous substances and consumer safety standards relating to product screening for harmful substances is a mitigation strategy.

Sources for this study challenge the generalization of air pollutant-related health effects as an urban challenge [2]. Evidence from the study points out that the floating ability of PM concentration with the capacity to travel over miles can impact air quality in rural areas [2]. Individual-specific factors such as indoor air quality have also been identified to pose air pollution health-related risks similar to regional and general factors such as dust, fumes, gas, mist, and smoke [18]. Inefficient energy sources, particularly fuel combustion using wood stoves, expose households to greater air pollution health risks [20]. Specific evidence on regional topography and proximity to industrial locations identified the areas of Mt Isa and Port Pirie as subject to greater health risks associated with air pollutants due to topography and conventional waves, respectively [20]. On the other hand, epidemiological studies provide evidence that weakened immunity due to preexisting lung and heart disease predisposes to medical conditions related to air pollution [10]. Evidence also exists on the correlation between exposure to air pollutants and stillbirths among pregnant women.

5 Climate Change Effects

The evolving nature of climate change poses risks and opportunities for air pollution-related health impacts. Unfavorable climatic conditions such as high temperatures, rising sea levels, and unpredictable conditions for drought and increased bushfire rates impact PM concentration. Other direct climate effects on air pollution include depletion of the ozone layer and trapping harmful PM in the atmosphere for more extended periods. The Australian EPA states that increased hot and drier conditions are risk factors attributed to rising cases of bushfires and dust storms influencing the concentration of PM [8]. Though the Australian Senate inquiry report does not classify climate change as an immediate risk factor for the increased harmful health effects of air pollution, sensitisation programs in this area are critical.

Climate change-related opportunities include incentives for initiatives aimed at reducing air pollution. Programs that promote the use of efficient and sustainable energy sources should be encouraged in a bid to reduce GHG emissions. The Australian government should explore alternative fuel-burning energy sources such as hydro, solar, and wind power to reduce harmful PM concentrations. Consistent with the Senate inquiry report identifying burning fuel as the leading source of air pollutants, community sensitisation programs that adopt sustainable and efficient energy sources will reduce the concentration of harmful particulate matter. Other factors identified by the state agency that is likely to escalate air pollution health-related impacts in Australia include a growing aging population, migration trends, and demand for energy. Declining lung and cardiovascular immunity associated with aging increase air pollution-related health risks for

older adults. Increasing energy demand from a growing urban population could reverse gains in sustainable and efficient energy [5].

6 Interaction of Air Pollution Health Effects on Social Determinants

The health effects of air pollution interact with social determinants. Social determinants that exhibit the effects of air pollution include public health burdens, adverse birth outcomes, effects on neurological function, mental stress, and malnutrition.

7 Public Health Burden

The effects of air pollution burden the health system through increased mortality and morbidity [11]. The increase in mortality and morbidity comes from cardiovascular and respiratory diseases, with different effects on infants, the elderly and pregnant women. The American Journal of Medicine (2015) states that the global burden of disease caused by air pollution has increased since 2012, thus becoming a concern for the community.

The rise in air pollution results in an increase in the rate of people affected by its health effects. Therefore, the government has to spend more to cater the victims of air pollution. This, in turn, increases the number of people seeking health care in public facilities, as exhibited in California bay [4].

7.1 Adverse Birth Outcomes

Air pollution leads to adverse birth outcomes such as low birth weight, pre-term births, and reduced gestational age that affect the growth and development of infants [7]. The adverse birth outcome results from maternal exposure to harmful pollutants, affecting their health and having pregnancies at an early age. It is a major concern resulting in increased neonatal mortality and morbidity [7].

Gray et al. (2014) research revealed that the population exhibiting adverse birth outcomes were the minorities and economically disadvantaged people. The economically disadvantaged people include low incomes and low levels of education. These people who tend to settle in areas where the air quality is not standard. Most of these areas are where industries operate, increasing air pollution [7]. As evidenced by [7], most pregnant women facing adverse birth outcomes were from neighborhoods with low levels of education status and income, hence were not able to know the impacts of air pollution [15].

An adverse birth outcome, pre-term birth is caused by prenatal exposure to air pollution during the gestation period [13]. The air pollutants are traffic density, organic pollutants, pesticides, and air toxins [13]. Pre-term births exhibit disparities, i.e., populations with low socioeconomic status (SES) are affected [13]. Minorities such as Asians, Hispanics, and Black Americans experience a high level of air pollution, making them most vulnerable [13].

7.2 Mental Stress and Negative Behavioral Outcomes

Exposure to air pollution can lead to mental disorders and negative behavioral outcomes in affected populations [21]. To be specific, air pollutants, directly and indirectly, affect the central nervous system (CNS) [20]. CNS effects are exhibited with experienced bipolar disorders, depression, and autism cases [20]. Hence, autism spectrum disorder results from exposure to air pollution during development which alters brain development with subsequent alteration to social behaviours of the adults [20].

The air pollutants with adverse effects on brain development include sulfur dioxide, nitrogen dioxide, particulate matter, carbon monoxide, and lead [20]. These pollutants get deposited into human lungs and circulate into the body, creating the blood-brain barrier. Hence, this results in an inadequate supply of blood into the nervous system [20]. The circulating blood containing contaminants further leads to its direct exposure to the central nervous system causing neurotoxicity in the affected population [15, 20]. It results in neuroinflammation and affects brain development.

7.3 Malnutrition

Air pollution affects the ozone layer and leads to global warming. Hence, this results in acid rain, which affects the quality of agriculture. Acid rain deprives plants of the required nutrients, producing low-quality nutrients. Consumption of some of these yield cause diseases associated with air pollutants, leading to malnourished children and adults, which increases the rate of mortality in affected regions.

7.4 Mitigation Measures

The public health concept refers to building knowledge on a topical medical issue, assessing preventative measures, and enhancing community sensitization [17]. Mitigation measures adopted by the Australian government to address air pollution-related health impacts should be consistent with public health approaches. The approach developed and implemented by stakeholders takes into account the views of affected parties and addresses any trade-offs that may arise from the proposed mitigation measures [12]. Focus areas for the government should include compliance with regulations designed to improve air quality and incentives to encourage efficient and sustainable energy innovation. Even though compliance requirements are an integral part of policy programs implemented for industrial stakeholders, industries may shut down if such policies are punitive and costly. Addressing one health issue may lead to another health issue without considering the dual effects of mitigation programs. Stakeholder engagement informs a key component of public health, which is to seek consensus with affected parties and to consolidate efforts toward compliance.

In collaboration with global partners, medical research institutes, and community health workers, among other stakeholders, the Australian government has developed several mitigation measures for air pollution health risks.

7.5 Ambient Air Standards

Epidemiological research provides the basis for linking components of PM to medic conditions. Such research also tells the size, concentration and exposure to PM that pose a health risk as a medical basis for setting ambient air standards. The Australian National Environmental Protection Management (NEPM) agency should conduct regular monitoring and compliance checks on the ambient air standards.

7.6 Sensitisation

Building awareness of health risks is the primary function of public health workers. Prevention measures can only be undertaken where the target population is aware of risk factors. Anthropogenic activities influence increased climate-related risks, moreover, human-induced emissions pose health risks. Such effects should be discussed with stakeholders. An array of forums is available for the government to convey relevant information on the sources of emissions and related health impacts.

7.7 Advocating for Public and Active Transport

Fume emission from vehicles significantly results in air pollution [16]. The government should encourage the use of public and active transportation methods to reduce private motor use. Therefore, implementing policies that promote the use of public means to travel and active transport would change the travel behaviors of the population [16]. Governments should encourage active transportation such as cycling and walking for people commuting short distances, trains, and buses for people commuting long distances. Through this strategy, the government will reduce the number of vehicles on the roads hence reducing the rate of fume emission that is harmful to the population.

7.8 Reduction of Use of Solid Fuel Among Households

The household sector is attributed to air pollution through solid fuels in heating systems such as wood and coal [16]. The government should ensure that the use of solid fuels in households is reduced by improving combustion efficiency [16]. The low combustion efficiency caused by the use of solid fuels leads to air pollutants that have health consequences for the affected population. The combustion efficiency can be improved by using biogas, a renewable energy source that is beneficial to human health. To ensure the efficient use of renewable energy sources, the government should implement strict regulations for energy suppliers and household users [16].

A healthy diet is essential to mitigate the effects of air pollution. Residents should be taught the importance of healthy diets that keep stable health status [16]. For instance, the consumption of food rich in antioxidants hinders air pollutant-related health effects. This is due to the neutralizing substances found in antioxidants that reduce the impact of air pollutants on human health through their free radicals [16]. A healthy diet in this context contains the consumption of greens and fruits while limiting the use of animal products. Also, air purifiers are necessary to be placed at home, it can remove dust, pollutants and particle exposure in the air and protect one's physical and mental health and improve air quality [19].

8 Adoption of Sustainable Technologies

Industries as air pollution contributors through the use of fossil fuels require initiatives in support of shifting to renewable fossils [16]. To reduce the negative impact of air pollution, initiatives encourage industries to use renewable energy sources. These initiative programs should find solutions in technological use, such as clean coal technologies (CCT) [16]. CCT technologies are essential in treating and using coal efficiently through quality management and measures of GHG reduction.

9 Conclusion

Air pollution is an environmental issue that negatively affects people's health. The sources of air pollution include anthropogenic processes, chemical processes, and natural phenomena. These activities affect the health of the exposed population, resulting in diseases such as respiratory and cardiovascular diseases. It also results in poverty, mental issues, and malnutrition. Hence, the mitigation measures mentioned above would effectively help the government reduce the effect of air pollutants on the population.

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