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Toxic Effects of Nanoparticles from Environment and Indoor / Outdoor Workplaces

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INTRODUCTION TO NP TOXICITY

The environment is constantly in touch with human skin, lungs, and gastrointestinal system. While the skin serves as a good barrier against external chemicals, the lungs and gastrointestinal system are more susceptible. Natural or manmade NPs are most likely to enter via these three routes. Other methods of exposure include injections and implants, which are mostly restricted to engineered materials. NPs may translocate from these entrance sites into the circulatory and lymphatic systems, and then into human tissues and organs, due to their tiny size. Depending on their composition and size, certain NPs may cause irreversible oxidative stress and/or organelle injury in cells. These negative health consequences aren't caused by all NPs. Size, aggregation, composition, crystallinity, surface functionalization, and other variables all influence NP toxicity. Furthermore, the toxicity of any NP to an organism is governed by the genetic complement of the person, which supplies the biochemical toolbox via which it may adapt to and combat hazardous compounds.

Nervous system uptake, oxidative stress, inflammation, and genotoxicity

The brain, spinal cord, and nerves that link the brain and spinal cord to the rest of the body make up the nervous system. In addition to breathing, NP may be taken into the nervous system via additional routes, such as the dermis. The most researched routes are the olfactory nerves and the blood-brain barrier. While the precise method by which NPs have proinflammatory effects is unknown, it is thought that they produce reactive oxygen species, which alter intracellular calcium concentrations, activate transcription factors, and cause cytokine production.

Interactions among organisms, NPs, and contaminants

When NPs interact with hazardous materials and organic molecules, they may either enhance or decrease their toxicity. As a result, although NPs may have negative consequences for the

environment, they can also be beneficial. Contaminants may be absorbed by NPs, lowering the quantities of free pollutant molecules in the vicinity of cells and decreasing the pollutants' harmful effects. However, no toxic effects may be seen if the NP or its combination with the pollutant is not hazardous.

Environmental risk assessment of NPs

The effects of nanoparticles on the environment are determined by how they are utilised in the workplace, how they are divided into various media (e.g., water and air), their mobility in each of these media, and their stability. To assess NPs' risks, such basic information about their behavior and toxicity is required; however, a realistic assessment cannot be made solely on the basis of this information; rather, some data on the expected concentration of NPs in environmental systems is required, and there is no accurate data on such concentrations to date. The resources, environmental routes, and uses of NPs, as well as the plants and animals that are sensitive to NPs, must be identified as a starting point for the environmental risk assessment of NPs.

Indoor pollution and health effects

According to the Environmental Protection Agency, indoor air may be 10 times more contaminated than outside air. Indoors, humans and their activities produce a significant quantity of particulate matter. Cooking, smoking, cleaning, and combustion (e.g., candles and fireplaces) are all typical indoor activities that produce NPs. Textile fibres, skin particles, spores, dust mite droppings, chemicals, and smoke from candles, cooking, and cigarettes are examples of indoor NPs. Particles have also been shown to infiltrate buildings via ventilation systems from the outside. Because people spend more than 80% of their time inside, indoor pollution has a direct impact on our health. Indoor smoke from solid fuels causes significant mortality in many parts of the globe, particularly in Africa and Asia. Poorly ventilated stoves utilising biomass fuels such as wood, agricultural waste, dung, and coal are the primary cause of mortality, with more than half of the victims being children under

the age of five. According to the World Health Organization, more than half of the world's population cooks and heats using solid fuels, including biomass fuels. Because wood is a renewable resource, it is often overlooked as a source of NPs and thought to be environmentally friendly.

NPs in outdoor spaces

NPs are released in both indoor and outdoor areas as a result of a variety of natural and artificial activities. Some construction workers, gas and petroleum transmission pipeline workers, police officers, farmers, and employees in a variety of other occupations work outside. Few studies have been done on the consequences of such employees' exposure to NPs; nevertheless, the minimal research that has been completed indicates that such workers are at an elevated risk of unfavorable health effects as a result of their exposure to NPs. The penetration of NPs from indoor locations into the outside environment is possible in certain circumstances. For example, NPs that pass past a filtering system may reach outdoor areas through ventilation ducts and have an impact on employees. NPs easily penetrate and are disseminated across indoor and outdoor workplaces due to their unique physical and chemical characteristics. They may harm the human body's biochemistry by causing certain responses in the cells. Many studies are now monitoring the concentrations of

different NPs in indoor and outdoor workplaces to establish worker exposure limits. To evaluate the interactions of NPs with biological systems, further study is required. Studies on the absorption routes for NPs, the processes through which they interact with cells, their bio-distribution, and their excretion pathways in the human body should also be addressed. Researchers have recently performed studies on detecting NPs in various settings and monitoring these chemicals in both indoor and outdoor work situations. They've created methods and equipment for measuring NP concentrations in a range of work settings, making it easier to keep track of employees' exposures.

Inhaled NPs associated diseases

Asthma, bronchitis, emphysema, lung cancer, and neurological disorders like Parkinson's and Alzheimer's are all linked to inhaled NPs. Crohn's disease and colon cancer have been related to NPs in the gastrointestinal system. Arteriosclerosis, blood clots, arrhythmia, heart disorders, and eventually cardiac mortality are all linked to NPs that enter the circulatory system. Translocation to other organs, including as the liver, spleen, and kidneys, may result in illness in those organs as well. Some NPs have been linked to the development of autoimmune disorders including systemic lupus erythematosus, scleroderma, and rheumatoid arthritis.