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HEAVY METALS IN DRINKING WATER AND THEIR IMPACT ON HUMAN HEALTH

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ABSTRACT

In the study work (articles) of different writers, the concentrations of heavy metal pollution in different water sources such as ground, surface, and tap water were gathered from diverse water origins (sources) in a specific region. The heavy metal content was measured by the researchers using conventional literature methods in their individual study. Atomic Absorption spectroscopy, Differential Pulse Anodic Stripping Voltammetry (DPASV), samples acidified to 1% with nitric acid, and then kept in double-capped polyethylene bottles were used in their study. Heavy metals discovered in their study work included Cd, Cr, Cu, Fe, Pb, Co, Mn, Hg, Ni, and Zn. When contrasted to national and international agencies such as WHO (2008), USEPA, EUC, and EPA, the amounts found were greater than the standard permissible and recommended level. The scientists discovered detrimental impacts on human health as a result of the heavy metal contents found in their study effort. Water tests are not acceptable for drinking reasons until they are treated with water agencies due to the quantities of heavy metals(determined) examined from the study papers. As a result, the purpose of this study is to evaluate the research work on heavy metal concentrations in drinking water sources done by various writers in their published studies. The physiological consequences (damages) to public health have been seen when water from such sources (regions of their respective territories) is used for drinking purposes.

KEYWORDS: *Concentration, Drinking, Heavy Metals, Human Health, Physiological Parameters.*

1. INTRODUCTION

Toxic metals are often employed in industrial, governmental, and urban runoff, and they may damage people and other living things. Growing levels of trace metals, particularly heavy metals, have been found in our waterways as a result of increased urbanization and industrialization. Many hazardous chemical components collect in the soil and sediments of water bodies after being discharged into the environment(1)(2)(3).

There are more than 50 elements classed as heavy metals, with 17 of them being very hazardous and easily accessible. Anions play a significant role in drinking water, and the consequences have been shown to have an impact on health. The degree of toxicity is determined by the kind of metal, its biological function, and the species that are exposed to it. Heavy metals have a significant impact on aquatic flora and fauna, which, via bio magnification, penetrates the food web and eventually affects humans. Lead, iron, cadmium, copper, zinc, chromium, and other heavy metals in drinking water have all been related to human toxicity(4)(5)(6).

They are needed by the body in tiny quantities, but in high concentrations, they may be harmful. If present, they form a significant category of ecologically harmful chemicals. Heavy metals, such as copper, are necessary trace elements, but they may be hazardous in large levels in drinking water. Cadmium is highly hazardous at low doses, and it will bio-accumulate in organisms and ecosystems. Cadmium has a biological half-life of 10 to 33 years in the human body. Renal impairment is also caused by long-term exposure to Cadmium. As a result, cadmium is one of the most closely monitored contaminants in most nations and international agencies. Water pollution is inextricably linked to water contamination. The quality of ground and surface water sources must be constantly assessed(7)(8)(9). Damaged or decreased brain and central neurological function, as well as a lower energy level, are recognized deadly consequences of heavy metal poisoning in drinking water. They also induce plasma composition irregularities, wreaking havoc on critical organs including the liver and pancreas. Exposure bracketing to heavy metals results in physical, muscular, and cognitive degeneration processes that lead to Alzheimer's disease, Parkinson's disease, muscular dystrophy (progressive skeletal muscle weakening), and multiple sclerosis (a nervous system disease that affects brain and spinal cord), Lead is also one of the most frequent heavy metals found in drinking water, and when levels exceed the legal limit, it causes general metabolic poisoning and enzyme inhibition(10)(11)(12).

Lead has the capacity to replenish calcium in bone, allowing long-term replacement sites to develop. Heavy metals, like as copper, are necessary trace components, but they may be harmful in excess. Toxicity may be caused by any heavy metal if it is present in water supply in excess of its original limitations. Drinking water comes from a number of places, including wells, rivers, lakes, reservoirs, and ponds. Because of the pollution of these supplies, the different sources of water represent the biggest danger to human health. Heavy metals, bacteria, fertilizers, and hundreds of hazardous organic compounds are the most common water contaminants. Heavy metals in water are only present in tiny amounts, yet they are more harmful to humans. Given the dangers of heavy metals pollution in water, it was necessary to start this research to evaluate the issue and propose methods to reduce the risk of harmful heavy metals pollution of drinking water(13)(14).

Going to follow the analysis of the United Nations International Drinking Water Supply and Sanitation Decade (IDWSSD) from 1981 to 1991, (since June1991) the onset of a new era of economic reform efforts and liberalization, drinking water has been debated as a good or service to be priced or paid for by the user. Within the federal structure, constitutional rights and responsibilities regarding water are muddled, as all three levels of government, namely the federal government, state governments, and city municipalities at the village and city level, deal with water. Guidelines for the concentration of heavy metals in drinking water have been established by several international institutions such as the USEPA, WHO, EPA, and the European Union Commission in order to reduce the toxicity of heavy metals in drinking water and to safeguard human health(15)(12)(11).

2. DISCUSSION

The work of (different) writers on water contaminants has been (discussed) examined. The amount of heavy metals discovered in their study has been included together with the maximum permissible level. The resultant trace elements and their concentrations in drinking water were compared to WHO, USEPA, EPA EUC, MAC, and other international organizations. The average concentration of all examined metals in the waters studied were far below their desired limits (WHO-2008), resulting in a number of health-related concerns. Heavy metals found in drinking water samples were Pb, Cd, Cu, Zn, As, Mn, Cr, Ni, Co, Fe, and their amounts were determined by the authors. The presence of heavy metals in drinking water samples has been linked to the development of chronic illnesses. Various writers have compiled lists of heavy metals in drinking water, as well as their negative impacts on human health. Surface, ground, and tap waters were gathered in various parts of Lagos Metropolis as the source of drinking water sample(10)(16)(17).

Lead, copper, and cadmium were detected in the samples, and their amounts were compared to WHO (2008) recommended contamination limits for drinking water. The findings revealed that all these heavy metals are present in significant quantities in all the well fluid and bore whole water samples tested. The amounts of lead and cadmium were found to be higher than the WHO's maximum tolerable levels (MAC). Copper values above the WHO (MAC) for copper were found in none of the samples. Only the sample taken from the Odo-lyaalaro stream indicated that Ojota was not contaminated with lead(13). All of the metals tested were polluted in other samples. As a consequence, the results indicated environmental risks, including significant lead (Pb) emissions in drinking water from the combustion of ships and boats that utilize the route. The amount of lead detected in drinking water samples ranged from 0.020 mg/L to 0.215 mg/L. Lead is a toxic element that may harm nerve connections (particularly in young children) and cause blood and brain problems, therefore the maximum permissible concentration findings are concerning. Disruption with haemosynthesis, which leads to hematological damage, is one of the most significant and severe biochemical consequences of lead(18). The discovery of high amounts of Pb and Cd in nearly all argons is cause for worry, as is the possibility of human exposure to heavy metals from eating fish caught in the lakes. A powerful neurotoxic that builds up over time in soft tissues and bone. It is a cumulative toxin that may cause cancer in humans. The populace has been compelled to utilize whatever grade of water is available in local water sources due to the insufficient and inconsistent delivery of water via the pipe water supply. Waterborne illnesses and other health risks result as a result. The maximum permissible concentration of metals is 0.l mg/L. (WHO-2008). A little amount of copper is necessary for optimum health, but too much may be detrimental.

Copper poisoning may result in mortality due to nervous system, liver, and renal failure if significant quantities of copper compounds are consumed. The lowest copper concentrations found in tap, surface, and ground waters were 0.020 mg/L, with the highest value being 0.120 mg/L, according to the results of the study. Copper concentrations in the water samples were all below the maximum permissible level (1.5 mg/L). Copper, on the other hand, was found in all of the water samples, and because toxicity is linked to long-term low-level exposure, this may lead to severe health consequences. Copper poisoning may induce vomiting, stomach discomfort, nausea, and diarrhea, and copper has been known to leak into drinking water from copper pipes. Heavy metal pollution may be avoided by simply removing plumbing components that include lead, copper, or galvanized steel(19). Chronic anemia may be caused by consuming water contaminated with a high amount of copper. Ingesting copper has been related to coronary heart disease and high blood pressure in studies, but copper deficiency has also been connected to coronary heart disease. All of the samples had measurable levels of Cadmium, with values above the maximum permissible concentration for drinking water (0.003 mg/L) and surface water (0.01 mg/L) based on the results of the DPASV Cadmium analysis. Cadmium concentrations in drinking water samples ranged from 0.010 mg/L to 0.110 mg/L. There have been a few cases of Cd poisoning in humans due to the eating of contaminated seafood. The highest Cd concentration that may be tolerated is 0.005 mg/L.Thus, only the surface water sample 8 showed no Pb contamination and no water sample exhibited Cu pollution, whereas all the other samples showed Pb and Cd pollution. (As a result, the water sample is unfit for human consumption(20)(21).

Similarly to Ehi-Eromosele C. O. et al., the author Javid Hussain et al. collected water samples from Mardan District, KPK, Pakistan, to evaluate trace element concentrations such as Ni, Pb, Cr, Cd, Zn, and Cu. They also measured the levels of cations such as Na, K, Mg, and Ca in a drinking water sample from Mardan, KPK, Pakistan. The water from the Mardan tube well is only suitable for drinking once Mg is removed by boiling, according to the results of the date analysis. Heavy metal concentrations in drinking water samples varied from 0.01–0.10 mg/L to 0.00–0.03 mg/L, 0.01–0.02 mg/L, 0.00 mg/L, 0.01–0.16 mg/L, and 0.00– 0.01 mg/L. According to international organizations such as the World Health Organization (WHO-2008), the normal concentrations of each current heavy metal are Ni – 0.05 mg/L, 0.05 mg/L, 0.005 mg/L, Zn – 5.0 mg/L, 0.05 mg/L, and Zn – 5.0 mg/L, respectively. Na+, K+, Mg2+, and Ca2+ concentrations were determined to be 24.5–140 ppm, 3.5–5.9 ppm, 62.4–144 mg/L, and 144–292.8 mg/L, respectively. As a result, the drinking water in the Mardan regions was hard, and hardness promotes cardiovascular disease death in humans(22).

So, according to Javid Hussain et al.,2012[11], the heavy metal ions density in Mardan districts drinking water, as well as the levels of sodium cations potassium, calcium, and magnesium, but the water of the Mardan division was free of any heavy metal pollution, and all analyses were found to be within the permissible limit except the Mg level. GebrekidanMebrahtu and Samuel Zerabrukconducted research on heavy metals in drinking water and found that the concentrations of heavy metals in drinking water samples collected from urban areas in the Tigray region of Northern Ethiopia had some physico-chemical parameter values that were higher than the WHO recommended maximum admissible limits. A total of 106 samples of drinking water were taken from 16 highly populated metropolitan regions(23). They used conventional procedures to evaluate six physicochemical parameters, including temperature, conductivity, total dissolved solids (TDS), salinity, pH, and turbidity, as well as 10 heavy metals, including As, Cd, Co, Cu, Cr, Fe, Mn, Ni, Pb, and Zn. Other national and international standards were used to compare the findings.GebrekidanMebrahtu and Samuel Zerabruk In terms of physicochemical parameters, 84.01 percent for electrical conductivity, 47.17 percent for TDS, and 31.13 percent for sediment show concentrations higher than 93.4 percent of the samples were within the USEPA admissible pH limit (6.5-8.5), and all of the samples analyzed were within the Eu(1998) admissible pH limit (6.5-9.5)(24).

Manganese and copper were found to be below the WHO's maximum permissible levels in all samples, while arsenic (40.3%), cadmium (7.46%), chromium (64.18%), iron (37.31%), nickel (7%), and lead (29.85%) above the WHO's maximum permissible and desirable values (2008). The WHO does not specify a maximum permissible level for cobalt in drinking water, however all of the samples tested met the New Zealand (1000 g/L) and USEPA (100 g/L) maximum permissible limits. Despite the fact that WHO (2008) has not established a standard for zinc levels in drinking water, 94.02 percent of the samples tested meet the New Zealand standard, and 97.01 percent meet all of the maximum permissible values referred to in their research. As a result, the area's environmental risks and poor drinking water treatment methods are revealed, with serious human health consequences. As a result of their study, the government and other relevant authorities are advised to take necessary remedial action.

During the years 2003-2007, N. H.-Zarel, N. Saadati1, M. Hassonizade1, P. Barati1, M. Ahmadi1, and Z. Nazari2 collected 52 grab water samples from the Karun river in Ahvaz city. The researchers wanted to see how much chromium, copper, lead, cadmium; zinc, manganese, and iron were in the water of the Karun River in Ahvaz. Cr, Cu, Pb, Cd, Zn, Mn, and Fe levels in samples were found to be in the range of (150.86-3.22), (69-8), (36.71-3.18), (51.4-0.02), (1578.5-19.3), (365-1.97), and (8295-815), respectively. Cd had the highest and lowest mean values, 2.42 and 2940.33 ppb, respectively. As a result, the mean amounts of all examined metals in the waters tested were substantially underneath the WHO and EPA maximum contamination limits for drinking water.

Heavy metals, such as nickel, have been shown to have a cancerous impact on rats, according to Sunderman. Although Ni accumulates in aquatic life, its amplification throughout the food chain has not been shown. Similarly, although zinc is necessary for good health, too much of it may be detrimental and lead to zinc toxicity. Because cobalt is a component of vitamin B12, which is important for health, it is helpful to humans. It promotes the formation of red blood cells and is used to treat anemia in pregnant women. Co concentrations that are too high may be harmful to people's health. Local institutions should be focused on preserving, developing, and enhancing water bodies in the event that the water becomes polluted.At this point, the presence and functioning of para-statal agencies in various rural regions of the nation must be mentioned. Such initiatives by NGOs/CBOs or even charitable individuals, while irregular and frequently at a micro-level, are significant in and of themselves(25).

3. CONCLUSION

According to the authors' study, metal concentrations in water samples collected are higher than the permissible and acceptable limits (WHO, EUC, EPA, USEPA). The majority of the water samples were taken at the population level, making them unfit for human consumption. The scientists stated in their article that constant monitoring of different water sources is required since the findings revealed high levels of contamination, indicating that a large percentage of the population is at danger high toxicity of such metals. The drinking water in the affected regions has to be purified by quality control authorities. Unless someone has gone through a specific water treatment process, the water is safe to drink. People may get ill as a result of consuming water with excessive levels of heavy metals. They may have physiological effects on the kidneys, the digestive system, the circulatory system, the neurological system, as well as other organs and systems in the body.

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