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IMPACT OF INDOOR AIR QUALITY ON WORKERS HEALTH AND PRODUCTIVITY

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Abstract

Harmful health outcomes from exposure to air pollution have been documented for decades. Air pollution outdoors and indoor air pollution have detrimental effects on workers' health and productivity in different working environments. Indoor air pollution seriously affects occupants' health as individuals spend most of their time indoors completing other activities of daily living, working, and sleeping. A large number of epidemiological research have demonstrated that the influence of indoor air pollution results in damaging health effects. Various kinds of indoor air contamination have different impacts on occupants. Environmental conditions and individual human characteristics are associated with illness distribution, and people experience results differently. Some factors may enlarge the risk of adverse health outcomes, while others can promote health and well-being. This paper aims to summarize the different aspects of exposure to indoor air pollution and the adverse effects of indoor air pollution on workers' health and productivity in various working environments.

Key words: *indoor air pollution, working environment, occupational safety and health*

1. Introduction

Indoor air pollution (IAP) has become a considerable public health concern as people spend about 90% of their time indoors (Chijioke et al., 2023). This includes homes, offices, and other workplaces where inadequate air quality can cause health issues and decreased productivity. Several studies have shown the unhealthy effects of indoor air pollutants such as volatile organic compounds (VOCs), particulate matter, mold, and carbon dioxide (CO_2) (Seguel et al., 2017).

This paper aims to summarize the various types of indoor air contaminants, their health impacts, and the connection between indoor air quality and worker

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productivity. It will also examine individual characteristics that affect susceptibility to IAP and the environmental circumstances that worsen these effects.

2. Types of Indoor Air Pollution

1.1 Volatile organic compounds

Volatile organic compounds (VOCs) are a group of organic substances that quickly evaporate at room temperature. They are usually found in numerous everyday products in offices, factories, and other working environments. Sources of VOCs include paints, solvents, adhesives, cleaning agents, office equipment like printers and copiers, and even furnishings. Exposure to VOCs can lead to a spectrum of short-term health effects, such as headaches, dizziness, eye and respiratory irritation, and nausea. Long-term exposure may result in more intense health issues, including damage to the liver, kidneys, or central nervous system. Certain VOCs are also classified as carcinogenic, meaning they could potentially contribute to cancer (Goodman et al., 2017).

1.2 Particulate Matter

Particulate matter (PM), particularly $PM_{2.5}$, is a significant indoor pollutant often found in environments with poor ventilation and combustion processes (e.g., from cooking or heating). Studies have linked exposure to PM with cardiovascular diseases, respiratory conditions, and even premature mortality.

Particulate matter (PM) refers to small particles or droplets in the air that can be inhaled. These particles vary in size, composition, and origin. They are typically categorized by size:

- PM_{10}: Particles with a diameter of 10 micrometers or smaller.
- $PM_{2.5}$: Fine particles with a diameter of 2.5 micrometers or smaller.

Industrial processes, combustion, cleaning activities, and natural and biological sources of particulate matter in the workplace are among the causes.

Elevated concentration levels of particulate matter in the working environment cause numerous harmful effects on health, including respiratory and cardiovascular problems, neurological effects, irritations, and allergic reactions (Felgueiras et al., 2022).

1.3 Mold and Biological Contaminants

Mold and other biological contaminants thrive in damp indoor environments and can cause allergic reactions, respiratory illnesses, and other health problems.

Mold is a type of fungus that thrives in damp environments, while biological contaminants include various microorganisms such as bacteria, viruses, and allergens (like pollen and pet dander). These can pose health risks in workplace settings.

1.3 CO_2 in working environment

CO_2 has been identified as a workplace hazard at high concentrations for over a century. However, it's crucial to recognize that CO_2 is naturally present in the air at a concentration of about 0.037% and is not dangerous to health at low concentrations. At room temperature and atmospheric pressure, CO_2 is a colorless and odorless gas, and because of this, people can't see it or smell it at higher concentrations. CO_2 is not combustible and will not support combustion. However, it's in caught spaces that the need for precautions is most crucial. As the concentration of CO_2 in the air rises, it can cause different health problems: headaches, dizziness, haze, and loss of attention. Since CO_2 is heavier than air, mortality from asphyxiation occur when, at high concentrations, it enters enclosed spaces such as tanks, sumps, or cellars and displaces oxygen. It's also possible for CO_2 to accumulate in channels or depressions outside following leaks, and this is more likely to occur following a pressurized release where the released CO_2 is colder than the surrounding air. These potential dangers highlight the need for strict protection in confined spaces to ensure the safety and protection of all employees (Zarco-Periñán et al., 2022).

2. Productivity Effects of Poor Indoor Air Quality

Inadequate indoor air quality (IAQ) directly affects health and productivity in the workplace (Saidin et al., 2020). Although it may not be visible, the symptoms of IAQ include decreased cognitive function, insufficient concentration, and lower productivity. Employers need to understand the threat of poor IAQ and the steps they can take to improve it.

2.1 Reduced Efficiency

Poor IAQ can significantly reduce overall work efficiency. Workers may struggle with fatigue, decreased motivation, and an inability to concentrate, leading to longer task completion times. A numerous studies found that improved IAQ correlated with increased employee performance and productivity.

2.2 Increased Sick Leave

Health issues stemming from poor IAQ often lead to increased absenteeism. Employees who experience respiratory problems or other health concerns are more likely to take sick leave, disrupting workflow and affecting team performance. According to the American Thoracic Society can incur substantial costs due to increased sick leave resulting from poor IAQ (Onwusereaka et al., 2022).

2.3 Employee Morale

Good IAQ contributes to a positive workplace atmosphere. Employees are more likely to feel valued and engaged in a clean, well-ventilated environment. High

morale can lead to better job satisfaction and lower turnover rates, further enhancing productivity and reducing hiring and training costs.

2.4 Enhanced Focus

A workplace with good IAQ enables employees to maintain focus and alertness. Enhanced concentration contributes to improved performance, creativity, and innovation, all of which are crucial in competitive business environments. Environments with optimal air quality foster a culture of productivity and engagement.

3. Strategies for Improving Indoor Air Quality

3.1 Regular Monitoring

Implementing air quality monitoring systems is essential for maintaining optimal IAQ. Regular assessments can help identify potential pollutants and areas for improvement, ensuring a healthier work environment.

3.2 Ventilation Improvements

Enhancing ventilation systems to ensure a continuous supply of fresh air is vital. Proper ventilation reduces the concentration of indoor pollutants and helps regulate temperature and humidity levels.

3.3 Use of Air Purifiers

Installing air purifiers can significantly reduce harmful particles and allergens in the air. HEPA filters, in particular, can effectively capture small particles that may contribute to poor air quality.

3.4 Maintenance of HVAC Systems

Regular maintenance of heating, ventilation, and air conditioning (HVAC) systems is crucial to ensure they function optimally. Neglected systems can become a source of pollutants, circulating dust, mold, and other contaminants throughout the workspace (Al-Awadi et al., 2019).

4. Conclusion

The impact of indoor air quality on workers' health and productivity cannot be overstated. Organizations that prioritize IAQ can enhance employee well-being, reduce health-related costs, and improve overall productivity. By implementing effective strategies to monitor and improve air quality, businesses can create a healthier, more engaging work environment that fosters employee satisfaction and success.

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