Chronic Kidney Disease of Unknown Etiology (CKDu) In Hadejia Valley (Kano, Jigawa and Yobe States, Nigeria): Preliminary Assessment of Heavy Metals in Water From Different Sources Along The Valley

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ABSTRACT

Chronic kidney disease of unknown etiology (CKDu), a major life-threatening disease is becoming rampant in Nigeria and notable in Hadejia Valley. Continuous exposure to heavy metals and environmental toxins in water contributes to diseases like CKDu. This research is conducted in Hadejia Valley covering part of Yobe State, (Gashua and Nguru) Jigawa State, (Birniwa, Kirikasamma, Hadejia, Auyo, Gujungu, Taura, and Ringim), and Kano State (Zakirai), to determine the effects of environmental toxins and gene polymorphism on CKDu. The study intends to find out the presence, and concentration of Fluorine (F), Cadmium, (Cd) Lead (Pb) Arsenic (As), from randomly selected water from different sources. Sources were (i) River Water -WRW (ii) Pond Water -WPW (iii) Well Water -WWW (iv) Tap Water –WTW and (v) Bore Hole Water –WBW. Collected water samples were digested and analyzed using an Atomic Absorption Spectrophotometer (AAS model Agilent-AA55) Findings from the research suggest significant contamination of water sources in Hadejia Valley, particularly with lead and cadmium, both of which are nephrotoxic heavy metals linked to chronic kidney disease. Hadejia has the highest levels of fluorine and lead, making it a hotspot for contamination. Gashua shows the highest cadmium contamination, which is concerning due to cadmium's strong link to kidney disease. Auyo has the highest arsenic levels, posing long-term health risks. Cadmium and lead pose the highest health risks, exceeding WHO limits in multiple locations. The lack of significant variation between water sources suggests a widespread pollution issue rather than localized contamination. Immediate intervention is needed to ensure safe drinking water and mitigate CKDu risks. Other measures including urgent monitoring of water sources are required to prevent or at least reduce CKDu outbreaks.

Keywords: Kidney, Water, Hadejia Valley, Heavy Metals, Concentration and Contamination

INTRODUCTION

Chronic kidney disease of unknown etiology (CKDu) is a term used to describe a form of chronic kidney disease that is not attributable to any traditional risk factors, such as diabetes or hypertension and no specific single agent has yet been identified (Lunyera et al., 2015). Kidney disease is one of the major life-threatening health problems. (Ahmed, et al., 2017). There is documented evidence of CKDu in Nigeria notable in some communities of the Hadejia Area of Kano, Jigawa, and Yobe States. (Ahmed et al., 2017).

Exposure to heavy metals and environmental toxins occurs in water, foods and air over some time (Hassan et al., 2015). The protective role of metallothionein proteins against nephrotoxic heavy metals toxicity has been established. (McNeill et al., 2019). Genetic polymorphisms of the Metallothionein gene in humans can lead to low expression of MT or the production of an abnormal form of the metallothionein protein leading to low expression of MT and possibly CKDu. Considering the rampant cases within the study area and the fact that CKDu affects the life and socio-economic development of the population, the study becomes indispensable.

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Reports of kidney-related diseases of unknown causes have been rampant in Kano, Jigawa, and Yobe States for over 10- 20 years with findings from this area indicating the highest prevalence of 35% when compared to many other parts of the country with a record of only 20 to 25% prevalence (Nuraddeen et al., 2018).

The level of toxins exposure by humans is linked to chronic kidney diseases in humans (Chen et al., 2019), similarly, environmental factors and genetic variations contribute to disparities in the disease risk. Low MT expression theoretically predisposes an individual to heavy metals and differences in MT could alter the susceptibility of an individual's kidney to disease due to toxicity by nephrotoxic heavy metals (Klaassen, et al., 2009).

Heavy metal pollution index (HPI) HPI is a critical indicator assessing the suitability of water for drinking and various other purposes (Moldovan et al. 2022; Baskaran and Abraham 2022). The HPI values, spanning from 4909 to 8830 (Fig. 8) were significantly higher than the standard limit of 100 (Oni 2016; Baskaran and Abraham 2022). Consequently, the groundwater is contaminated and considered unsuitable for human consumption.

Heavy metal evaluation index (HPI) is a critical measure used to gauge the levels of heavy metal pollution in water sources (Herath et al. 2022; Chorol and Gupta 2023). In the recent analysis, HEI ranged from 408 to 673 (Fig. 8), significantly surpassing the acceptable threshold of 20 (Rezaei et al. 2019; Herath et al. 2022; Chorol and Gupta 2023). These results indicate that the exanimated water samples are severely contaminated with Ni, Co, Cd, Cr, Pb, As, Hg, Li, and MO, rendering them hazardous to human health.

The concentrations of heavy metals in water in every region can be compared with the standard range set by the World Health Organization (WHO). For heavy metals, such as Fe the highest and maximum desirable limit is 1.0 and 3.0 mg/l, Pb and Mn 0.4 and 0.4 mg/l, Cd 0.003 and 0.0 mg/l 3, Cu 0.5 and 2.0 mg/l, Zn 1.0 and 3.0 mg/l, Hg 0.001 and 0.001 mg/l and As 0.001 and 0.001 mg/l.

Level of toxins exposure by human is linked to chronic kidney diseases in human (Chen et al., 2019), similarly, environmental factors and genetic variations contribute to disparities in the disease risk. It is unknown whether genetic polymorphisms of MT and environmental toxins including heavy metals are mediated to adversely affect individual’s kidney. Low MT expression theoretically predisposes individual to heavy metals and differences in MT could alter the susceptibility of individual’s kidney to disease due to toxicity by nephrotoxic heavy metals (Klaassen, et al., 2009).

Heavy metal evaluation index (HPI) The HEI is a critical measure used to gauge the level of heavy metal pollution in water sources (Herath et al. 2022; Chorol and Gupta 2023). In the recent analysis, HEI ranged from 408 to 673 (Fig. 8), significantly surpassing the accept able threshold of 20 (Rezaei et al. 2019; Herath et al. 2022; Chorol and Gupta 2023). These results indicate that the exanimated water samples are severely contaminated with Ni, Co, Cd, Cr, Pb, As, Hg, Li, and MO, rendering them hazardous to human health.

An important feature that my influence the water quality in any given area is the anthropogenic activities and geology of an area. The geology of the Hadejia valley in Jigawa State, Nigeria, is characterized by a mix of sedimentary and basement complex formations and the valley is underlain by the Chad formation in the northeast and a basement complex of igneous origin in the south while the subsurface lithology includes various rock types such as sandstones, shales, limestone, silt, and clay. Muhammad et al., (2023). The area also was reported to contain weathered layer and a fresh basement (bedrock) and the northern part of the valley is covered by the Chad formation, a sedimentary deposit. The southern portion of the valley is underlain by a basement complex, consisting of solid igneous rocks with a weathered mantle on top.

The subsurface of Hadejia Valley is composed of various layers, including topsoil, weathered basement, fractured basement, and fresh basement. Resistivity surveys reveal varying electrical resistivity values for different layers, indicating the presence of different rock types and their relative water-bearing potential. Implications for Water Resources showed aquifer potential. The geological formations, including the weathered layer and fractured basement, play a role in groundwater recharge and storage, (Idris, 2023).

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RESEARCH METHODOLOGY

The research currently is been conducted in some parts of Yobe State, (Gashua and Nguru) Jigawa State, (Birniwa, Kirikasamma, Hadejia, Auyo, Gujungu, Taura, and Ringim), and Kano State (Zakirai). All the sites lie midway along the Hadejia Valley. In each of the 10 sites concentrations of nephrotoxic heavy metals and residual herbicides and pesticides in soil water and plant materials from different sources of water and soil were collected from and analyzed using an atomic absorption spectrophotometer (AAS). The samples were analyzed using two research centres and the data was derived after validation of the AAS analysis of the sample.

All Statistical analyses involve SPSS Version 23 computer software (SPSS Chicago, IL, USA), and data were recorded as mean± standard deviation. All statistical tests was considered significant at $p \leq 0.05$.

Samples Collection

All samples were collected on the indicated GPS points and within 3km to the nearest indicated named towns.

Study Area

Source: Cartography Unit, Bayero University Kano, Nigeria (2022)

Sampling Points

S/No	Collection Area	Collection Points
1	Gashua	12’52’01N 11’01’10’E
2	Nguru	12’52’12’N 10’26’07’E
3	Birniwa	12’47’30’N 10’14’36’E
4	Kiri Kasamma	12’41’04’N 10’15’09’E
5	Hadejia	12’26’26’N 10’01’47’E

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6	Auyo	12’21’54’N 09’55’21’E
7	Gujungu	12’21’29’N 09’34’51’E
8	Taura	12’13’20’N 09’17’26’E
9	Ringim	12’08’12’N 09’09’46’E
10	Zakirai	12’05’39’N 08’52’51’E

Water Samples Collection Techniques

The River Water –WRW, Pond Water –WPW, Well Water –WWW, Tap Water –WTW and Bore Hole Water –WBW were collected from the field. Sterilized Labelled Sampling Bottles were used for the collection of all water samples.

The predetermined location (GPS) of all collection sites was accurately identified and recorded, in-situ parameters including the Location, pH, temperature, and Electricity Conductivity of the water were determined and recorded before each sample was collected.

River Water (WRW) samples were collected from nine points in the river including the mid-river and points close to the two banks on the left and right side of the river and on each point water sample was collected from the surface, mid-way down the depth and the bottom of the river. Water from the nine points was mixed thoroughly and 10ml was collected from such, in a labeled specimen bottle stored in an iced box and transported to the laboratory for storage and analysis.

Pond Water (WPW) samples were also collected from nine points including the mid pond and points close to the two banks on the left and right side of the pond on each point water samples were collected from the surface, mid-way down the depth and the bottom of the pond, the water mixed thoroughly and 10ml finally collected from such, in a labeled specimen bottle and transported to the laboratory for storage and analysis. Well Water (WWW) samples were drawn from the well using the plastic container three consecutive times and mixed thoroughly and 10ml was collected.

Tap Water (WTW) samples were collected by opening the tap and immediately water was drawn after the water in the tap ran for about 30 seconds another sample collected and the third sample collected after another 30 seconds and later mixed thoroughly and 10ml finally be collected.

Bore Hole Water (WBW) samples were collected from mechanized boreholes at each sampling bole hole it was operated to allow water to run and immediately water drawn and afterward the second sample was collected as water ran out for about 30 seconds and the last sample collected as water runs out for another 30 seconds.

The water collected was mixed thoroughly and 10ml was collected. All the above-mentioned measurements and analysis processes are made according to the international standard of the WHO and as reported by Ahmed et al., 2025.

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Water Sample Digestion and Analysis

To digest water samples, 10ml each of the samples was digested with perchloric acid and nitric acid ratio (1 : 1) HNO_3-$HCLO_4$, followed by sulphuric acid. The mixture was heated at 200°C for 30 minutes. The complete digest was then cooled to room temperature and made up to 50 ml scale with distilled water.

Determination of Metal Concentrations

All the samples were subjected to Fluorine (F), Cadmium, (Cd) Lead (Pb) Arsenic (As) analyses using Atomic Absorption Spectrophotometer (AAS model Agilent-AA55) after selecting the various wavelengths at which the heavy metals were determined. An analytical blank was prepared similarly. The obtained results were expressed as mg/kg wet weight.

RESULTS AND DISCUSSION

Key statistical analyses, including descriptive statistics, ANOVA, LSD, correlation analysis, and visualization through heatmaps and boxplots, provided a deeper understanding of contamination patterns across different water sources presented in the result.

The results of the analysis of the five heavy metals in the water samples collected from ten (10) locations including Gashua, Nguru, Birniwa, Kiri-Samma, Hadejia, Auyo, Gujungu, Taura, Ringim, and Zakirai as compared with WHO Limit across Hadejia Valley is shown in the Table 1 below.

Heavy Metals in Water Samples

The result of the analysis of the heavy metals in the water samples collected is shown in Table 1 below.

Table 1: MeanConcentrations of Flourine (F), Cadmium, (Cd), Lead (Pb) and Arsenic (As) (mg/kg) in River Water –WRW, Pond Water (WPW), Well Water (WWW), Tap Water (WTW) and Borehole Water (WBW) from Hadejia Valley, July, 2022

$p \leq 0.05$. **Gashua Nguru Birniwa K/Samma Hadejia Auyo Gujungu**

	Locations											

Taura Ringim Zakirai LSD WHO Limit

12’52’01N 12’52’12’N 12’47’30’N 12’41’04’N 12’26’26’N 12’21’54’N 12’21’29’N 12’13’20’N 12’08’12’N 12’05’39’N

11’01’10’E 10’26’07’E 10’14’36’E 10’15’09’E 10’01’47’E 09’55’21’E 09’34’51’E 09’17’26’E 09’09’46’E 08’52’51’E

Water Source Heavy Metals

River Water Fluorine (F), 1.502 1.501 1.428 1.383 1.517 1.429 1.301 1.302 1.411 1.333 0.184 1.500

(WRW) Cadmium, (Cd) 0.012 0.005 0.006 0.007 0.012 0.011 0.011 0.004 0.005 0.006 0.006 0.005

Lead (Pb) 0.052 0.059 0.063 0.051 0.068 0.059 0.046 0.057 0.052 0.052 0.011 0.050

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	Arsenic (As)	0.050	0.051	0.052	0.053	0.053	0.057	0.049	0.046	0.048	0.045	0.009	0.050
Pond Water	Fluorine (F),	1.505	1.500	1.523	1.524	1.657	1.528	1.521	1.420	1.567	1.502	0.237	1.500
(WPW)	Cadmium, (Cd)	0.013	0.005	0.006	0.006	0.014	0.012	0.004	0.004	0.005	0.006	0.034	0.005
	Lead (Pb)	0.059	0.063	0.063	0.066	0.057	0.045	0.057	0.052	0.054	0.012	0.050	0.050
	Arsenic (As)	0.049	0.051	0.052	0.052	0.057	0.059	0.052	0.045	0.049	0.051	0.01	0.050
Well Water	Fluorine (F),	1.651	1.505	1.519	1.529	1.632	1.511	1.500	1.402	1.512	1.500	0.132	1.500
(WWW)	Cadmium, (Cd)	0.012	0.005	0.006	0.006	0.011	0.012	0.003	0.003	0.005	0.006	0.008	0.005
	Lead (Pb)	0.061	0.054	0.053	0.060	0.062	0.064	0.051	0.050	0.052	0.054	0.012	0.050
	Arsenic (As)	0.053	0.051	0.051	0.053	0.056	0.054	0.051	0.040	0.040	0.051	0.132	0.050
Tap Water	Fluorine (F),	1.440	1.412	1.500	1.500	1.522	1.510	1.508	1.431	1502	1.400	0.012	1.500
(WTW)	Cadmium, (Cd)	0.006	0.006	0.007	0.006	0.012	0.013	0.003	0.004	0.005	0.004	0.009	0.005
	Lead (Pb)	0.045	0.050	0.051	0.051	0.055	0.053	0.050	0.052	0.051	0.052	0.012	0.050
	Arsenic (As)	0.042	0.043	0.046	1.046	0.053	0.051	0.048	0.046	0.045	0.050	0.013	0.050
Borehole Water	Fluorine (F),	0.501	1.455	1.510	1.511	1.513	1.511	1.502	1.448	1.503	1.403	0.1.08	1.500
(WBW)	Cadmium, (Cd)	0.011	0.005	0.009	0.008	0.016	0.015	0.009	0.003	0.005	0.006	0.013	0.005
	Lead (Pb)	0.050	0.051	0.056	0.056	0.052	0.051	0.048	0.051	0.048	0.051	0.008	0.050
	Arsenic (As)	0.048	0.047	0.048	0.049	0.054	0.052	0.049	0.040	0.042	0.049	0.012	0.050

Concentrations of Heavy Metals in Water from Different Sources

River Water (WRW) from all the locations indicated the presence of the heavy metals with samples in most locations having values above WHO limits. It can be observed that river water mid-way in the Valley was found to be more concentrated than upper and lower parts of the valley. Hadejia and Auyo locations that happened to

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be areas of appreciable irrigation agriculture were seen to have higher values of heavy metals. The highest Fluorine (1.517mg/kg) was found in Hadejia and (1.429mg/kg) was observed in Auyo. Zakirai in the uppermost part of the Valley has the least heavy metal concentrations. The higher values of the metals in these areas can be explained by the fact that chemicals including herbicides and pesticides are commonly used in irrigation farming in the area. Ahmed et al (2025) reported Arsenic and Cadmium pollution reaching levels threatening to human health in Wadi Ranya, Saudi Arabia. The heavy metals were observed to be integrated into the river from geological parent material and some agricultural activities in the area Marcelo et al., (2025), made a similar discovery in Brazil where observed suspended matter in river water accounts to a great extent the pollution status of the river.

Pond Water (WPW) sampled from all the locations indicated the presence of the heavy metals with samples in most points having values above WHO limits. It was observed that pond water mid-way in the Valley like river water was found to be more concentrated with the heavy metals than the upper and lower part of the valley. Hadejia and Auyo locations have the highest Cadmium, Lead, and Arsenic (0.014, 0.012, 0.066 and 0.057, 0.057, 0.059mg/kg). The levels of concentrations of the heavy metals in Pond Water (WPW) were observed to be higher than concentrations in the river water. A similar trend of heavy metal contamination where the canal discharge of the Karnaphuli River is significantly more polluted than the river itself (Manik et al., 2024).

Well, Water (WWW) from the ten (10) locations consistently has the presence of heavy metals most ahead of WHO limits. Hadejia, Kiri Kasamma, and Gashua have the highest level of contamination, and highest Arsenic in the Auyo and Hadejia sites. (0.056 and 0.054mg/kg) and Cadmium (0.062 and 0.064mg/kg). It can be observed that the level of contamination in most sampling sites exceeds the level of the heavy metals present in the river water suggesting an indigenous source of pollution in the study area.

Tap Water (WTW) sampled from all the locations indicated the presence of the four heavy metals with some exceeding WHO limits. It can be deduced that Tap water in all locations has the least amount of heavy metals owing to the filtration process the water passes through before delivery to the public.

Borehole Water (WBW sampled from all ten (10) locations indicated the presence of heavy metals and samples in most sampling sites have values above WHO limits. It can be observed that water sampled from boreholes found in the middle part of the Valley like river water was found to be more concentrated than the upper and lower part of the valley. Hadejia and Auyo locations have the highest Cadmium, Lead, and Arsenic (0.016, 0.015, 0.052 and 0.051, 0.054, 0.052mg/kg).

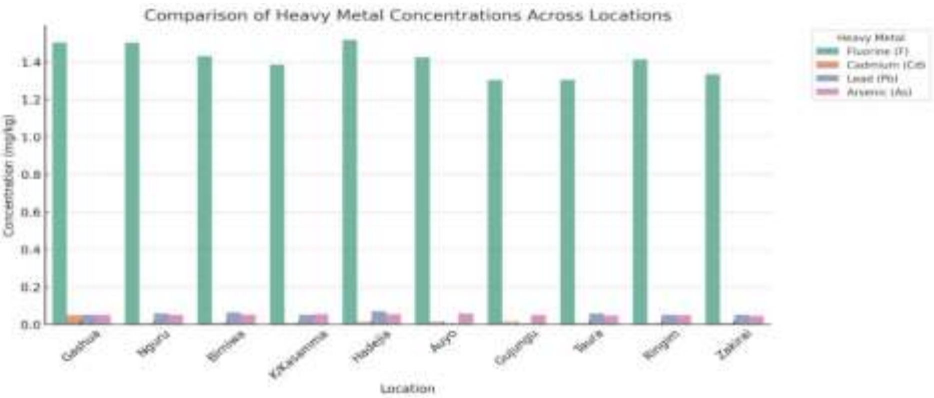

Figure 1: Concentration of Heavy Metals Across 10 Locations in Hadejia Valley, July, 2022

Generally, Hadejia has the highest levels of fluorine and lead, making it a hotspot for contamination. Gashua shows the highest cadmium contamination, which is concerning due to cadmium's strong link to kidney disease. Auyo has the highest arsenic levels, posing long-term health risks.

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Generally, Fluorine (F) was found in three (3) locations exceeding the WHO limit of 1.5 mg/kg. Cadmium (Cd): 7 locations exceeded the WHO limit of 0.005 mg/kg. Lead (Pb): 8 locations exceed the WHO limit of 0.050 mg/kg. Arsenic (As): 5 locations exceed the WHO limit of 0.050 mg/kg.

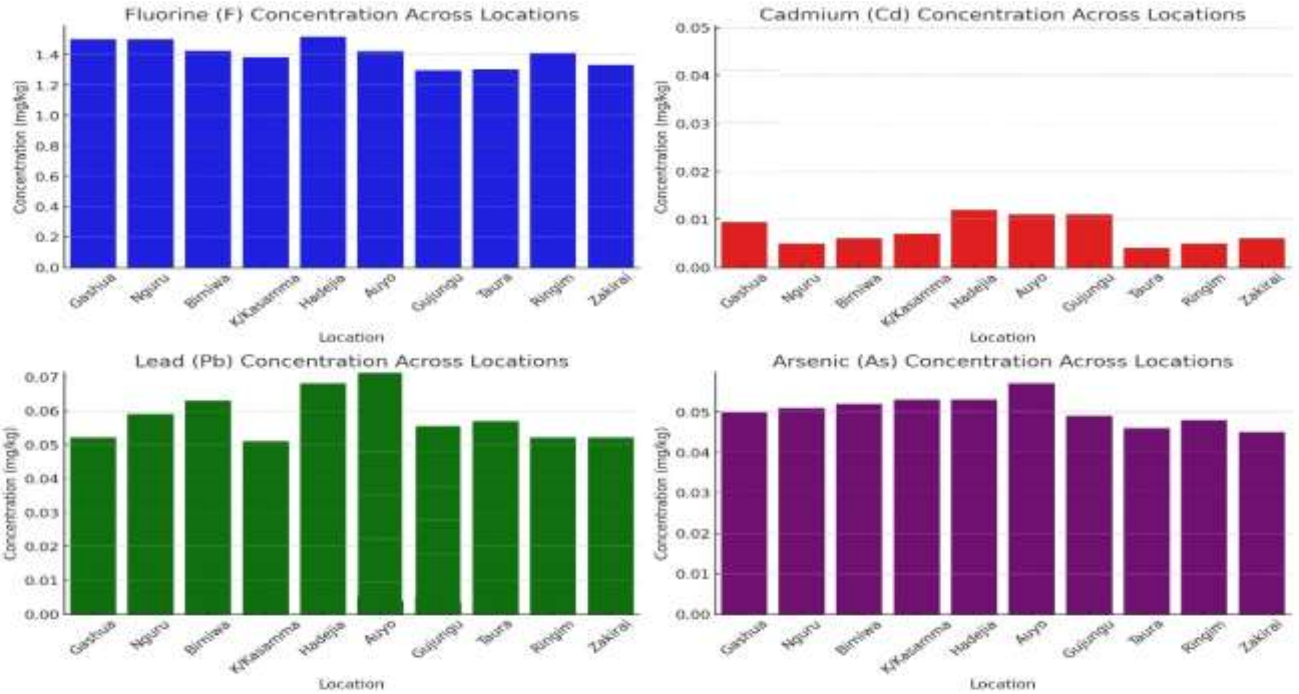

Figure 2: Relative Concentration of Fluorine, Cadmium, Lead and Arsenic in Ten (10) Locations within Hadejia Valley, July, 2022

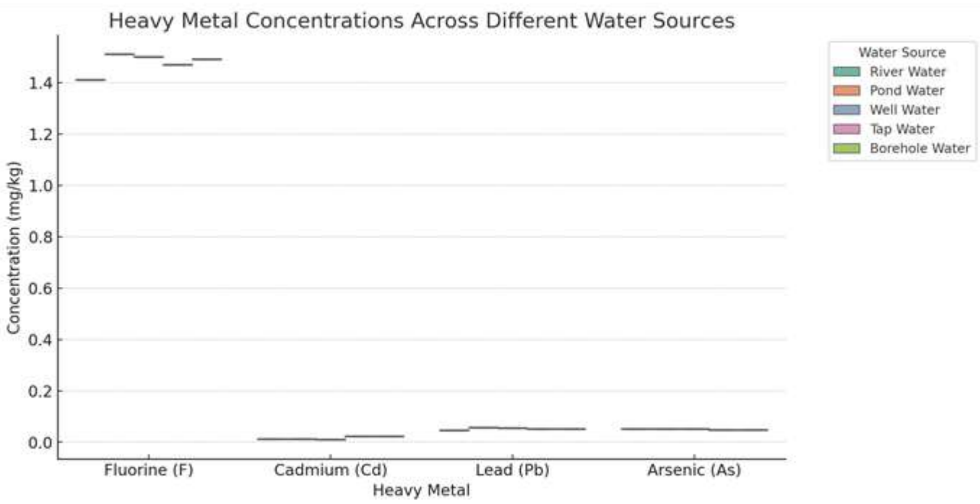

Figure 3: Heavy Metal Concentrations Across 10 Different Water Sources in Hadejia Valley, July, 2022

These findings agree with the work of Eneji, et al, (2023) who discovered permissible limits for safe drinkable water, though high mean values of Fe was observed at the control sites compared to order samples but elevated Pb levels above the WHO permissible limit were recorded in most of the sampled areas with Orji, Okwu-Uratta, and Ihitte-Ogada showing higher average values of 0.07 ± 0.03, 0.08 ± 0.02 and0.07 ± 0.04 mg/L.

The presence and concentration of the heavy metals particularly Lead and Cadmium can be attributed to the geology of the study area that was reported to compose of mix of sedimentary and basement complex formations and the valley is underlain by the Chad formation in the northeast and a basement complex of igneous origin in the south while the subsurface lithology includes various rock types such as sandstones, shales, limestone, silt,

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and clay. Muhammad et al., (2023). Sediments from the area is found to have some Lead and Cadmium. Gashua and Hadejia locations are relatively more cosmopolitans than other sites hence industrial and other commercial activities in these two areas is likely the factor that makes heavy metals to be higher in Hadejia and Nguru.

Correlation of the Heavy Metals

Fluorine (F) and Lead (Pb) showed a strong positive correlation (0.93) and this suggests that areas with high fluorine contamination also tend to have high lead contamination. The result may indicate a common contamination source (e.g., industrial waste, or soil leaching). Cadmium (Cd) and Arsenic (As) had a strong negative correlation (-0.94). It was observed that water sources with high cadmium levels tend to have lower arsenic concentrations and vice versa. This is likely due to geochemical interactions where one metal dominates adsorption sites in soil/water.

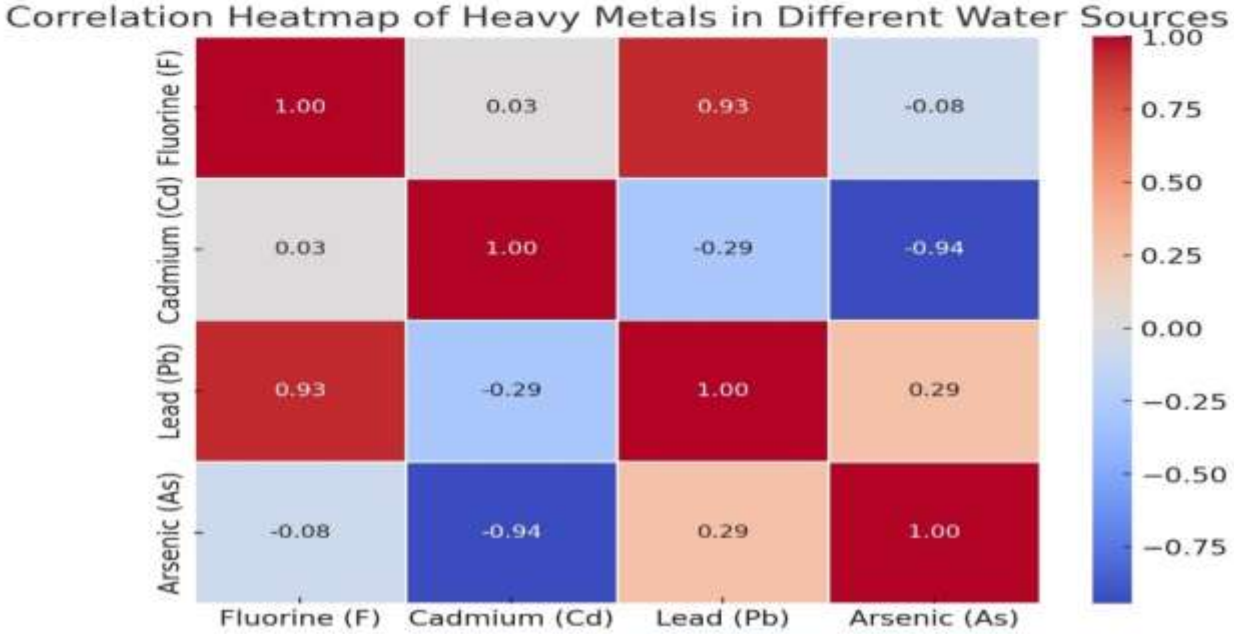

Figure 4: Correlation Heatmap of Heavy Metals in Different Water Sources in Hadejia Valley, July, 2022

Lead (Pb) and Arsenic (As) had a weak correlation (0.29). No significant co-occurrence pattern was observed.

The strong correlation between fluorine and lead suggests that certain sites might be affected by similar pollution sources (e.g., industrial effluents, and agricultural runoff). The negative correlation between cadmium and arsenic indicates potential differences in contamination sources or water treatment mechanisms.

The contamination levels are relatively uniform across different water sources. This suggests a widespread environmental issue affecting all water types rather than localized pollution and possible explanations include geogenic contamination (heavy metals naturally occurring in soil and leaching into water probably agricultural activities uniformly affecting all water sources.

Fluorine (F) and Lead (Pb) are strongly positively correlated (0.93): This suggests that areas with higher fluorine contamination also tend to have higher lead contamination. Cadmium (Cd) and Arsenic (As) are strongly negatively correlated (-0.94): This indicates an inverse relationship, meaning that water sources with higher cadmium levels tend to have lower arsenic concentrations and vice versa. Fluorine (F) and Cadmium (Cd) show no significant correlation (0.03): This suggests that their presence is independent of each other in different water sources. Lead (Pb) and Arsenic (As) have a weak positive correlation (0.29): A minor association exists, but it's not strong enough to indicate a definitive pattern.

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The correlation analysis revealed interesting relationships between the heavy metals. Fluorine (F) and Lead (Pb) showed a strong positive correlation (0.93) and this suggests that areas with high fluorine contamination also tend to have high lead contamination. The result may indicate a common contamination source (e.g., industrial waste, or soil leaching). Cadmium (Cd) and Arsenic (As) had a strong negative correlation (-0.94). It was observed that water sources with high cadmium levels tend to have lower arsenic concentrations and vice versa. This is likely due to geochemical interactions where one metal dominates adsorption sites in soil/water.

Lead (Pb) and Arsenic (As) had a weak correlation (0.29). No significant co-occurrence pattern was observed.

Heavy Metal Concentration Levels and WHO Limits

Fluorine (F) Mean concentration: is 1.41 mg/kg while the WHO limit stands at 1.50 mg/kg. It exceeded the WHO limit in 3 locations but the values were relatively close to the WHO limit, indicating moderate contamination in some areas.

Cadmium (Cd): Mean concentration: 0.0115 mg/kg while WHO limit is 0.005 mg/kg. It exceeded the WHO limit in 7 locations. The presence of cadmium above the permissible limit is concerning as cadmium is nephrotoxic and a major risk factor for kidney diseases.

Lead (Pb): Mean concentration: 0.046 mg/kg and WHO limit is 0.050 mg/kg exceeded WHO limit in 8 locations. Lead contamination was the most widespread issue, strongly associated with kidney damage, cognitive impairments, and other health problems.

Arsenic (As):Mean concentration: 0.0504 mg/kg and WHO limit is 0.050 mg/kg, exceeded WHO limit in 5 locations. Arsenic exposure is linked to long-term kidney damage, cancer, and cardiovascular diseases.

Generally it can be deduced from the research that Cadmium and lead showed the highest number of exceedances relative to WHO limits. The contamination levels suggest that long-term exposure to these metals could be contributing to CKDu in the region. The high presence of these metals in drinking water sources (well and borehole water) poses serious health risks.

The strong correlation between fluorine and lead suggests that certain sites might be affected by similar pollution sources (e.g., industrial effluents, and agricultural runoff). The negative correlation between cadmium and arsenic indicates potential differences in contamination sources or water treatment mechanisms.

The contamination levels are relatively uniform across different water sources. This suggests a widespread environmental issue affecting all water types rather than localized pollution and possible explanations include geogenic contamination (heavy metals naturally occurring in soil and leaching into water probably agricultural activities uniformly affecting all water sources.

Potential Health Impacts of the Heavy Metals

A 2023 study by Zakariyya, et al, (2023) focused on evaluating groundwater quality in Hadejia and Atafi districts of Jigawa State, Nigeria, by analyzing heavy metal concentrations in selected boreholes. The study found that some boreholes exceeded the permissible limits for chromium and iron, while other heavy metals were within acceptable ranges. Additionally, the study highlighted the importance of understanding hydrogeological factors and potential contamination sources for effective groundwater management in Nigeria and the study revealed that certain boreholes in the Hadejia and Atafi districts had elevated levels of chromium and iron, exceeding both Nigerian and World Health Organization standards for drinking water.

The presence of lead, cadmium, fluorine, and arsenic in water sources observed in this study is alarming due to their well-documented effects on kidney health: Cadmium (Cd) is a known nephrotoxin that accumulates in kidney tissue over time. It causes proximal tubule dysfunction, leading to CKD and irreversible kidney failure.

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Long-term exposure is linked to bone demineralization, lung disease, and cancer.

Lead (Pb) Impairs kidney function by causing oxidative stress and inflammation. Chronic exposure is linked to hypertension, neurological damage, and cardiovascular diseases. Arsenic (As) Chronic exposure causes nephrotoxicity, diabetes, and cancer. Epidemiological studies link arsenic-contaminated water to CKD hotspots worldwide.

Fluorine (F) while necessary in trace amounts, excess intake can cause skeletal fluorosis, kidney dysfunction, and dental problems.

CONCLUSIONS

Findings from the research suggest significant contamination of water sources in Hadejia Valley, particularly with lead and cadmium, both of which are nephrotoxic heavy metals linked to chronic kidney disease

Hadejia has the highest levels of fluorine and lead, making it a hotspot for contamination. Gashua shows the highest cadmium contamination, which is concerning due to cadmium's strong link to kidney disease. Auyo has the highest arsenic levels, posing long-term health risks. Cadmium and lead pose the highest health risks, exceeding WHO limits in multiple locations. The lack of significant variation between water sources suggests a widespread pollution issue rather than localized contamination.

Immediate intervention is needed to ensure safe drinking water and mitigate CKDu risks.

As the research is ongoing particularly the polymorphism of Apo-lipoprotein and Metallothioneins genes are being investigated in the study area, correlation of the polymorphism and the pollutants will be investigated and ascertained at the end.

Recommendations

The research revealed the urgent need for water safety and quality control measures to be employed in the study area.

The area equally require urgent monitoring of water sources to reduce the risk of CKDu reported in the study area.

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