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STUDIES AND EXAMINATIONS OF HEAVY METAL IONS IN BLOOD SAMPLES FROM HUMANS

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Abstract:

Toxic heavy metals are persistent, non-biodegradable contaminants that accumulate via the food chain. Therefore, the presence of any hazardous heavy metal in the soil, water, air, or food beyond a specific threshold is regarded to pose a major danger to human health. There is no hard data on the amount of heavy metal content in Keralans' blood or the degree of heavy metal contamination in food or other environmental samples. One of the biggest causes of mercury pollution for consumers and professionals worldwide continues to be dentistry. One of the main causes of human exposure to mercury is thought to be fish intake. Even though some Keralites lead completely vegetarian lives, rice and fish continue to be the typical diet of the ordinary Keralite. In the aforementioned d circumstances, a quasi-experimental examination was conducted on the accumulation of nine heavy metals in human blood, particularly mercury in connection to dentistry, and three dangerous metals including mercury in some environmental samples. Based on each heavy metal's blood levels (BL), the effects of heavy metals on people were evaluated. Fish, rice, paddy soil, fairness creams, and drinking water samples were among the environmental and dietary items examined. The three sources of human mercury exposure that were specifically examined were fish eating among the study population, occupational exposure in dentistry owing to amalgam treatment, and exposure due to amalgam treatment in both dental practitioners and the general public.

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1 INTRODUCTION:

Heavy metals are substances that are at least five times as heavy as water. These metals or their compounds are found all over the place in nature, whether as dissolved salts or ions in water, minerals found in soil or rocks, or as particulates or fumes in the air. When heavy metal levels exceed particular thresholds, they may poison species in a variety of ways. Heavy metals can infiltrate food chains and other systems. Heavy metal pollution may come from human, industrial, or natural sources. The main entry points for heavy metals into the human body include contaminated soil, air, drinking water, food, medications, or medical facilities. Most heavy metals are toxic to living things even at low doses. Once the harmful heavy metals have entered the body, they may affect the cellular production of extremely reactive free radicals, which will then cause the sulfhydryl groups of proteins to oxidize. Heavy metals are hence referred to as systemic toxicants.

According to the World Health Organization, the top three substances of substantial public health concern are arsenic, lead, and mercury. Most heavy metals are hazardous to many living things, notably humans, yet they generally have no recognized advantages. But nowadays, it is normal for people to be exposed to such dangerous heavy metals. One of the causes of heavy metal poisoning in humans continues to be careless or negligent handling of heavy metals or similar minerals. As a result, monitoring the buildup of heavy metals in individuals has become a crucial public health approach in many countries. Unfortunately, due to little research and inadequate knowledge of the origins and toxicities of heavy metals, such relevance is not recognized in underdeveloped countries.

Metals are not biodegradable and remain in the environment, in contrast to organic hazardous compounds (Jan et al. 2015). As a result, the presence of any hazardous heavy metal in soil, water, air, or food in excess of a particular amount is deemed to pose a major danger to human health. This is due to the fact that dietary intake and food chain pathways are thought to be significant means through which

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harmful heavy metals accumulate in people. Metal toxicity varies depending on the kinds, forms, and exposure pathways. Mercury is a deadly poisonous heavy metal that is present in the environment, making exposure to it very risky.

The environment we ostensibly "live in" has developed into a massive repository for hazardous elements. Due to rising chronic exposure to such metals that negatively impact people's quality of life, human health is constantly at danger of declining. The quest to provide for man's fundamental needs of food, clothes, and shelter has continuously increased biosphere pollution. The degradation of human health as a result of exposure to heavy metals has grown to be a significant global problem. Heavy metal exposure persists and in some places is even increasing, especially in less developed nations, despite the fact that emissions have decreased in the majority of developed countries over the past century. This is despite the fact that the harmful health effects of heavy metals have long been known.

2 LITRAETURE SURVEY

Because of their direct impact on living things, metals with atomic densities greater than 5 g/cm-3 and atomic weights ranging from 63.5 to 200.6, such as zinc (Zn), iron (Fe), lead (Pb), chromium (Cr), mercury (Hg), and nickel (Ni), are considered the main pollutants for fresh water reserves (Nurhadi et al., 2018). One of the most elusive and persistent environmental risks to the world's inhabitants throughout time has been the percolation of heavy metals into water bodies and ecosystems (Chee).Based on their toxicity and mobility in naturally occurring water streams, heavy metal ions are categorized as priority pollutants. However, since they cannot be eliminated or degraded, heavy metal ions remain stable and persistent against changes in the environment. The issue has worsened as a result of the mass discharge of highly concentrated metal ions containment effluent into the rivers as industrialisation increases. The scientific community has used a variety of treatment techniques to date to cleanse the water and remove any heavy metal ions. These techniques include membrane filtration, coagulation, evaporation, ion exchange, adsorption, chemical oxidation or reduction, chemical precipitation, reverse osmosis, and ion exchange.

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Adsorption is one of the most economical methods because it is simple to use, highly effective, and requires little maintenance, whereas other treatment options may have drawbacks like high reagent and energy consumption, incomplete metal removal, low selectivity, high operational costs, and issues with disposing of the secondary waste produced during the treatment process. The most well-known and often used adsorbent has been activated carbon, although its cost is high. As a result, research is being done to replace activated carbon with alternative inexpensive adsorbents as fish bone (im et al., 2012). The discharge of wastewater from the industrial, agricultural, and household sectors into waterways may lead to the contamination of that water with hazardous heavy metals, which is a serious issue for environmental experts. Arsenic, cadmium, and chromium emission are significantly attributed to rapid industrialisation and population growth. Mercury, nickel, copper, lead, and other hazardous heavy metals are found in water streams. Since these metals are nonbiodegradable and bioaccumulative, becoming concentrated throughout the food chain, they may be separated from other harmful contaminants. Heavy metals are released into the environment as industrial effluents by a number of different businesses.

The primary sources of heavy metal contamination in the environment are battery manufacturing, electroplating, metal processing, mining, paint and pigment manufacturing, petroleum refining, pesticides, printing and photographic industries, and tanneries. Since these heavy metals are responsible for a number of diseases and disorders, they must be eliminated before discharge. 2016 (Shalini Srivastaval). Due to their persistence and nonbiodegradability, hazardous materials that are released in large quantities into the environment, such as when sewage is used to irrigate agricultural fields, have caused a number of environmental issues and may pose a serious threat to human health (Reena Malik, 2015).For their removal from industrial effluents, a variety of Physico-chemical techniques have been suggested. Adsorption is a powerful filtration and separation method used in industry, particularly in the treatment of water and wastewater. Cost is a crucial factor to consider when evaluating different adsorbent

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materials. In aqueous solutions, fish bone will be examined as a potential metal ion adsorbent. (2018) Hakima El Knidrio

3 METHODS AND ANALYSIS

Heavy metal contamination in the soil is an issue that has been generated by many anthropogenic operations without any safety precautions. This problem has persisted as a result of mass industrial and anthropogenic activity for many generations and is expected to become worse in the future. A vast set of elements with densities typically more than 5 g/cm3 are referred to as heavy metals[4]. These components are crucial for both industrial and biological processes. Different quantities of heavy metals may be found naturally in the earth's crust and surface soils [5]. Small quantities of metals are removed from the bed rocks by natural processes like weathering and erosion, which then let them move about in water and the atmosphere. Heavy metals including Zn, Se, Cu, and Fe are crucial for maintaining the body's metabolism and are involved in many enzymatic, chemical, biological, and biochemical processes in the cells of plants, animals, and people [6].

Due to their non-biodegradability, lengthy biological half-lives, and capacity to accumulate in many bodily areas, heavy metals are very hazardous [7]. Due to their solubility in water, the majority of heavy metals are very poisonous [8]. Heavy metals may be harmful to humans and animals even at low doses since there is no effective way to remove them from the body. The heavy metals are absorbed more quickly than they are broken down or eliminated. Even the heavy metals that are thought to be necessary may become harmful if there is an excess of them [9]. The danger to human health from heavy metals is that they may impede crucial metabolic processes [10]. There are more than twenty heavy metals, but just four, lead (Pb), cadmium (Cd), mercury (Hg), and arsenic (As), are particularly harmful to human health and the environment [11]. They are poisonous and even in extremely small doses they may be harmful. The U.S. Department of Health and Human Services' Agency for Toxic Substances and Disease Registry (ATSDR), located in Atlanta, Georgia, has created a priority list known as the "Top 20 Hazardous Substances." This list includes the heavy metals arsenic (1), lead (2), mercury (3), and cadmium (7) [11]. via

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chemical immobilization, bio-concentration in plants, or biomagnifications via a food chain, these heavy metals may build up to potentially dangerous amounts in soils and sediment [12].

A full chemical analysis of a material with an unknown composition entails the identification of its elements using qualitative analytical techniques and the quantification of the amounts in which these components are present. In general, a preliminary qualitative analysis is necessary. The identification of a single chemical is often the primary goal of qualitative inorganic analysis. The basis for qualitative analysis is the use of concrete examples of key chemical ideas such ionic equilibria, solubility products, oxidation-reduction processes, and the creation and stability of products [13]. The substances utilized for any qualitative analysis exercise are often in the form of salts, although other substances such as free elements (metals and non-metals), metallic oxides, hydroxides, and free acids may also be detected by using standard techniques. The identification of chemical elements in a sample by the emergence of an analytical signal, such as the creation of any precipitate, a distinctive crystal, a change in color, the separation of gaseous products, etc., is known as qualitative detection of any element. A chemical reaction produces any analytical indication. Some components in mixes using fractional techniques are detected using particular reagents and processes.

4 RESULTS AND DISCUSSION

Generally speaking, the chemical reactivity of metal ions with cellular structural proteins, enzymes, and membrane system is what causes their toxicity in mammalian systems [3]. It has been shown that these heavy metals may damage humans and other animals both acutely and chronically [4]. Excessive levels of heavy metals in the environment pose a major danger to all living things. The food chain turns into the primary route through which persistent heavy metals infiltrate higher species since these heavy metals bio collect and bio amplify in live creatures [5]. All of the human blood samples obtained from various locations were examined. According to the method recommended in the literature, the chosen heavy metals (As, Pb, Cd, and Hg) were qualitatively assessed in human blood samples. According to the findings of a qualitative

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examination of human blood samples for heavy metals, 30% of the samples tested positive for the presence of As. Hg was found to be present in 16% of the total samples. 44% of samples were found to contain Pb, while 11% of samples showed the presence of Cd. The research of the identification of specific heavy metal ions in blood samples is shown in the following figure.

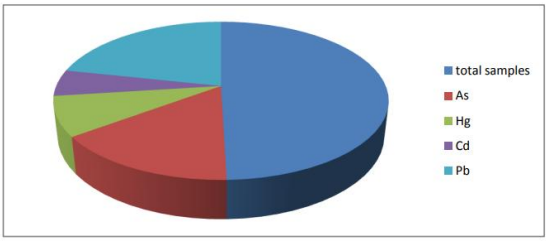

Figure 4.1 Identification of selected heavy metals in collected human blood samples

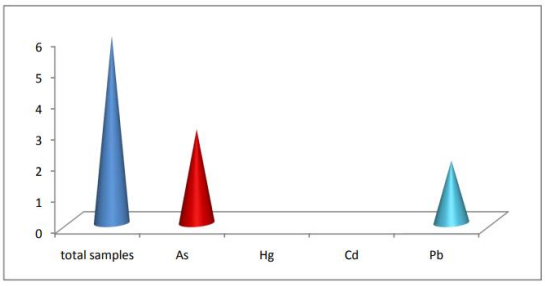

Figure 4.2 Graphical representation of selected heavy metals in human blood samples collected from Nimbahera

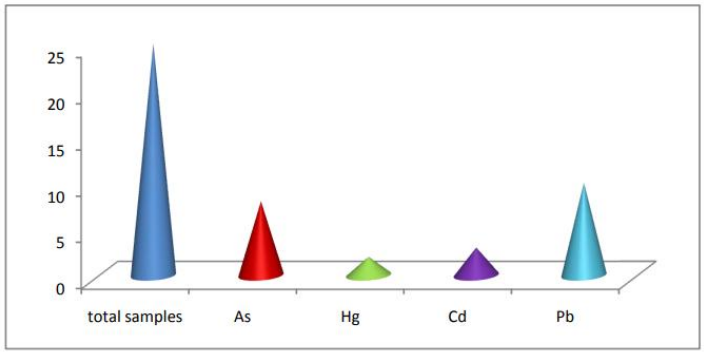

Figure 4.3 Graphical representation of selected heavy metals in human blood samples collected from Kota

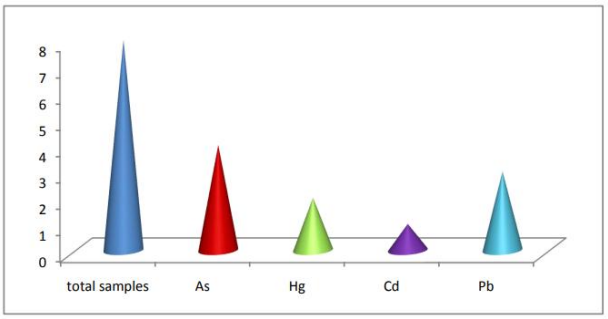

Figure 4.4 Graphical representation of selected heavy metals in human blood samples collected from Jaipur

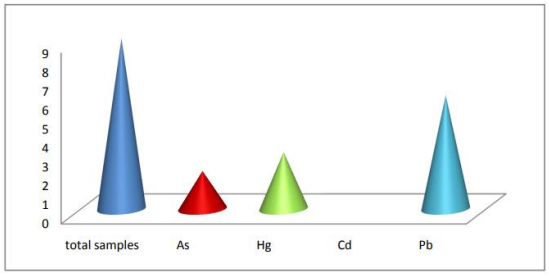

Figure 4.5 Graphical representation of selected heavy metals in human blood samples collected from Ajmer

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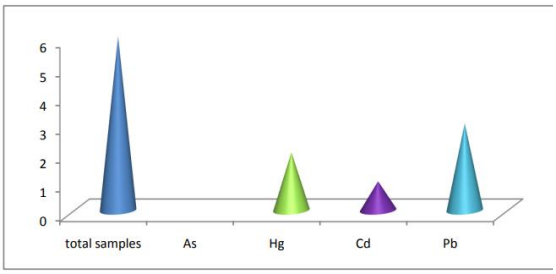

Figure 4.5 Graphical representation of selected heavy metals in human blood samples collected from Chittorgarh

The aforementioned information demonstrates that blood samples taken from major cities like Jaipur and Kota have higher percentages of certain heavy metals present. The production and usage of arsenical pesticides and wood preservatives may be the origins of arsenic pollution in these cities .Due to the increasing population density in these cities, increased levels of heavy metal pollution (mostly Pb and Cd) may also be brought on by automotive emissions. Heavy metal content was increased close to the roadside soil, according to soil study in a few chosen Kota roadside sites . In addition to that, drinking water has also been implicated in the pollution of heavy metals in a small number of Kota district locations. High concentrations of hazardous heavy metals have been observed in textile manufacturing effluents. In some cities, untreated industrial effluents that are released either separately or alongside home waste water also create issues. Such wastewaters are utilized for irrigation in rural India, which has caused heavy metal biomagnification in crops and grains [16].

5 CONCLUSION

It was discovered by qualitative analysis that samples older than 20 years included more Pb than As, with 25% of samples older than 20 years containing As. Intake of lead per unit body weight is greater in children than in adults, which increases the possibility of negative consequences from lead exposure in children. Lead exposure in young children is also caused by certain toys, which contain lead. Nearly 27% of the total samples from people in the age range of 21 to 40 were found to contain As, while nearly 40% of the samples tested positive for Pb. In 9% of the blood samples from this age range, Hg and Cd were present. Because heavy metals have a wider range of applications in household, industrial, and agricultural settings, as well as having a widespread dispersion in the environment, volunteers in this age group may have occupational or non-occupational exposure to heavy metals. Nearly 47% of the blood samples from

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the third subcategory, which included samples from those aged 41 to 70, tested positive for As, while 42% of the samples tested positive for Hg. Indicators of Cd and Pb were found in 13.3% and 20% of the samples, respectively. Since the volunteers in this age group have been exposed to the environment for a longer period of time than others, it is predicted that they have experienced more heavy metal exposure.

It is clear from the above statistics that a significant portion of volunteers between the ages of 20 and 40 were positive for Pb, and a significant portion of samples between the ages of 41 and 70 were positive for As. There were also a considerable number of samples from the age groups of 41–70 and 21–40 that contained Cd and Hg.

Heavy metal contamination in human blood samples is a widespread issue that is unrelated to any particular age group, geographic location, or sex. We are all equally susceptible to the harmful effects of heavy metals, and both occupational and non-occupational exposure might be to blame. Using qualitative analysis, one may quickly and affordably identify the presence of heavy metals in samples of human blood. The results of the study above show that young children are more susceptible to lead poisoning, which has also been shown in earlier research. It is also known that lead exposure rises with age. When it comes to cadmium, there may be some gender differences to be noted. According to worldwide research, cadmium retention is often found to be greater in females, and its level in blood is typically impacted by smoking behaviors. Arsenic's distinct and well-known toxicity has long been understood. The main ways that people are exposed to pollutants are via food, inhalation, and skin absorption, however environmental amounts vary greatly depending on the local geology and pollution sources. In many regions of the globe, surface and groundwater contain large amounts of arsenic. Since it is mostly of natural origin, it could be a notable component even in places with very little industrial or other pollution. Therefore, regular people's exposure to arsenic might result in a bad situation.

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