ASIA PACIFIC JOURNAL of MEDICAL TOXICOLOGY
APJMT 12;3 http://apjmt.mums.ac.ir September 2023

REVIEW ARTICLE

A Mini Review on Environmental Pollutants in the Workplace: Implications for Worker Health

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Abstract

Background: The World Health Organization (WHO) defines human health as the optimal state of balance and well-being encompassing physical, mental, and social dimensions. The execution of any activity or work induces alteration in the work environment, rendering it a potential source of adverse stimuli, impacting the health of involved workers.
Contaminants, whether inert or living matter, manifest in the work environment, giving rise to what is commonly recognised as hygienic risk.
Methods: This paper conducts a targeted review, utilizing databases such as Medline/PubMed, Google Scholar, Web of Science, Cochrane and Ovid®, encompassing publications in all languages. The selection of articles is based on scientific relevance, considering the impact and visibility of the journal. All articles undergo thorough scrutiny during the selection process.
Results: The review delineates diverse categories of contaminants within the work environment, elucidating the routes of entry into the body, the duration of exposure, and their associated risks to the worker's health.
It explicates the influence of working conditions and the susceptibility of individuals to environmental contaminant exposure. Additionally, measures are outlined to eliminate polluting agents from the work environment.
Conclusions: This comprehensive examination of current knowledge on contaminants in the work environment underscores the necessity for actions to diminish the concentration of contaminants to which workers are exposed.
These measures must be tailored to address the emission source, transmission modalities, and protective actions directed toward workers. Endeavours to eradicate such contamination significantly contribute to improving workers' overall health.

Keywords: Workplace, Chemical exposure, Thermal stress, Routes of entry.

How to cite this article: Fortunato Biango H, Serrano Sanchez T, Favier Poll M, Pedro Neto A. A Mini Review on Environmental Pollutants in the Workplace: Implications for Worker Health. Asia Pac J Med Toxicol 2023; 12(3):107-112.

INTRODUCTION

Pollutants exist in an environment where their presence at levels beyond acceptable limits can lead to adverse health effects. [1;2]. While numerous chemicals enhance the quality of life without harming the environment or human health, there exist xenobiotics, that in specific quantities, can be detrimental and should only be employed when their risks can be adequately managed [1;3].

Despite the ongoing research efforts, it is imperative to stay abreast of both naturally and industrially induced pollutants, and comprehend the mechanisms underpinning the harm they inflict on human health.

This study aims to undertake a comprehensive review and synthesis of contaminating substances present in the workplace, elucidating their potential impact on health. Furthermore, it offers practical recommendations for mitigating these deleterious effects through informed approaches.

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METHODS

Search Strategy: We implemented a meticulous search strategy utilizing reputable databases, including Google Scholar, Web of Science, PubMed, Cochrane and Ovid®.

Search Terms: Targeted search terms such as "Chemical Substances", "Work Environment", "Worker Health", "Contaminants", "Hygienic Risk", and "Human Health" were employed to uncover relevant content.

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Inclusion and exclusion Criteria: The selection criteria for article inclusion were based on the current and relevance of the content, encompassing aspects such as types of contaminants, routes of entry into the body, duration of exposure, working conditions, and individual susceptibility.

Conversely, articles are excluded if they do not align with the study's focus, lack relevance to environmental workplace exposure, or fail to establish a clear connection to workers' health. Articles published before 1975 are excluded to maintain currency and relevance. While no language limitations are imposed, only articles cited in the specified databases are included.

Articles meeting these criteria were assessed for their scientific rigor and impact. The inclusion process involved a comprehensive review to ensure the selected articles contributed meaningfully to synthesizing knowledge on environmental workplace toxic exposures and their implications for workers' health.

The selection of the articles was carried out independently by the authors, which followed a consensus process for the final inclusion of the articles taken into account for the review.

RESULTS

The initial search yielded a total of 210 records. Following a meticulous screening of titles and abstracts, 102 full texts were assessed. From these, we incorporated 45 articles. The selection process is visually depicted in the flowchart illustrated in Fig. 1.

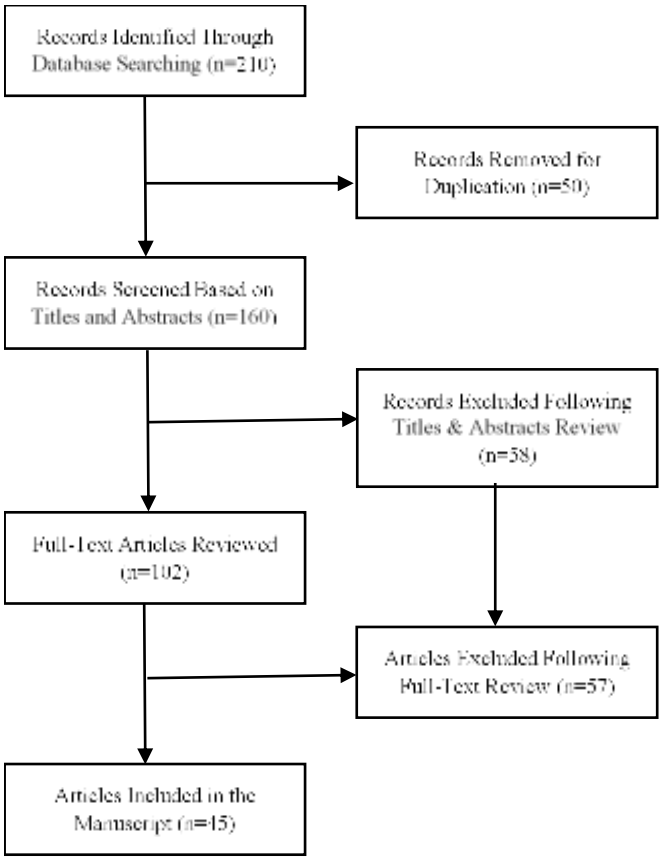

Figure 1. Flow Diagram of the Selection Process

I. Types of Contaminants:

The most important environmental pollutants are divided into three fundamental categories of potentially harmful agents: chemical, physical and biological (Figure 2). Discussing ionizing and non-ionizing radiation, waste, and light pollutants is beyond the scope of this article.

Most of these contaminants tend to increase, so industrial control must be carried out to safeguard the health of workers. It is about highlighting the significance of the dangers and risks that exposure to contaminants has for human health.

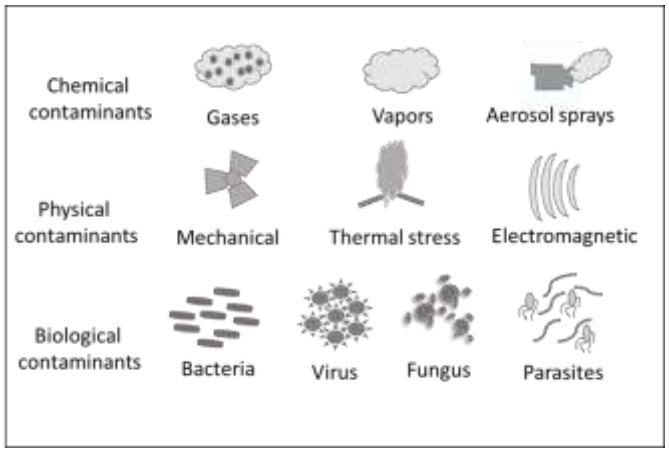

Figure 2. Pollutant Classification. (Source: Author´own)

Chemical Contaminants

Chemical contaminants consist of inert matter and can manifest in the air as who must handle chemicals in their regular work. The distinction between the two lies in the size of the particles and their behavior when inhaled. Globally, there has been a growing incidence of human health effects caused by occupational exposure to chemical contaminants [4,5].

Environmental pollutants include not only polychlorinated biphenyls (PCBs), dioxins, persistent chlorinated pesticides, and brominated flame retardants, but also metals such as arsenic, cadmium, lead, and mercury [6]. Many of these pollutants derived from industrial processes, such as those Involved in industrial painting, fertilizers and pesticides manufacturing facility cleaning, oven and boiler combustion, plastic production, metal surface degreasing, among others, are numerous, [7].

Numerous workers, including cleaning staff, chemical laboratory workers, and maintenance personnel regularly handle chemicals. The primary route of penetration for toxic substances in the work environment is through the nose and mouth, ultimately reaching the lungs. The air contains various contaminants, including dust, fumes, gases, aerosols and vapors, which are inhaled through the

respiratory tract. [7,8]. Table 1, provides certain examples of chemical contaminants.

Physical Contaminants

Physical pollutants are different forms of energy by emanating from specific sources, exerting effects on individuals exposed to them. These energies exhibit crucial distinctions giving rise to diverse physiological impacts [9]. Physical pollutants take different forms as energy emanates from specific sources, exerting effects on individuals exposed to them.

Impacts on Health and Reproduction:

Extended exposure to physical pollutants may adversely affect human health and reproductive patterns. The potential consequences include an elevation in allergic reactions, a deterioration of respiratory and cardiovascular conditions, and an increased risk of developing cancer.

WHO Warning and Covid-19:

The World Health Organization (WHO) has specifically highlighted the potential impact of physical pollutants on individuals suffering from diseases like Covid-19, indicating a heightened risk and potential exacerbation of the prognosis [11].

In conclusion, understanding the nuanced effects of various physical pollutants, especially in environments prone to their generation, is imperative. This knowledge not only helps assess potential health risks, but also underscores the need for proactive measures to mitigate adverse outcomes.

Environments most susceptible to these contaminants are those generating elevated levels of noise, vibrations, radiation, humidity and extreme lighting, temperature, and potential collisions with objects, while it is estimated that at the average intensity levels, to which adults are commonly exposed, adverse health effects may not occur [10].

It is essential to recognize these factors as potential sources of social alarm. Notably, certain contaminants can affect human health and reproductive system based on the duration of exposure. Toxic exposure may lead to an increase in allergies and worsen respiratory and cardiovascular diseases. Additionally, it has the potential to contribute to the development of cancer. The World Health Organization (WHO) has warned of potential exacerbation prognosis of patients with diseases such as Covid-19 due to exposure to contaminants [11]. Table 2, provides a summary overview, offering specific examples of physical pollutants comprehensive reference.

Biological Contaminants

Biological contaminants encompass microscopic living beings (microbes, viruses, fungi, etc.) that may be present in the work environment. Unlike chemical and physical contaminants, they are living organisms with a specific life cycle, which upon coming into contact with humans can cause a specific disease, whether infectious, parasitic, allergic or of another nature. The most frequent job that involve biological contamination are located in hospitals, laboratories, pharmaceutical industry, agriculture and livestock, wastewater treatment, urban cleaning,

Table 1. Different Types of Chemical Contaminants in the Work Environment.

CHEMICAL CONTAMINANTS	
Gases	Among the most commonly used industrial gases are acetylene, argon, carbon dioxide, oxygen, nitrogen and hydrogen
Vapors	Ethanal, dichloro-methane, potassium chloride, etc.
Aerosol Sprays	Sulfate aerosols from volcanoes or industrial emissions

Table 2. Different Types of Physical Pollutants in the Work Environment.

PHYSICAL POLLUTANTS	
Mechanic	Blows or collisions with or by objects. Cuts with or through objects. Particle projection. Entrapments/crushing/imprisonments.
Thermal Stress	Due to high (due to the location, physical activity or clothing of the worker) or low temperatures (from general or local causes)
Electromagnetic	Due to excessive exposure to electromagnetic emissions generated by telephone antennas, high voltage lines, transformers, etc.

Table 3. Different types of biological contaminants in the work environment.

BIOLOGICAL CONTAMINANTS	
Bacteria	Escherichia coli, Bacillus thuringiensis, clostridium botulinum., klebsiella, pseudomonas, streptococcus enterococcus etc.
Virus	Influenza, gastrointestinal infections and others.
Fungus	Aspergillosis, histoplasmosis, candida infections, pneumocystis infections, mold, athlete's foot.
Parasites	Entamoeba, giardia, leishmania, balantidium, plasmodium, etc.

slaughterhouses, food industry, wool and derivatives industry, tanning industry, cotton industry, among others [12,13]. Table 3 shows, in an expanded manner, some examples of biological contaminants.

II. Routes of entry into the body

The contaminating substance enters the body following both an exposure or absorption route. Also, the amount of substance that enters the blood in a given time depends on the route [14-17]. On the other side, the acute exposure occurs in a very short period of time, usually 24 hours; however, chronic exposures occur over long periods of time, sometimes lasting weeks, months or years. Additionally, the amount of exposure and type of contaminant will determine the toxic effect on the body [14-17].

The respiratory tract is the main route of penetration of chemical substances, which is one of the most important ways for the entry of pollutants and toxic substances into the work environment since dust, fumes, aerosols, gases, and vapors can enter our body with the air we breathe that is contaminated with volatile products. In this way they pass into the blood, and can then affect other organs such as the brain, liver, kidneys, etc. [16, 17]. These phenomena are favored by the integrity, or otherwise of the body's protective barriers. The skin, the intestinal tract and the lungs play an important role in the mechanism of entry of toxic substances, with the skin protecting the body from contaminants outside the body.

The gastrointestinal system protects the inside of the body from ingested contaminants like toxins. Likewise, the membranes within the lungs protect the inside of the body from inhaled contaminants [18], although this penetration route is unusual given that we do not introduce the manipulated substances into the mouth. The possible way for contaminants to enter through this route is when eating, smoking, and drinking at the workplace without washing your hands beforehand. It is worth mentioning that maintaining proper personal hygiene could contribute to avoiding this route of penetration.

The parenteral route is generally produced by direct penetration of the contaminant into the body through a break in the skin, an open wound, or a puncture. This is a minority route since it is not common for workers with open wounds to handle any type of contaminant [19, 20]. This, like other routes, may or may not produce an effect depending on the time of exposure to the contaminating substance. Another route of entry for contaminants is through the conjunctival mucosa of the eye. It is a rare route, but it can also be the gateway for environmental pollutants [21, 22]. Figure 3 shows, in an expanded manner, the access routes of contaminants to the human body.

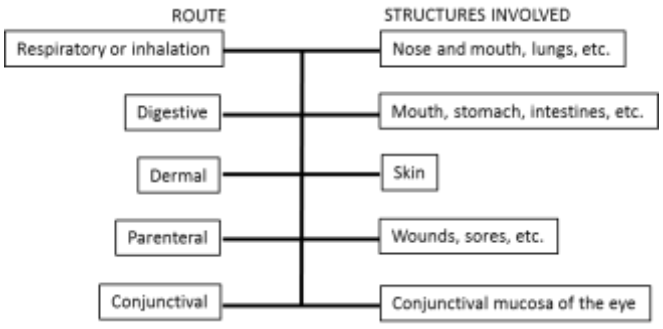

Figure 3. Routes of entry of contaminants into the work environment

III. Exposure Time and Risks to the Worker's Health

It is of transcendental importance to define the limits of exposure to contaminants in the short and long term of exposed workers, and the environment in which they work. It has been established that exposure to a contaminant is acute if the duration is less than 24 hours, chronic when the time exceeds three months, subacute when less than one month, and subchronic if between one and three months [23-25].

Typically, when contact with the toxicant is brief (acute exposure), the effects appear shortly after exposure and do not last long; however, chronic or prolonged exposure to these substances throughout life increases the risk of suffering from different non-communicable diseases such as lung cancer, cardiovascular diseases, strokes and chronic obstructive pulmonary disease [26-30].

IV. Working Condition and Individual Susceptibility of Each Individual

To avoid contamination we must apply basic prevention and control measures, along with appropriate work procedures, information and training of workers, and the corresponding collective and individual protective equipment. This implies the improvement of working conditions with the inclusion of general and individual measures to guarantee that safety, health, and work environment standards are met in factories, workshops, offices, premises and other places where work must be carried out in order to prevent accidents and occupational diseases, besides adopting preventive and corrective measures that include occupational health plans at work, evaluation and inspection of areas and workers, training of employees, promoting open communication, investigating work incidents, maintaining records, and documenting health and safety events in the workplace. [31-34].

The individual susceptibility of each person is an important factor when evaluating the damage caused by polluting substances since individuals responds unequally to exposure to pollutants, and also because this is influenced by a combination of genetic and environmental factors marking the different types of reaction among people who are exposed to dangerous substances [35-37]. In general, some individuals will be able to protect themselves against exposure to the harmful source and others will have an effect on their health that will be more intense in those individuals in whom risk factors increase the probability of developing diseases.

V. Pathways to eliminate pollution in the work environment

Contamination can cause different damages depending on the conditions to which the worker has been exposed. There are many ways to prevent pollution in the work environment. Each country includes international

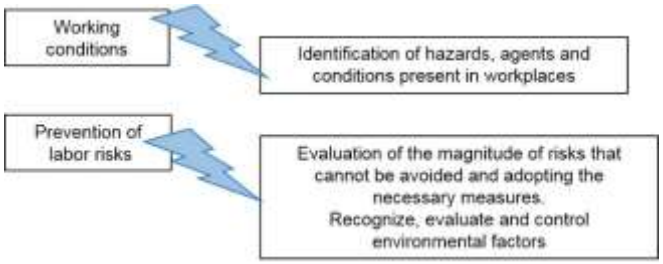

Figure 4. General and Individual Measures to Maintain Health within the Work Environment

CONCLUSION

Several decades of research in occupational health have yielded intriguing insights into the contaminants prevalent in work environments and the essential preventive measures to safeguard human health [43-45].

The comprehensive measures undertaken within work environment, encompassing factors such as lighting, ventilation, cleanliness, order, visual and auditory stimuli, air conditioning, among other safety measures, serves as crucial determinants in elevating the comfort and morale of workers. This transformative effect on the physical environment is paramount to work performance.

Safety measures play an integral role in work performance. The meticulous implementation of measures in the work environment is pivotal in shaping the work experience, where each component contributes synergistically to enhancing safety and improving overall work performance. The preventive paradigm against occupational diseases involves a proactive approach beyond immediate benefits, such as enhanced comfort and heightened morale. This holistic strategy aims to avert diseases arising from inherent risk factors in occupational activities, comprehensively addressing potential health risks. Implementing collective measures safeguards workers against the adverse effects of their multifaceted tasks.

In conclusion, a well-managed work environment is vital for human health. A proactive approach improves immediate well-being and prevents occupational health hazards, guiding continuous efforts to enhance work environments for the benefit of employees and organizational performance.

ACKNOWLEDGMENTS

The author sincerely thanks Professor María de Los Angeles Robinson for her invaluable review and corrections.

Conflict of interest: None declared.
Funding and support: None

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