



AN OVERVIEW OF THE MOST PREVALENT POLLUTANTS FOUND INDOORS

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ABSTRACT

Considering the growing amount of time people spend in enclosed places, indoor air pollution has become a serious health and environmental issue. This review article offers a thorough examination of pollution in the indoor environment, addressing a number of issues including its identification, origins, effects on health, adverse effects on vulnerable groups, methods of assessment, and mitigation tactics. Household goods, building materials, and external contaminants that seep into inside environments are only a few of the many sources of indoor pollutants. Long-term exposure to these contaminants has been associated with a number of health problems, such as allergies, cardiovascular disease, and respiratory diseases. Children, the elderly, pregnant women, and people with pre-existing medical issues are some of the population groups that are most susceptible to the negative effects of indoor pollution. The evaluation assesses several methodologies and technologies. In order to improve indoor air quality and protect public health, it also highlights the importance of putting into practice efficient mitigation techniques, such as adequate circulation, purifying the air, and environmentally friendly construction materials. This review study calls for more awareness and group action to create better indoor environments for overall well-being by illuminating the complex aspects of indoor air pollution.

KEY WORDS – Indoor, Pollution, Contamination, Volatile Organic Compound (VOC).

INTRODUCTION

When dangerous compounds and pollutants are present in enclosed areas, it is referred to as indoor air pollution. These pollutants can have a negative impact on both individuals as well as the natural world. The causes of pollutants in homes are numerous and include everything from everyday items, construction materials, and activities that are to outside contaminants that seep into indoor areas. The impacts of outdoor air quality on human health and environmental pollution have received a lot of attention over the past few years. But a significant percentage of our lives are spent indoors, whether at home, at work, in school, or in other places that are indoors. As a result, interior pollution becomes a major issue and indoor air quality becomes an essential aspect of our total health (Arungu, 1984), (Tran & Lee 2020). The World Health Organization (WHO) estimates that 3.8 million people die each year as a result of indoor air pollution (WHO, 2020).

MITIGATION

Mitigation of indoor air pollution involves taking specific actions and implementing measures to reduce or eliminate the presence of harmful pollutants indoors. Ensure that windows and doors can be opened regularly to

let fresh air in, and consider using mechanical ventilation systems, such as exhaust fans and air purifiers, to enhance indoor air circulation. Some air purifiers are also equipped with activated carbon filters, which can help trap gases and odors from sources like cooking and tobacco smoke. Avoid smoking indoors, and designate smoking areas outside the house. Use low-emission building materials and choose household products with fewer volatile organic compounds (Kumar,2023) , (Sofia et al 2022).

SOURCES OF INDOOR AIR POLLUTION

COMBUSTION OF FUELS AS INDOOR AIR POLLUTION

One of the major contributors to indoor air pollution is the indoor burning of fuels. When fuels like wood, coal, gas or kerosene are used indoors for lighting, heating or cooking, a number of hazardous contaminants are released into the air. Among the typical contaminants created by indoor combustion are fuels that don't burn all the way through release a gas called carbon monoxide (CO), which is tasteless and colorless. Because carbon monoxide interferes with the body's ability to transport oxygen, high concentrations of the gas can be exceedingly harmful and even fatal. Nitrogen Dioxide (NO₂) is created during combustion when nitrogen in the air combines with oxygen. Asthma and other respiratory disorders like irritation from nitric oxide can get worse. When fuels are burned indoors, small particles are released into the air that can be breathed all the way into the lungs, leading to respiratory and cardiovascular disorders. Volatile Organic Compounds (VOCs) are a byproduct of incomplete fuel combustion that can irritate the eyes, nose, and throat as well as help to create ground-level ozone. Formaldehyde is a VOC that can be released during the burning of some fuels and is known to irritate the respiratory tract and have other negative health effects (Tran & Lee 2020).

TABACCO SMOKE AS INDOOR AIR POLLUTION

One of the main causes of indoor air pollution is tobacco smoke. Indoor smoking of tobacco products like tobacco products, cigars, or pipes causes a complex brew of hazardous chemicals to be released into the air. Secondhand smoke or ambient tobacco smoke (ETS) are terms used to describe this tobacco smoke-related indoor air pollution.

Apparently the hazardous substances found in tobacco smoke consist are the addictive component of tobacco known as nicotine that can cause dependency and addiction. A sticky, dark substance which may film surfaces and has been linked to respiratory and lung problems. Toxic gas carbon monoxide (CO) lowers the blood's capacity for transporting oxygen and can cause cardiovascular issues. Volatile Organic Compounds (VOCs) are harmful substances can irritate the respiratory system and contribute to indoor air pollution. Particulate Matter (PM) are tiny airborne particles that can enter the respiratory tract and cause a number of health issues. A damaging gas that may trigger irritation in the respiratory system is ammonia. A hazardous gas that can prevent the body from properly using oxygen is hydrogen cyanide. (Repace et al , 1980) , (Nazaroff & Singer , 2004).

POOR VENTILATION AS INDOOR AIR POLLUTION

The process of ventilation involves replacing stale indoor air with clean outdoor air to maintain a high standard of indoor air quality in a structure or other enclosed area. Indoor pollutants can build up if ventilation is insufficient or nonexistent, resulting in a reduction in air quality and possible health hazards for residents. Poor ventilation is caused by a number of elements, which can change based on the usage, construction, and design of the building. Poor ventilation can cause indoor air pollution in a number of ways, such as Poor ventilation causes the air to get stagnant, which makes it possible for contaminants to build up and persist without being properly dispersed. Activities like cleaning, smoking, cooking, and using specific materials and products can all cause airborne contamination. These contaminants can build up to dangerous levels if there is not enough ventilation. Insufficient ventilation can cause interior humidity levels to rise. Inadequate moisture can encourage the growth of mould and mildew, which releases spores along with additional allergens into the atmosphere. Carbon dioxide (CO₂) accumulation is a result of human actions including breathing. Poor ventilation can cause CO₂ levels to rise, causing stuffiness and discomfort as well as possible effects on cognition and general well-being. Poor ventilation can result in increased amounts of this radioactive gas, which is known to be carcinogenic, in places where radon is a naturally occurring gas. Household items like furniture and building supplies have the potential

to release dangerous substances like volatile organic compounds (VOCs) and are the pollutants might linger in the interior air due to insufficient ventilation. Pollutant concentrations in indoor air are often higher than those in outdoor air due to inadequate pollutant dilution. By blending interior and outside air, proper ventilation reduces the concentration of contaminants in the air. (Kumar et al , 1730).

BUILDING MATERIALS AND FURNISHINGS AS INDOOR AIR POLLUTION

Due to the emission of volatile organic compounds, or VOCs, and other potentially dangerous elements, building materials and furniture can be important sources of pollution to the indoor environment. VOCs are organic chemicals that easily evaporate into the air at room temperature, causing these chemicals to off-gas from a variety of items and materials used in building and interior design. VOCs can lead to poor indoor air quality and may result in a number of health problems when they are present in the air indoors at high concentrations.

Paints and varnishes: VOCs are commonly employed as solvents in paints and varnishes that are applied to walls, ceilings, and furniture. Depending on the type of paint used, these VOCs are released into the air both during and after application, which means that off-gassing can last for weeks to months. VOCs are frequently present in the glues, adhesives, and sealants used in building, flooring, and furniture assembly. VOCs may be released into the interior air when these goods are used or applied. Some flooring options, including carpet, vinyl, and laminates, might produce VOCs and other pollutants. Padding and carpet glue may potentially contaminate indoor air. Textiles used for upholstery, curtains, and furniture can contain VOCs along with additional chemicals that could release fumes into the home's air. If improperly installed or vented, certain types of insulation substances, such as fiberglass and foam insulation, can emit VOCs and allergens. Grouts, caulks, and other sealants utilized in kitchens and bathroom installations can potentially contain volatile organic compounds (Wang, 2004), (Kozicki, & Niesłochowski, 2020).

BIOLOGICAL CONTAMINANTS AS INDOOR AIR POLLUTION

The prominent category of indoor air pollution that poses a risk to human health is biological pollutants. Numerous germs and particles generated by living things are among these pollutants. They can survive and even grow in enclosed spaces with too much moisture, inadequate ventilation, and improper cleaning procedures. Typical biological pollutants that can affect the quality of indoor air include:

Mildew and mould: Mildew spores are tiny reproductive units that can fly through the air and proliferate. Mould spores can irritate the skin, trigger allergies, and create respiratory issues when they are inhaled or come into contact with the skin. In humid, moist environments like bathrooms, basements, and places where there are water leaks, mould growth is frequent. Coughing, sneezing, or even just talking can cause bacteria and viruses to enter the air. Infectious diseases including the common cold, the flu, and other respiratory infections can spread more easily in crowded indoor areas and poor ventilation. Dust mites are minute arthropods that are common allergies and live in the dust. Dust mite faces and body parts can become airborne and cause allergy reactions, especially in people who are allergic to dust mites. Animals like cats and dogs can shed minute pieces of skin that might get airborne and trigger allergic reactions in some people. In those who are sensitive, airborne particles from cockroach bodies, droppings, and saliva can cause asthma attacks and allergies. When regular cleaning and dusting are neglected, particulate matter comprising different allergies and contaminants can collect in interior environments (Kumar et al, 2021).

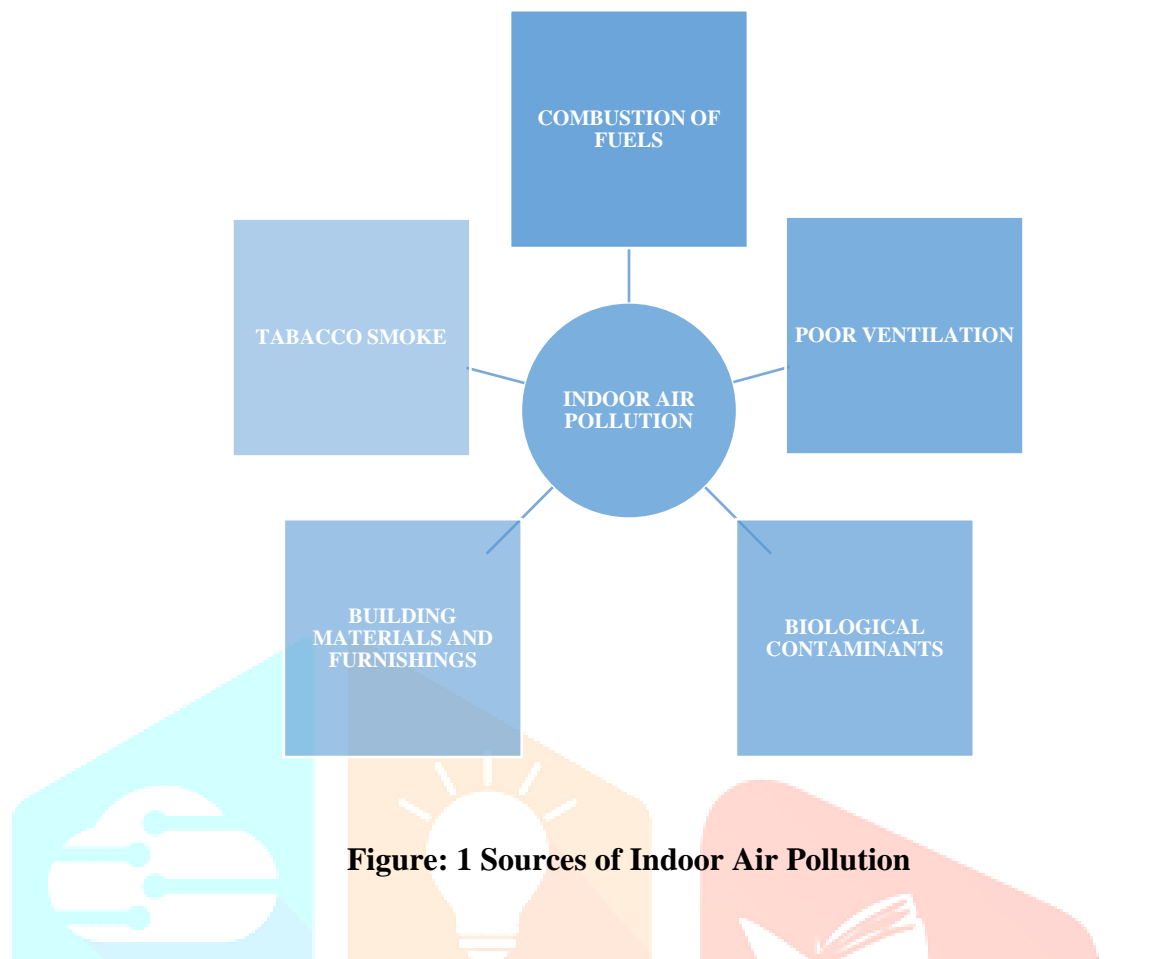


Figure: 1 Sources of Indoor Air Pollution

HEALTH IMPACTS OF INDOOR AIR POLLUTION

Particulate matter, dust mites, mould, pet dander, and pollen are examples of indoor air pollutants that can cause or aggravate respiratory disorders such as asthma, chronic obstructive pulmonary disease (COPD), bronchitis, and allergic rhinitis. Additionally, it has the potential to trigger allergic reactions in those who are vulnerable, resulting in symptoms including sneezing, itching, runny noses, and watery eyes. Asthma symptoms make asthma attacks more common and more severe for those who already have the condition. Tobacco smoke, particulate matter, and volatile organic compounds (VOCs) are just a few indoor pollutants that can cause inflammation of the airways and chronic bronchitis, which is characterized by a persistent cough. Inhaling tiny water droplets contaminated with the *Legionella* bacteria, which are frequently found in unkempt air conditioning units, showers, and water fountains, results in Legionnaires' disease, a serious form of pneumonia. Sick building syndrome (SBS) is a phrase used to describe a collection of vague symptoms that are brought on by spending time in a specific building, including headache, weariness, dizziness, and irritation of the eyes, nose, or throat. It is thought that indoor air pollution, poor ventilation, and other environmental conditions may be contributing factors. Incomplete fuel combustion, including that of petrol, wood etc (Tran et al , 2022

CONTROL MEASURE OF INDOOR AIR POLLUTION

The impact of indoor air pollution on human health is enormous, so it's critical to put control mechanisms in place to limit exposure to dangerous contaminants. Some of few efficient ways to reduce indoor air pollution are Ventilation helps in maintaining good indoor air quality requires proper ventilation. Make sure your building or residence has enough ventilation, such as air vents, windows and exhaust fans, to let fresh air flow and reduce indoor pollution. Dust, pollen, mould spores, pet dander, and various volatile organic compounds (VOCs) can all be eliminated from the air by using an air purifier. Ensure that the air purifier you choose uses high-efficiency particulate air (HEPA) filters or other reliable filtration methods. Controlling indoor humidity are which should be between 30% and 50%, will help keep dust mites and mould at bay. Dehumidifiers should be used in moist places, water leaks should be fixed right once, and bathrooms and kitchens should have adequate ventilation. Avoid Smoking Indoors is one of the main sources of indoor air pollution is smoking. To stop the release of secondhand smoke and toxic tobacco smoke, advice smokers to smoke outside.Utilise Eco-Friendly Cleaning

Supplies which has many commercial cleaning supplies include hazardous chemicals that can pollute indoor air. Choose cleaning supplies that are natural or environmentally friendly and contain fewer harsh chemicals and volatile organic compounds (VOCs). Keep Indoor Plants helps in absorbing some contaminants and releasing oxygen, some indoor plants can help enhance the quality of indoor air. Aloe vera, peace flowers, and spider plants Control Combustion Sources helps to stop the emission of carbon monoxide and other combustion byproducts, make sure that fuel-burning appliances (such as stoves, heaters, and fireplaces) are properly maintained and vented. Use low-emission paints, adhesives, and building materials when remodeling or constructing structures to reduce the release of volatile organic compounds (VOCs). Chemicals should be stored correctly to reduce indoor air pollution. Store home chemicals, solvents, paints, and pesticides away from inhabited areas in well-ventilated places. Radon is a radioactive gas that can infiltrate into homes from the ground. Having your home radon tested, and if levels are excessive, take the necessary precautions to lessen its presence. (NCBI, 2021), (Ajith, 2022).

CONCLUSION

In particular, respiratory conditions including asthma, allergies, and chronic obstructive pulmonary disease (COPD) can be brought on by indoor air pollution. Additionally, it has the potential to worsen current health issues, particularly in vulnerable populations like children, the elderly, and those with pre-existing diseases. Both indoor and outdoor sources can produce indoor air pollution. Solid fuel cooking, smoking, construction materials, mould, pet dander, domestic cleaning supplies and insufficient ventilation. Good indoor air quality must always be maintained, which requires proper ventilation. By enabling clean outdoor air to circulate within and dilute the pollutants, adequate ventilation helps to lower the concentration of pollutants there. To enhance indoor air quality and safeguard public health, this issue must be addressed by individuals, communities, and governments working together.

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