# Occupational Exposure and Its Risks Exposure and Threats

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***Abstract***

*Chemicals are widely used in industries. Many chemicals and radiations have bio-importance but the toxic effects of many of them in human biochemistry are of great concern. All these carcinogenic harmful substance pose serious public health issue as they are one of the most widespread environmental and industrial toxins. Hence, there is the need for proper understanding of the conditions, such as the concentrations and states, which make them harmful. It is also important to know their sources, processes, chemical conversions and their modes of deposition to pollute the environment, which essentially supports lives. These are released into the environment by both natural and anthropogenic sources. They percolate into underground waters, moving along water pathways and eventually depositing in the soil. Poisoning and toxicity in animals occur frequently through exchange and co-ordination mechanisms. Exposures to hazardous materials have been associated with a number of serious systemic toxicological effects involving the nervous system, blood-forming organs, reproductive system, lung and kidney. Studies have shown genotoxic effects in workers exposed to toxic chemicals.Occupational exposure assessment is the strategy which helps employers to protect the health of workers who are exposed to chemicals in their workplace. Our study suggest workers comprise the risk group requires adequate safety, precautionary and preventivemeasures could only minimize exposure and the related health hazards.*

**Keywords -** *Exposure, Metal, Radiations, Pesticides, Toxicity, Genotoxic effects.*

## I. INTRODUCTION

Exposure is any contact between the human body and a potentially harmful substance. Anoccupational exposure occurs when a person is exposed to potentially harmful chemical, physical or biologically exposedduring the performance of job duties on the workplace. It may pose a worker at risk of infection. The highest risk occurs when body surfaces, such as the skin, nasal passages and lungs, come in direct contact with the harmful substance. There is absorption, distribution, biotransformation, excretion of substance in the body. These harmful substances can be cancer-causing which mayabsorb or inhaled. Specific exposures are related to the type of work and the safety precautions taken to reduce exposure.Potential health risks may also be associated with how certain industries provide services or production. The level of risk depends on the amount and length of exposure, how powerful the substance, the presence of other risk factors and a person's susceptibility. Some workers may have greater and longer exposures to harmful chemicals in the workplace and their risk of cancer may be a lot higher than the others. People who work with cancer-causing substances (carcinogens) on the job may be exposed to much higher levels of these substances than they would be at home or in their community. Since higher exposure can lead to greater cancer risk, eliminating or reducing exposure is important in the primary prevention of cancer.Workers who are more likely to come in contact with carcinogenicchemical substances includes construction workers, woodworkers, miners, painters, pesticide workers and workers in the chemical, rubber or dye industries. Formaldehyde, radon, asbestos, ionizing radiation, benzene, beryllium, cadmium, chromium, arsenic, nickeland vinyl chloride are few examples of carcinogens that workers may be exposed to in the workplace.

Formaldehyde ($CH_2O$) is the most simple and the reactive aldehyde. It is a colourless chemical with an unpleasant smell. Its pungent suffocating odor is recognized by most human subjects at concentrations below 1 ppm [1]. Formaldehyde is widely used as a preservative and disinfectantin variousindustries.Formaldehyde is normally present in indoor and outdoor air at low levels. Materials containing formaldehyde can release formaldehyde gas or vapour into the air [2]. Certain workers may also be exposed to formaldehyde. Formaldehyde is used in building and construction materials, found in furniture and cabinets made from pressed-wood products (such as particleboard, plywood, medium-

density fibreboard) and glues and adhesives used to make these products, used in household products such as certain paints, varnishes and floor finishes, found in permanent press sheets, drapes and clothing, a by-product from burning certain substances, cigarette smoke, unvented fuel-burning appliances such as gas or wood-burning stoves and kerosene heaters, forest fires and vehicle exhaust. Occupational exposure involves not only workers in direct production of formaldehyde and products containing it, but also in industries utilizing these products, such as those related with construction and household.Some other industries throughwhich workers are exposed to formaldehyde are textile manufacturing, wood product manufacturing, plastic and resin production, funeral industry, medical and other healthcare services, Formaldehyde is used as a preservative and embalming agent, fungicide spraying, Formaldehyde is commonly used as an industrial fungicide (to control diseases caused by moulds) and as a disinfectant (to destroy microorganisms) [3].According to the Report on Carcinogens, formaldehyde (FA) ranks 25th in the overall U.S. chemical production, with more than 5 million tons produced eachyear [4]. Studies in humans have suggested that formaldehyde exposure is associated with certain types of cancer. Studies have shown that formaldehyde increases the risk of developing nasopharyngeal cancer and leukemia [5, 6].There is limited evidence for an association between formaldehyde and an increased risk of sinonasal cancer (which includes nasal cavity and paranasal sinus cancer).

Radon is a colourless, odourless, tasteless radioactive gas found naturally in the environment. It is released into the air during the natural breakdown of uranium in rocks and soil. Once released, radon breaks down into radioactive elements that can attach to dust and other substances in the air. We are exposed to radon when we breathe in contaminated air in many ways. Workplace exposure can occur from air in uranium and other underground mines that naturally have high levels of radon if proper ventilation systems are not in place. Radon can also be found in water. Radon in water can be a problem when the water is from the ground, such as from private or community wells. Radon is released from the water into the air during normal use such as showering or cooking. Exposure to radon gas increases your risk of lung cancer. This risk depends on the level and length of exposure, as well as if you are a smoker. Lung cancer can develop after years of radon exposure.

Asbestos is the name for a group of naturally occurring fibrous minerals that have had numerous commercial applications because of their durability and ability to resist high heat. There are 2 main categories of asbestos:

Amphibole asbestos, which is commonly known as blue or brown asbestos, is known to cause cancer and is not used very much anymore. Amphibole asbestos has many different subtypes, including actinolite, amosite, anthyophyllite, crocidolite and tremolite. Serpentine asbestos is sometimes called white asbestos. The only type of serpentine asbestos is called chrysotile asbestos. It is also known to cause cancer. Chrysotile asbestos is currently the most commonly used form of asbestos in the world. It is found in almost all asbestos-based products available today, which includes brake linings, building materials, water and sewer pipes, and insulation. The use of asbestos, including chrysotile asbestos, has been banned in many countries.

Exposure to asbestos is highest for people who work with it in construction, maintenance in certain industries (i.e. smelting, petroleum, refining and pulp and paper), and repair of automotive brakes and ships. People who work with asbestos can expose their families if fibres come home on them or their clothing. Some existing structures, particularly older buildings, might contain asbestos. As these structures begin to wear with age or undergo renovation, you can be exposed to asbestos fibres that are released into the air and breathed into the lungs. Asbestos is known to cause many cancers, including lung cancer, mesothelioma (a rare cancer of the lining of the chest or abdominal cavity), laryngeal cancer, ovarian cancer, and possibly pharyngeal, stomach and colorectal cancers. It often takes decades after exposure for an asbestos-related cancer to develop. The more asbestos you were exposed to and the longer you were exposed, the greater your risk of developing cancer. Those who are exposed to asbestos and who use tobacco are at even greater risk of developing lung cancer. Pesticidesare used to control pests that can affect our health, safety or food supply. Pesticides are also used to make lawns, gardens and other green spaces look better. People can be exposed to pesticides at home or in the community in several ways: through the skin (absorption; passing into the body through the skin), breathing into the lungs (inhalation), swallowing (by eating what remains on vegetables and fruit, drinking contaminated water or touching contaminated hands to mouth[7]. In homes pesticides are being used outdoors on gardens, an insect repellent for mosquitoes, ants, termites and cockroaches. During agricultural practice pesticides are being used to protect growing crops, stored crops and livestock from damage on farms. Children are at risk of being exposed to higher levels of pesticides than adults because some activities increase their exposure such as crawling and playing in grass or gardens treated with pesticides or putting contaminated objects in their mouth. Pesticides can be absorbed through their skin more easily. They take in more air, water and food relative to their body weight compared to adults,

which increases their total exposure. Pesticide exposure may do more harm to children because their bodies are still developing and may not be able to deal with these substances. Children can also be exposed to potentially harmful pesticides through their parents. For example, there is evidence that children whose parents work with pesticides are at increased risk of exposure to pesticides in the home. Another possible type of exposure is prenatal (before birth). Some studies suggest that the timing of exposure, such as prenatal exposure to pesticides [8]. Studies show that there may be a connection between pesticides and cancer in adults and children. Studies have shown a stronger link between some types of pesticides and cancers. Studies suggest a possible connection with cancers such as leukemia [9,10], non-Hodgkin's lymphoma[11], soft tissue sarcoma [12], Parkinson disease [13], multiple myeloma [14], stomach and prostate malignancies[15] testicular, colorectal, endocrine glands and brain cancers [16]. Pesticides may cause reproductive effects [17, 18], developmental problems and very recently neurodegenerative disorders, such as Parkinson and Alzheimer disease [13] Studies of pesticides and childhood cancer show a possible connection with leukemia, and non-Hodgkin lymphoma. Pesticides should be used as the last option, in the smallest possible amount and only where needed to make a place usable. People should stay away from treated areas for at least 48 hours after the last amount of pesticide is applied.In the agriculture business, there are usually more rules in place to reduce exposure, such as training for people who apply pesticides to properly use equipment that protects them, plans to reduce residue levels and pesticide drift, and rules to limit access to sprayed areas.

## II. RADIATIONS

Radiation is energy that travels through space in the form of waves or particles. It occurs naturally in sunlight. Man-made radiation is used in X-rays, nuclear weapons, nuclear power plants and cancer treatment.If a person is exposed to small amounts of radiation over a long time, it raises risk of cancer. It can also cause mutations in the genes, which could pass on to children. Radiation over a short period can cause burns or radiation sickness (19). Symptoms of radiation sickness include nausea, weakness, hair loss, skin burns and reduced organ function. If the exposure is large enough, it can cause premature aging or even death. Radiation exposure is measured primarily in Rem (in the US) and the Sievert (SI unit), and is a measure of the radioactive dose absorbed relative to its possible health effects on the body. This is called the “equivalent dose”. There are two types of radiation: ionizing and non-ionizing.

Ionizing radiation has enough energy to break chemical bonds between molecules or to form charged molecules (cause ionization). This means that ionizing radiation is strong enough to damage cells and DNA and strong enough to increase the chance of developing cancer[20]. Sources of ionizing radiation exposure includes natural background radiation (sources of exposure include cosmic rays from the solar system and radioactive materials in the soil and rocks), background radiation from human activities (includes testing and using nuclear weapons as well as generating nuclear power), animal and laboratory experiments, studies of survivors of the atomic bombings, observations of certain occupational groups and populations, outcomes of patients who were treated with medical radiation at high doses [21].

Non-ionizing radiationisn’t as strong as ionizing radiation, and it doesn’t have enough energy to break bonds between molecules. But being exposed to some types of non-ionizing radiation can still harm you. Non-ionizing radiation exposure includes radiofrequency fields (including cell phones, cell phone towers and microwave ovens), electromagnetic fields (including power lines and household appliances), ultraviolet (UV) rays (including the sun and indoor tanning beds).

## III. HEAVY METALS

Heavy metals are defined as metallic elements that have a relatively high density compared to water [22]. Metals form crucial part in the biological system. Many essential elements such as copper, zinc, iron, manganese controlsvarious pathways. Zinc is an important cofactor for several enzymatic reactions in the human body, vitamin B-12 has a cobalt atom at its core, and hemoglobin contains iron. Likewise, copper, manganese, selenium, chromium, and molybdenum are all trace elements that are important in the human diet. Another subset of metals includes those used therapeutically in medicine; aluminum, bismuth, gold, gallium, lithium, and silver are all part of the medical armamentarium. Some metals are toxic in nature are known as toxic metals. [23]. Heavy metals are naturally occurring elements that are found throughout the earth’s crust, most environmental contamination and human exposure result from anthropogenic activities such as mining and smelting operations, industrial production and use, and domestic and agricultural use of metals and metal-containing compounds. Environmental contamination can also occur through metal corrosion, atmospheric deposition, soil erosion of metal ions and leaching of heavy metals, sediment resuspension, and metal evaporation from water resources to soil and groundwater [24]. Natural phenomena such as weathering and volcanic eruptions have also been reported to significantly contribute to heavy metal pollution [22,24, 25,

26,27]. Industrial sources include metal processing in refineries, coal burning in power plants, petroleum combustion, nuclear power stations and high tension lines, plastics, textiles, microelectronics, wood preservation, and paper-processing plants [28, 29,30]. Different metals have different mode of toxicity.Copper: Property of copper that also makes it potentially toxic because the transitions between Cu(II) and Cu(I) can result in the generation of superoxide and hydroxyl radicals [31, 32]. Also, excessive exposure to copper has been linked to cellular damage leading to Wilson disease in humans [33,34].

## IV. ARSENIC

Environmental pollution by arsenic occurs as a result of natural phenomena such as volcanic eruptions and soil erosion and anthropogenic activities [35]. Exposure to arsenic occurs via the oral route (ingestion), inhalation, dermal contact, and the parenteral route to some extent [35, 36,37]. Workers who produce or use arsenic compounds in such occupations as vineyards, ceramics, glassmaking, smelting, refining of metallic ores, pesticide manufacturing and application, wood preservation, and semiconductor manufacturing can be exposed to substantially higher levels of arsenic [37]. Several epidemiological studies have reported a strong association between arsenic exposure and increased risks of both carcinogenic and systemic health effects [38] including cardiovascular and peripheral vascular disease, developmental anomalies, neurologic and neurobehavioral disorders, diabetes, hearing loss, portal fibrosis, hematologic disorders (anemia, leukopenia, and eosinophilia), and carcinoma [39, 35, 40]. Arsenic exposure affects virtually all organ systems including the cardiovascular, dermatologic, nervous, hepatobiliary, renal, gastrointestinal, and respiratory systems [38]. Most cases of human toxicity from arsenic have been associated with exposure to inorganic arsenic. Inorganic trivalent arsenite [As(III)] is 2–10 times more toxic than pentavalent arsenate [As(V)] [41]. By binding to thiol or sulfhydryl groups on proteins, As(III) can inactivate over 200 enzymes. This is the likely mechanism responsible for arsenic's widespread effects on different organ systems. As(V) can replace phosphate, which is involved in many biochemical pathways [41, 42].

## V. CADMIUM

Cadmium is a heavy metal of considerable environmental and occupational concern. Cadmium is frequently used in various industrial activities. The major industrial applications of cadmium include the production of alloys, pigments, and batteries [43]. The main routes of exposure to cadmium are via inhalation or cigarette smoke and ingestion of food. Skin absorption is rare. Human exposure to cadmium is possible through a number of several sources including employment in primary metal industries, eating contaminated food, smoking cigarettes, and working in cadmium-contaminated workplaces, with smoking being a major contributor [4, 30]. Other sources of cadmium include emissions from industrial activities, including mining, smelting, and manufacturing of batteries, pigments, stabilizers, and alloys [44]. Cadmium is also present in trace amounts in certain foods such as leafy vegetables, potatoes, grains and seeds, liver and kidney, and crustaceans and mollusks [45]. Cadmium is a severe pulmonary and gastrointestinal irritant, which can be fatal if inhaled or ingested. After acute ingestion, symptoms such as abdominal pain, burning sensation, nausea, vomiting, salivation, muscle cramps, vertigo, shock, loss of consciousness, and convulsions usually appear within 15–30 min [46]. Acute cadmium ingestion can also cause gastrointestinal tract erosion; pulmonary, Heavy Metal Toxicity and the Environment 141 hepatic, or renal injury; and coma, depending on the route of poisoning [46, 47]. Chronic exposure to cadmium has a depressive effect on levels of norepinephrine, serotonin, and acetylcholine [48]. Rodent studies have shown that chronic inhalation of cadmium causes pulmonary adenocarcinomas [49, 50]. It can also cause prostatic proliferative lesions including adenocarcinomas, after systemic or direct exposure [51].In some studies, occupational or environmental cadmium exposure has also been associated with development of cancers of the prostate, kidney, liver, hematopoietic system, and stomach [49,50]. Carcinogenic metals including arsenic, cadmium, chromium, and nickel have all been associated with DNA damage through base pair mutation, deletion, or oxygen radical attack on DNA [52].

## VI. CHROMIUM

(Cr) is a naturally occurring element present in the earth's crust, with oxidation states (or valence states) ranging from chromium (II) to chromium (VI) [53]. Chromium enters into various environmental matrices (air, water, and soil) from a wide variety of natural and anthropogenic sources with the largest release occurring from industrial establishments. Industries with the largest contribution to chromium release include metal processing, tannery facilities, chromate production, stainless steel welding, and ferrochrome and chrome pigment production, metallurgical, refractory, and chemical industries. Commercially, chromium compounds are used in industrial welding, chrome plating, dyes and pigments, leather tanning, and wood preservation. Chromium is also used as anticorrosive in cooking systems and boilers [54,].Occupational and environmental exposure to Cr(VI)-containing compounds is known to cause multiorgan toxicity such as renal damage, allergy and asthma, and cancer of the respiratory tract in humans [41, 56]. Breathing

high levels of Cr(VI) can cause irritation to the lining of the nose and nose ulcers. Some individuals are extremely sensitive to Cr(VI) or Cr(III); allergic reactions consisting of severe redness and swelling of the skin [57].Studies with animal models have also reported many harmful effects of Cr(VI) on mammals. Subcutaneous administration of Cr(VI) to rats caused severe progressive proteinuria, urea nitrogen and creatinine, as well as elevation in serum alanine aminotransferase activity and hepatic lipid peroxide formation [58]. Similar studies reported by Gumbleton and Nicholls [59] found that Cr(VI) induced renal damage in rats when administered by single subcutaneous injections. Bagchi*et al*, 1995 [60] demonstrated that rats received Cr(VI) orally in water-induced hepatic mitochondrial and microsomal lipid peroxidation as well as enhanced excretion of urinary lipid metabolites including malondialdehyde [61]. Oxidative damage is considered to be the underlying cause of these genotoxic effects including chromosomal abnormalities [62] and DNA strand breaks [63]. Nevertheless, recent studies indicate a biological relevance of non-oxidative mechanisms in Cr(VI) carcinogenesis [64].Several studies have demonstrated that reactive oxygen species (ROS) production and oxidative stress play a key role in the toxicity and carcinogenicity of metals such as arsenic [40], cadmium [45], and chromium [54]. Because of their high degree of toxicity, these three elements rank among the priority metals that are of great public health significance.

## VII. CONCLUSION

Chemicals and raditions are important in many respects to man,especially in the manufacturing of certain important products of human use, such as accumulators (Pb), mercury-arch lamps and thermometers (Hg), utensils (Al) anda wide range of other products. But the bio-toxic effects, when unduly exposed tothem could be potentially life threatening hence, cannotbe neglected. While these carcinogenic chemicals are in many waysindispensable, good precaution and adequate occupational hygiene should be taken in handling them. Although poisoning could be clinically diagnosedand medically treated, the best option is to prevent chemical pollution and the subsequent human poisoning.

## RECOMMENDATIONS

Employers must educate workers about cancer and inform them about their exposure to carcinogens in the workplace. The use of personal protective clothing or equipment should be encouraged. Education and training programs for workers exposed to hazardous products in the workplace. Don't allow smoking and drinking at workplace.Make sure there is adequate ventilation. Maintain a moderate temperature and control moisture levels in your workplace. Heat and humidity tend to increase the release of products into the air.Wash permanent press clothing and sheets before you use them.Follow health and safety measures at work to reduce your exposure.

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