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Review Article

IMPACT OF HEAVY METALS ON THE ENVIRONMENT AND HUMAN BODY

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ABSTRACT

In the past decades, now and in the future, the issue of food security and the harmful effects of volatile contaminants on food quality, agriculture, human health, the environment, food security, and spoilage are critical issues. As technology has evolved, heavy metals have found their way into drinking water. Heavy metals cause soil contamination problems in artificial areas used for agriculture. When it comes to environmental toxins, heavy metals top the list. Even at the lowest concentrations, several of them can cause cancer and other diseases as well as autoimmune disorders. One of the major sources of water pollution by heavy metals is the decomposition and combustion of fossil fuels, exhaust fumes from vehicles, mining, agriculture, decomposition, and incineration of solid and liquid wastes. Heavy metals also occur naturally from natural events due to the toxicity of the heaviest metals to both humans and aquatic life, this pollution of the water poses a threat to all living creatures. They have many negative effects on various organisms, including plants, animals, and humans themselves, many other variables may intervene, such as lifestyle and dietary habits, levels of exposure to metals and age, gender, smoking, and mutation of ancestry. In this review, we intend to introduce further heavy substances that affect the human body in many ways.

INTRODUCTION

Metals have more technological applications whether freestanding or alloy and composite (Balci, Dagdelen, Mohammed & Ercan, 2022; Dagdelen et al., 2020; Kök et al., 2020; Kok, Qadir, Mohammed & Qader, 2022; Mohammed, Kök, Qader & Coşkun, 2021; Mohammed, Qadir, Kök & Qader, 2021; Mohammed, Balci, Dagdelen & Saydam, 2022; Mohammed et al., 2022; Mohammed et al., 2020; Mohammed, Kök, Qader & Qadir, 2022; Mohammed, Kök, Qader & Dagdelen, 2019; Mohammed Safar Saeed et al., 2020; Mohammed, Mohammed & Balci, 2023; Mohammed, Özen Öner, Ateş, Kanca & Kök, 2024; Mohammed, Qadir, Hassan, Mohammedamin & Ahmed, 2023; Qader, Mohammed & Dagdelen, 2022; Qader et al., 2021). The phrase "heavy metals" often refers to a class of metals and metalloids (semi-metals), along with the pollution they are often exposed to, causing ecological problems and toxicity. "Heavy metals" generally refers to a class of metals and their compounds, often referred to as "metals" or "semi-metals," and their contamination, which often causes toxicity and ecological problems. It makes no sense if there was no consensus among experts. Furthermore, it was

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recommended that any attempt to identify heavy metals based on density be abandoned as it would only lead to confusion, given that the International Union of Pure and Applied Chemistry (IUPAC) never defined the term “heavy metals.” In some samples of heavy metals (HMs) such as mercury (Hg), arsenic (As), nickel (Ni), cobalt (Co), copper (Cu), cadmium (Cd), and chromium (Cr), zinc (Zn), and other elements with higher atomic weights and densities. This illustrates even more of the ambiguity around the phrase. The definitions of the phrase before 1936 were "large guns or shot" and "great ability" (Duffus, 2002; Zaynab et al., 2022). Typically, heavy metals with an atomic number higher than 20 and a density larger than 5 grams per cubic centimeter are referred to as heavy metals. In most cases, metals function as cofactors, are involved in a variety of enzymatic and metabolic pathways, and are necessary for trace amounts of nutrients. However, high concentrations of these metals can become fatal or very suppressive to all living things, including people, animals, plants, and microbes. While some metals, such as mercury (Hg), arsenic (As), and cadmium (Cd), are exceedingly hazardous at very low concentrations (Mishra et al., 2019). Three classes are identified for the classification of metals and metalloid ions. Lead, mercury, and cadmium are Class I metals that can be hazardous in small amounts. Class II metals, including arsenic, thallium, bismuth, indium, and antimony, contain the least dangerous metals. Class III includes the minerals zinc, cobalt, copper, iron, and selenium; these substances are essential for several chemical and metabolic functions in the body and are dangerous only in low concentrations (Mishra et al., 2019; Verma, Vijayalakshmy & Chaudhiry, 2018). Heavy metals, among other pollutants found in indoor dust, should be studied carefully because of their high toxicity, incomplete nature, and adverse effects on humans. Furthermore, ingestion, inhalation, and skin contact are the three ways in which powdered heavy metals may enter a person’s body (Tan, Praveena, Abidin & Cheema, 2016). When heavy metals enter the soil, they cause organic matter to become more mineralized, which alters the soil-absorbing complex negatively by replacing calcium and magnesium. Since helpful microbes become less viable, the soil's enzymatic activity declines (Baibotayeva, Kenzhaliyeva & Bosak, 2019). The fact that makes this type of pollution the worst is that it is hidden, continuous, and irreversible (Zhang, 1999). As a result, the US Environmental Protection Agency and the Agency for Toxic Substances and Disease Registry have listed them within the top 20 list of hazardous compounds (Rai, Lee, Zhang, Tsang & Kim, 2019). Aquatic systems are seriously harmed by the mixing of metal pollutants through processes of dissolution, sewage, and waste leaching. The tanners produce a lot of chemicals throughout the process, which causes the water to become contaminated with harmful materials. The environment of fast urbanization, land, and population increase is now seriously threatened by pollution. Pollutants like radioactive materials, heavy metals, and different kinds of organic materials are being dumped more often by industries, contributing to environmental inorganic matter, and thus one of the main causes of metal contamination for aquatic creatures is the garbage industry (Pandey & Madhuri, 2014). Some metals are carried by wind or water, causing numerous ecological issues, while some are left behind as tailings strewn or disseminated in open or partially covered pits during mining procedures. Pb levels in soils that are too high may reduce soil production. Metal pollution refers to the toxicity of metals displayed by the mining, smelting, coal-burning, hydroelectric, and agricultural sectors, among other sources. As naturally occurring components of the earth's crust, heavy metals are persistent pollutants because they cannot be broken down or eliminated (Pandey et al., 2016; Sharma & Singh, 2015). In this review, we want to introduce heavy metals and their adverse effects on the environment, especially on humans.

SOURCE OF HEAVY METALS

Both manmade and natural processes have the potential to release heavy metals into the environment. Major sources of heavy metal contamination in soil environments include air sedimentation, animal feces, wastewater irrigation, mineral insecticides, and herbicides. Consumption of food products contaminated by pollen transport from soil to plant tissue or direct atmospheric deposition on plant surfaces, in addition to natural sources, poses serious health risks to humans (Rai, Lee, Zhang, Tsang & Kim, 2019). Heavy metals are persistent in the environment after being released from the earth's crust, where they have harmful impacts on humans, plants, animals, and microbes. These factors make the presence of heavy metal pollution in our environment one of the most pressing environmental problems of our day and a major source of concern for the future (Rahman & Singh, 2019). However, when heavy metal concentrations rise above a certain threshold, adverse consequences are manifested (Ali, Khan & Sajad, 2013). Large amounts of heavy metals often have harmful consequences, while the most dangerous heavy metals are those that are considered no-level poisons. Given their elevated levels of toxicity, they are most commonly referred to as toxic heavy metals (THMs) (Gavhane, Sapkale, Susware & Sapkale, 2021). These metals have a strong effect on disrupting biological activities, which makes them directly affect biological toxicity and environmental pollution (Yadav, Gupta, Kumar & Singh, 2017). The effects of heavy metals on humans can be from man-made or natural sources. For example, some human activities release more chromium into the environment (Hadzi, Ayoko, Essumang & Osae, 2019). Cadmium was first found in sewage, mining, industrial, and electroplating processes. Cigarette smoke is another source of cadmium. Foods also contain cadmium; however, the concentration fluctuates, and individual consumption varies owing to eating habits. Mercury may have industrial, coal-burning, or acid rain-induced soil leaching as its source. Lead can come from paint, mining, and vehicle exhaust (Ojo, Osho, Adewole & Olofintoye, 2017). Lead gasoline, lead solder feed cans, lead plumbing pipes, engine exhaust (lead tetraethyl), plastics, paints, antibacterial agents, scientific agencies, photography, fuel waste, solvents, battery fragmentation units, mining, electroplating, paints (cadmium yellow), wood preservatives, pesticides, and glass/copper solvents are some sources of heavy metals (Shah, 2017). The source of heavy metals and their harmful effects on human health are shown in Figure 1.

ENVIRONMENTAL IMPACT OF HEAVY METALS

Because metals are widely dispersed throughout the natural environment, the growing global population and yearly metal consumption per capita will eventually pose ecological issues. All soils, waterways, and living things naturally contain heavy metals. While many of these metals are necessary for a healthy life, high concentrations may have a severe detrimental effect on biological systems (Tiller K, 1989). In this chapter, the most important effects of heavy metals on the environment are discussed.

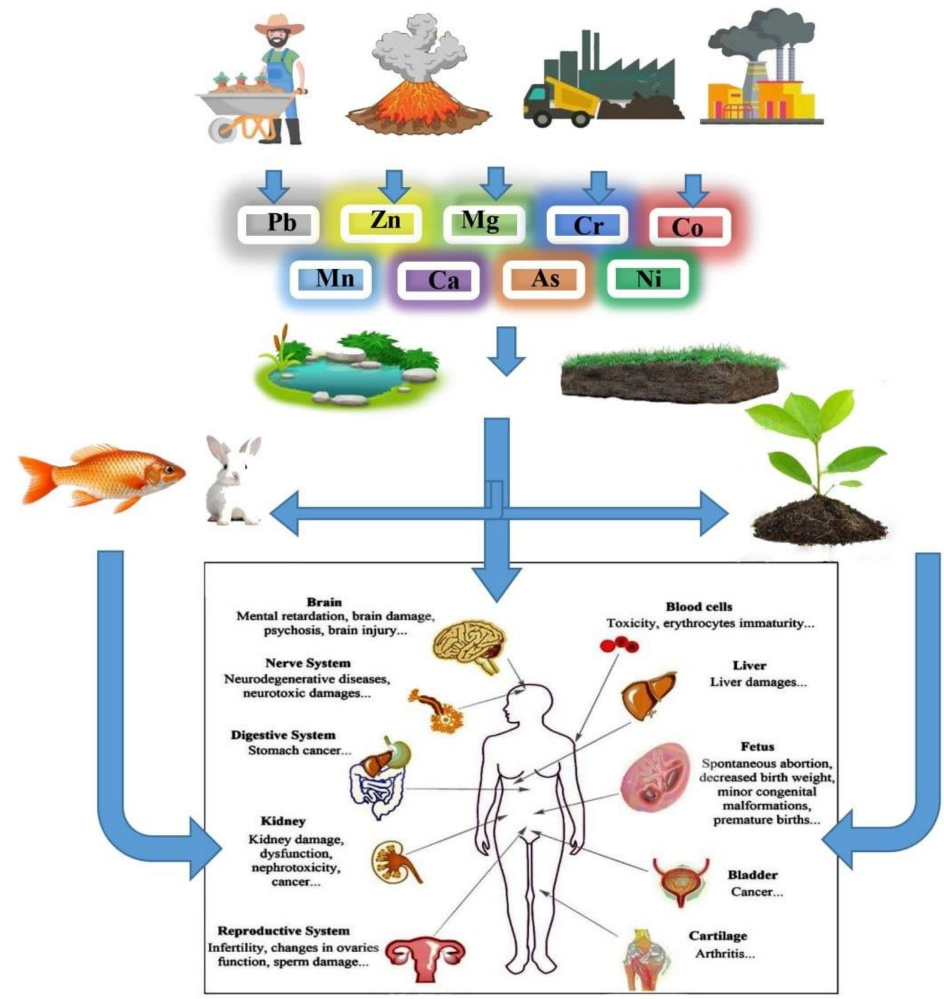

Figure-1. Source of Heavy metals and their harmful effects on human health (Sonone S S, Jadhav S, Sankhla M S and Kumar R, 2020).

Bioavailability of HMs in food webs

Food chains have the potential to transport and bio-accumulate heavy metals. There is also a pressing need for efficient monitoring of heavy metal concentrations in the marine environment. Issues are currently being brought to the fore at local, regional, and national levels due to concentrations of heavy metals (HMs), as well as their impacts, distribution, and environmental origin. Most organisms are significantly affected by heavy metal bioaccumulation patterns. Various sources of heavy metal release have negative effects on marine life (Khan, Zaidi & Musarrat, 2009). Due to their presence in the environment, which results from human activities such as farming, industry, or vehicle emissions, as well as contamination during food processing and storage, metals can arise as residues in food. It has been shown that the level of lead concentration in bread was affected by automobile exhaust fumes (Weli & Iwowari, 2014). There is a correlation between the number of cars and the amount of lead in the bus terminal (Al-Hassan & Norziah, 2012; Singh, Gupta, Kumar &

Sharma, 2017). Edible vegetables near road construction sites have been contaminated with heavy metals, affecting humans and animals living there (Otitoju et al., 2012). Herb toxicity is another problem, where herbs have long been used to treat and prevent a variety of diseases, including headaches, stomach pain, diabetes, hypertension, and others (Sankhla, Kumari, Nandan, Kumar & Agrawal, 2016; Song & Li, 2015). The presence of contaminants, including pesticides, bacteria, heavy metals, chemical toxins, and adulterants, may be the cause of phytotoxicity (Saad et al., 2006). Plants that are part of food need minerals as micronutrients. Plant roots contain large amounts of minerals involved in nitrogen metabolism, enzymes, and a significant proportion of many different proteins (Baby Joseph, Jency George & Jeevitha, 2012). Seafood has a high percentage of arsenic (Chouhan, Meena & Poonar, 2016). In agriculture, phosphate-based fertilizers, wastewater irrigation, livestock manures, atmospheric deposition, and metal pesticides are among the sources of heavy metals (Gall, Boyd & Rajakaruna, 2015). Many meals also contain lead, but the most important sources are fruits and vegetables. Zinc is abundant in dairy products, meat, fish, poultry, and grains. The range of arsenic is more limited, most commonly found in meat, fish, poultry products, and shellfish, but it is not important in the diet. It has been discovered in recent years that cereals are significant food sources (Rai, Lee, Zhang, Tsang & Kim, 2019).

Bioaccumulation of HMs in Seafood

Water is an essential need for all organisms on Earth. Since contaminated water can put citizens' health at risk through direct or indirect exposure to hazardous substances, clean water is necessary for a healthy lifestyle. Human activity and the industrial revolution have exacerbated environmental degradation. Large-scale pollution releases into the ocean have put coastal habitats at grave risk. Heavy metals (HMs) are extremely dangerous environmental contaminants due to their chronic toxicity, non-biodegradability, and environmental bioaccumulation (Munir et al., 2021; Zaynab et al., 2022). When minerals come into contact with water, they are dissolved. Acid mine drains are formed when sulfur rocks in mining are exposed to ambient oxygen. Consequently, heavy metal concentrations are important indicators of quality (Diami, Kusin & Madzin, 2016). Even when wastewater is treated in sewage treatment plants, heavy metals are typically not removed, which increases the danger of heavy metal contamination of the soil and, eventually, the food chain (Fytianos, Katsianis, Triantafyllou & Zachariadis, 2001). One of the main contaminants in our food supply is heavy metals. The human diet is incomplete without vegetables, which are especially rich in the well-known trace elements and heavy metals. If minor or trace elements originate from organic or plant sources, they are necessary for optimal health. On the other hand, they turn harmful if they originate from a metallic or inorganic source. The cycling of nutrients, including trace elements, from soil to plant is essential to plant development processes. Because their leaves absorb heavy metals, vegetables—especially leafy vegetables—accumulate larger concentrations of toxic metals (Mohamed et al., 2010). In cities, municipal drainage as a source of industrial land and soil-related wastes has been a common practice in many parts of the world for the past 400 years. Twenty million hectares (ha) of agricultural land globally are thought to be irrigated using wastewater. Studies conducted in several Asian and African cities reveal that 50% of vegetable wealth in urban areas comes from agriculture that relies on wastewater for irrigation (Wallvik, Själander, Johansson, Bjuhr & Jansson, 2007). Fish may be harmed by chromium released onto the water's surface (Sall, Diaw, Gningue-Sall, Efremova & Aaron, 2020). Many terrestrial and aquatic animal and plant species are hazardous to concentrations of cadmium. For example, it might distort small freshwater fish bones (Pinto et al., 2003). Fish that consume cadmium are known to have elevated blood pressure and cardiac disorders. Research indicates that mercury causes hemorrhages, blood cell depletion, and damage to the blood vessels in fish (Sonone, Jadhav, Sankhla & Kumar, 2020). Anemia and growth and development retardation are brought on by zinc deficiency (Duruibe, Ogwuegbu & Egwurugwu, 2007).

Bioaccumulation of HMs in soil

The primary components of the earth's crust are heavy metals, which are persistent environmental pollutants that can only be converted into benign forms via pure biodegradation (Mishra S et al., 2019). Acting as a non-renewable resource that is a barrier between land, air, and water, soil is currently dealing with complex pollution caused by human activities, indicating a significant contribution to elevated ambient metal concentrations. Heavy metal contamination may affect soils in various ways, especially when the soil is near industrial areas (Cocârţă D, Neamţu S and Reşetar Deac A, 2016). Because of the natural dissolution of parent materials, heavy metals are present in the soil at uncommon concentrations and are not always harmful. In an attempt to become more mobile in the soil and subsequently, biologically accessible than soil formation processes, heavy metals originate from man (Kaasalainen M and Yli-Halla M, 2003; Kabata-Pendias A, 2004; Pierzynski G M, 2000). The physiochemical characteristics of the soil and the relative effectiveness of crops in removing the metals from the soil determine how quickly heavy metals accumulate in the soil. Through various exposure mechanisms, heavy metals deposited in farmed soils can be transmitted to humans and hurt their health (Qishlaqi A, Moore F and Forghani G, 2008). Lead and Cadmium (Pb, Cd) are examples of metals without known physiological effects. Unintentionally adding Cd and potentially hazardous elements to the soil, such as Iron (F), Lead (Pb), and Mercury(Hg), is a result of certain phosphatic fertilizer applications (Mishra S et al., 2019). Many well-known pesticides that were once frequently used in agriculture had high metal concentrations. Arsenic-containing compounds were commonly used to manage livestock ticks and insects in banana plants (McLaughlin M, Hamon R, McLaren R, Speir T and Rogers S, 2000). The way plants use chromium is regulated by a system, on the other hand, plants show genetic changes when chromium concentration in soil is too high i.e. when it becomes toxic Furthermore, plant uptake of chromium may affect soil acidity (Hayat S et al., 2012; Shanker A K, Cervantes C, Loza-Tavera H and Avudainayagam S, 2005). In general, this scenario is only dangerous if plants are stored in areas where the soil contains large amounts of minerals. PH (soil acidity) affects how well plants absorb minerals. Minerals are more soluble and mobile in acidic environments, increasing the likelihood that they may be absorbed and stored by plants. Thus, some heavy metals are transferred from the soil to the human body during the use of plants of this class (Fu Z and Xi S, 2020). When the concentration of heavy metals in the soil gradually increases, it hurts fertility and yield The most common harmful element in soil is lead (Pb) (Mishra S et al., 2019; Zaynab M et al., 2022). The most significant soil chemical factor affecting the mobility of heavy metals in the soil is frequently the pH of the soil. It significantly affects metal speciation at the soil–solution interface and metal solubility, adsorption, and desorption processes. The redox reactions and pH-dependent precipitation or dissolution of the hydrated metal oxides in the soil might explain this. The redox reactions and pH-dependent precipitation or dissolution of the hydrated metal oxides in the soil might explain this (Abdu N, Abdullahi A A and Abdulkadir A, 2017).

Bioaccumulation of HMs in air

Air pollution from heavy metals by many human activities releases significant amounts of heavy metals into the biosphere, including mining, transportation, agriculture, and industrial production. Fossil fuel combustion is the main cause of metal pollution. Cities in emerging nations are mostly caused by unchecked pollution levels, which are a result of contributing factors including the expansion of industry and a sharp rise in the amount of petroleum-fueled transportation. Factors such as irrigation with tainted water, use of fertilizers and metal-based insecticides, industrial emissions, transportation, harvesting, storage, and/or sales can all lead to heavy metal contamination (Munir N et al., 2021; Sardar K et al., 2013). After their release and appearance in human and natural forms, heavy metals are released into many natural systems, such as the pedosphere, hydrosphere, biosphere, and atmosphere (Ayub H, 2020). Airborne minerals can be obtained through emissions from chimneys or pipes, gas or vapor spills, and temporary emissions such as dust from landfills and storage facilities. Metals from airborne sources are often released into the gas stream as particles. Certain metals such as Pb, as, and Cd can also adsorb at high temperatures (Tchounwou P B, Yedjou C G, Patlolla A K and Sutton D J, 2012). Gasoline combustion and volatile Pb emissions into the atmosphere increase, another significant cause of soil contamination, dramatically elevating Pb content in soils near roadways and in urban areas (Chen M and Ma L Q, 1998). The metals that are contained in the tailings are often dispersed by wind and water after their disposal reduced emissions may result from wet rain that eliminates some of the gas or from natural airflow over a large area that can circulate until it dries (Adriano D C and Adriano D C, 2001; Navarro E et al., 2008).

Bioaccumulation of HMs in plant

Certain heavy metals, such as Arsenic (As), Cadmium (Cd), Mercury (Hg), Lead (Pb), or Selenium (Se), are not necessary for plant development since they are not known to carry out any physiological functions in plants. Other elements, such as Cobalt (Co), Copper (Cu), Iron(Fe), Manganese(Mn), Molybdenum (Mo), Nickel (Ni), and Zinc (Zn), are necessary for plants to grow and function normally, but when their concentrations are higher than ideal levels, they can quickly cause poisoning (Garrido S, Campo G M D, Esteller M, Vaca R and Lugo J, 2005; Rascio N and Navari-Izzo F, 2011). Metal pesticides, phosphate fertilizers, use of untreated processed sewage sludge, runoff from roads and industrial areas, and atmospheric deposition of metal-containing particles are some of the ways metals may leak into soils (Gall J E, Boyd R S and Rajakaruna N, 2015). The movement of the metal and its availability in the soil determines the risk of entering the food chain. Minerals can accumulate in plants and other soil-dwelling organisms when they separate from these soil particles and enter the soil solution. The application of waste composts to enhance vegetable-growing soils may be a concern for agricultural productivity, since they may have unintended negative impacts. Given that most vegetable species include edible parts of the plant, it is important to be concerned about the possibility of heavy metals being transferred from soil to people (Jordao C, Nascentes C, Cecon P, Fontes R and Pereira J, 2006). Temperature, moisture, organic matter, pH, and the availability of nutrients are only a few of the variables that affect how heavy metals are absorbed and accumulate in plant tissue (Singh J and Kalamdhad A S, 2011). However, because soil metals are insoluble, only a small portion of them are easily absorbed by plants. Metal ions can enter plant tissues through the cellular membrane of the root and be transported there. Metals are first taken up by the roots apoplast, a free intercellular area that faces the xylem. Plant tissue experiences apo-plastic translocation of heavy metals because of the continuity of the root's cortex and epidermis (Sandeep G, Vijayalatha K and Anitha T, 2019). Plant development, yield potential, and growth pattern are all negatively impacted by metal pollution, which can have both acute and long-term harmful effects. Exposure to heavy metals disrupts respiratory and photosynthetic processes, damages cells, upsets ionic equilibrium, and produces more reactive oxygen. It also inhibits vital microelements, enzymes, and pigments (Reddy A S, 2007; Tchounwou P B, Yedjou C G, Patlolla A K and Sutton D J, 2012; Tepanosyan G, Sahakyan L, Belyaeva O, Asmaryan S and Saghatelyan A, 2018). Cd and Pb are considered nonessential elements for plants. However excess accumulation of such metals in plants severely harms plant growth and reproduction by damaging ion channels and disrupting metabolic reactions and absorption of essential elements (Shah F U R, Ahmad N, Masood K R, Peralta-Videa J R and Ahmad F u D, 2010).

IN HUMAN

Metals are absorbed by plants and animals from contaminated soil, water, and deposits on plant surfaces that are exposed to polluted air. An abundance of these metals in the diet is linked to the genesis of several illnesses (Al-Lami A M A, Khudhaier S R, Aswad O and Al-Lami A M A, 2020). Harmful heavy metals tend to accumulate in vital living organs (Baby Joseph B J, Jency George J G and Jeevitha M, 2012). Heavy metals impair the quality of natural waterways and may seriously damage human health in several ways, including the nervous, renal, liver, and respiratory systems (Tchounwou P B, Yedjou C G, Patlolla A K and Sutton D J, 2012). The phrase“metal trace elements” (MTEs) is often used rather than “heavy metals,” MTEs generalists generally carry a high risk of developing cancer (Sall M L, Diaw A K D, Gningue-Sall D, Efremova Aaron S and Aaron J-J, 2020). Additionally, MTEs can cause bio-regulatory system disturbance that results in functional or psychosomatic illnesses including chronic fatigue syndrome and neurodegenerative pathologies such as Parkinson's and Alzheimer's disease, as well as delays in human growth and development (Poëy J and Philibert C, 2000). Heavily due to agricultural and industrial activities in the soil, water, and air. Causing a wide range of illnesses, including bronchitis, asthma, pneumonia, emphysema, cancer, and heart problems (Singh J and Kalamdhad A S, 2011). When mined ores are poured on the ground surface for hand dressing, heavy metal contamination of surface and subsurface water causes significant soil pollution and pollution grows. The dumping of metals exposed to the air also changed the air environment, and the cement companies discharged a variety of absorbing compounds that impacted the soil's outer surface (Pandey R et al., 2016).

BIOLOGICAL INDICATORS AS A WARNING SYSTEM FOR HMS

Heavy materials originated naturally at the beginning of the Earth and may be evenly or unevenly distributed on Earth, but have entered the environment as a result of human activities including rapid industrial growth, soil and water pollution due to heavy metal accumulation, especially in rapidly developing industrial areas Mines and disposal into other sources (Singh R, Gautam N, Mishra A and Gupta R, 2011; Verma R, Vijayalakshmy K and Chaudhiry V, 2018). Typically, the amount of any pollutant that enters the human body in one of three ways inhalation, ingestion, or dermal contact (Cocârţă D, Neamţu S and Reşetar Deac A, 2016). Eating contaminated food or water high in heavy metals can cause stomach upset as well as diarrhea and vomiting. Increased levels of lead (Pb) may decrease reaction times and cause anemia, a blood disorder in humans (Fay R and Mumtaz M, 1996). In addition to humans, animals and plants are often negatively affected by heavy metals, which negatively affect the amount of bacteria at the microscopic level, which affects the ability of ecosystems to function. In the case of mammals, birds, poultry, crustaceans, and fish (Ansari T, Marr I and Tariq N, 2004; LeFauve M K and Connaughton V P, 2017). These are some of the heavy metals that affect the human body and the harmful effects of heavy metals on human health are tabulated in Table 1.

Zink

Enzymes involved in gene expression are among the many biological processes that zinc is engaged in. Electron transport involves zinc as well. Because of its bioaccumulation, excessive use can have harmful effects such as mutagenesis, teratogenesis, and carcinogenesis (Baby Joseph B J, Jency George J G and Jeevitha M, 2012; Ojo A A, Osho I, Adewole S O and Olofintoye L K, 2017). Enzymes involved in gene expression are among the many biological processes in which zinc is engaged (Das K, Das S and Dhundasi S, 2008). Zinc is a mineral that may be toxic to the brain, but it has a role in controlling decisions about life and death at the cellular level. Consistent with the hypothesis that too much zinc may cause nerve cell death. Zinc probably has a role in neurodegenerative illnesses as well. For example, zinc and dysregulated zinc homeostasis may have a role in the development and course of Alzheimer's disease (Devirgiliis C, Zalewski P D, Perozzi G and Murgia C, 2007; Plum L M, Rink L and

Haase H, 2010). A zinc deficiency raises the risk of diabetes and can cause problems with reproduction (Jamshaid M, Khan A A, Ahmed K and Saleem M, 2018).

Arsenic

Another carcinogen, known as arsenic, causes bladder, liver, lung, and skin cancer. Decreased exposure levels can cause vascular damage, arrhythmias, diarrhea, and vomiting, and decreased red and white blood cell formation (Martin S and Griswold W, 2009). Humans can become toxically exposed to arsenic by unintentional intake of powders or solutions containing the element, suicide, homicide, or consumption of tainted food or water. High dosages of arsenic have been linked to liver impairment, significant effects on the cardiovascular system, and hypertension. In rats, it suppresses gonadotrophin and testosterone secretion as well as spermatogenesis. Diabetes mellitus (type II) and arsenic exposure are correlated. In addition, consuming inorganic arsenic causes several skin conditions, including hyperkeratosis, hyperpigmentation, and hypopigmentation; it can also cause orbital enlargement, spontaneous miscarriage, and nervous system damage. The most prevalent inorganic arsenic in the air is arsenic trioxide (As2O3), although arsenates (AsO4)3- or arsenates (AsO2) can be found in food, water, or soil Increased zinc can cause a variety of health issues, including arteriosclerosis, stomach pains, skin inflammation, nausea, vomiting, anemia, pancreatic root difficulties, and problems with protein metabolism (Chouhan B, Meena P and Poonar N, 2016; Singh J and Kalamdhad A S, 2011).

Mercury

Respiratory mercury poisoning initially appears in vapor form and can then dissolve in blood, plasma, and hemoglobin. It can damage the brain, nervous system, and kidneys. It can easily pass through the uterus and reach the fetus in pregnant women. Due to breast milk contamination, there is still a risk after delivery because mercury can accumulate in this way and poison the nerves, especially in young babies. Mercury poisoning affects all lifestyles and may inhibit growth (Sall, Diaw, Gningue-Sall, Efremova & Aaron, 2020). Mercury causes serious damage to developing fetuses, kidneys, and the brain. All forms of mercury are highly sensitive to the nervous system. Irritability, shyness, tremors, visual or hearing abnormalities, and memory problems can all be consequences of brain dysfunction. Increased blood pressure or heart rate, skin rashes, eye irritation, vomiting, diarrhea, and lung damage can all result from brief exposure to high concentrations of metallic mercury vapors (Agrawal, Singh, Sharma & Agrawal, 2007; Martin & Griswold, 2009). Human neural systems can be harmed by mercury toxicity, particularly in young infants (Agrawal, Singh, Sharma & Agrawal, 2007; Sall, Diaw, Gningue-Sall, Efremova & Aaron, 2020).

Cobalt

Adults should take 3 micrograms of cobalt daily. Cobalt enters the body through one of the routes, as part of biomaterials (Czarnek K, Terpiłowska S and Siwicki A K, 2015). In addition, cobalt causes central nervous system abnormalities, lung illness, and asthma. Along with its genotoxic and carcinogenic properties, cobalt inhibits DNA repair, alters gene expression patterns, alters the shape of chromosomes, and causes abnormalities in the mitotic machinery (Dayan A and Paine A, 2001). Cobalt exposure may cause allergic dermatitis that resembles nickel dermatitis and causes scarlet cough with the usual form of hives. Those used in the manufacture of solid metals (tungsten carbide), printing, metalworking, ceramics, textiles, and leather are among the trades affected. Depending on its chemical form (particle, nanoparticle, ion, oxide, hydroxide), In humans, acute oral poisoning causes stomach discomfort, but continued absorption can cause abnormalities in the skin, heart, blood, or lungs. Known about allergies. As a result of further absorption cobalt becomes active, causing Cardiomyopathy characterized by fibrous damage, vacuoles, and interstitial edema with fibrous detachment (Payne L, 1977).

Chromium

It has a wide range of toxicity. For example, Cr^{6+} ions are around 1000 times more poisonous than Cr^{3+} ions. The subsequently reduced chromium species can mediate double-strand breaks in DNA and initiate DNA damage, potentially acting as an eventual genotoxic agent (Sall, Diaw, Gningue-Sall, Efremova & Aaron, 2020). Chronic chromium poisoning in humans can result in mucous membrane irritation, skin rashes, respiratory issues, and even broncho-pulmonary malignancies (Ahmad, Bhatti, Muneer, Iqbal & Iqbal, 2012). Chromium compounds are proven carcinogens to humans and are toxic. Breathing in chromium can irritate the nasal lining, causing nasal ulcers, a runny nose, and respiratory issues including wheezing, coughing, and shortness of breath (Martin & Griswold, 2009). Hexavalent (+6) chromium, which is produced by industrial contamination, is more harmful than trivalent (+3) chromium. Additionally, consuming too much of this form can lead to stomach issues, lung cancer, and skin discomfort (Jamshaid, Khan, Ahmed & Saleem, 2018). Chromium toxicity can cause low sperm count, lung problems, stomach and small intestinal lesions, anemia, and damage to the reproductive system in humans (World Health Organization [WHO], 2000). Chromium affects blood by causing anemia, eosinophilia, lymphocytosis, and injury to the bronchi and kidneys (Sonone, Jadhav, Sankhla & Kumar, 2020).

Lead

One of the most dangerous heavy metals is lead. Lead poisoning is the most common form of poisoning and has severe consequences for the heart, hematopoietic system, and nervous system of humans. High-concentration lead poisoning can cause blood, kidney, and brain problems. Additionally, it can lead to abnormalities in brain development, including psychopathology and learning disabilities. Reduced fertility, fetal death, and spontaneous abortion are all results of lead exposure. It affects the stomach, intestines, heart, and nerves, and can cause cancer and mutations (Pandey, Singh & Kalamdhad, 2016; Singh & Kalamdhad, 2011). Inhibition of hemoglobin synthesis, cardiovascular system damage, and acute and long-term harm to the central and peripheral nervous systems are further effects of lead poisoning (PNS and CNS). This may lead to kidney, blood vessel, nerve, or joint diseases such as rheumatoid arthritis (Odum, 2016). The toxicity of lead and its detrimental effects on human health are widely recognized. Lead penetrates the body through the skin, food, and/or inhalation, damaging the body, particularly the kidneys, and can enter through the blood, soft tissues, and bones. Lead causes mutagenesis and carcinogenesis in human lesions of the immune system, endocrine system, gastrointestinal tract, and reproductive system (Al-Lami, Khudhaier, Aswad & Al-Lami, 2020; Kazemipour, Ansari, Tajrobehkar, Majdzadeh & Kermani, 2008).

Cadmium

One recognized human carcinogen is cadmium. High doses induce severe stomach irritation, which can result in vomiting and diarrhea. Long-term cadmium exposure can cause lung damage, bone fragility, and renal disease (Martin S and Griswold W, 2009). The kidney is the primary human organ affected by cadmium exposure in both the general population and those who are exposed at work (Chouhan B, Meena P and Poonar N, 2016). The gradual accumulation of cadmium in the body causes several adverse health consequences, mostly to the kidneys, liver, and vascular system (Al-Lami A M A, Khudhaier S R, Aswad O and Al-Lami A M A, 2020). The appearance of its effects is almost as dangerous as that of lead and mercury. Cadmium can raise blood pressure and cause kidney problems in humans. In addition, breathing it in can be harmful. Chronic exposure to cadmium causes "itai-itai" syndrome, a condition that results in irreversible kidney disease and may eventually lead to kidney failure (Sall M L, Diaw A K D, Gningue-Sall D, Efremova Aaron S and Aaron J-J, 2020). The earth's crust naturally contains cadmium. Acute exposure to markedly elevated cadmium levels can cause a range of harmful health effects, such as vomiting, diarrhea, fever, lung damage, and muscle soreness. Chronic cadmium consumption can cause diseases like kidney and bone damage, reproductive issues, and potentially even cancer (Jamshaid M, Khan A A, Ahmed K and Saleem M, 2018).

Table 1. The harmful effects of heavy metals on human health (Jan A T et al., 2015; Sonone S S, Jadhav S, Sankhla M S and Kumar R, 2020).

Heavy metals	Hazards
Zn	Cramping, weariness, nausea, kidney damage, and dizziness.
As	Impacts several vital biological functions, including ATP production, oxidative phosphorylation, arsenicosis, carcinogen, and cancer.
Hg	Brain damage, lung and kidney failure, autoimmune illness, depression, sleepiness, tiredness, hair loss, insomnia, memory loss, restlessness, alteration of eyesight, tremors, and outbursts of rage.
Co	Paralysis, low blood pressure, and diarrhea.
Cr	Hair loss, ulcers, nephritis, and cancer.
Pb	Heart disease risk and neurotoxic effects.
Cd	Endocrine disruptors, carcinogens, carcinogenic substances, lung and kidney damage, and brittle bones all have an impact on how calcium is regulated in biological systems.
Ni	Lung cancer, allergies that cause itching, immunotoxicity, neurotoxicity, teratogenicity, carcinogenicity, genotoxicity, and mutagenicity, as well as issues with hair loss and fertility.

Nickel

Nickel has a special place among the heavy metals found in the crust of the earth.in air when can be exposed to the skin for a long time it can cause itching and sometimes sensitivity and inflammation. By entering the body, nickel salts can cause vomiting, diarrhea, and prolonged inhalation of nickel in the form of minerals or monoxide can cause some cases of asthma and bronchial dysfunction (Hayyat M S et al., 2020; Révész C et al., 2004). Red blood cells (RBCs) need nickel in small amounts to be assembled, but in large amounts, nickel becomes invisibly poisonous. Infants of women employed in a nickel hydrometallurgy refining factory showed an increase in anatomical abnormalities 89 Strong carcinogens, nickel compounds can cause neoplastic transformation in both human and rodent cells. There were additional observations of alveolar cell hyperplasia, bronchiole inflammation, and sometimes lumen congestion (Mishra S, Dwivedi S P and Singh R, 2010).

CONCLUSION

As a result of population growth, heavy discharges of agricultural wastewater containing chemical fertilizers, as well as industrial wastewater discharges from mining, chemical and electrical manufacturing, and soil degradation, lead to the formation of heavy substances. Given their widespread presence in the environment, through soil, plants, food, seawater, and air, heavy metals can cause several health problems, including cancer, growth problems, cardiovascular disease, kidney damage, and more Loss of bone. Regarding the future of heavy materials, no physical, chemical, or biological process can break down heavy metals into a harmless by-product only plants and bacteria can convert it to a less harmful form. Environmental toxicity of heavy metals is a major concern due to possible effects on human and animal health. Removing these metals from the soil and water around industrial plants has been difficult for many years. Therefore, to conserve rare natural resources and biodiversity they need more efficient solutions.

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