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Original Article

Relationships between Tsawa's prevalence of chronic kidney disease and water quality indicators

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ABSTRACT

Background AND AIM: This study investigates the correlation between the prevalence of chronic kidney disease (CKD) and water quality indicators in Tsawa, a city in southern Libya. Given the essential role of water quality in kidney health, this research aims to identify potential environmental risk factors contributing to CKD in the region. **MATERIALS AND METHODS:** 24 groundwater samples were collected from various wells across Tsawa. Each sample underwent biochemical analysis to assess total dissolved solids (TDS) levels and microbiological testing for bacterial contamination, specifically Escherichia coli. Additionally, concentrations of heavy metals, including lead (Pb), cadmium (Cd), and iron (Fe), were measured. Demographic data were gathered through questionnaires to determine water consumption patterns among residents. **RESULTS AND DISCUSSION:** The findings revealed that 20 out of 24 wells had TDS levels within the World Health Organization's (WHO) recommended limits for drinking water. However, one well exhibited a significantly high TDS level, exceeding 1300 mg/L. Microbiological analysis indicated the presence of E. coli in four wells, with low colony counts (3–6 CFU/100mL). Notably, heavy metals were undetectable in all samples. Survey data indicated that approximately 65% of residents consume well water, with 58% drinking 1–2 liters daily. Despite the presence of certain water quality issues, statistical analysis revealed a weak correlation between water quality indicators and CKD prevalence in Tsawa. These results suggest that while water quality may influence kidney health, other factors such as dietary habits, genetic predispositions, and healthcare access might play more significant roles in the development of CKD in this region. **Conclusion**, while water quality monitoring remains crucial, multifactorial approaches are necessary to comprehensively address CKD prevalence in Tsawa. Further research is recommended to explore other potential environmental and lifestyle factors contributing to CKD in southern Libya.

Key words: water, CKD, heavy metals, bacterial contamination, Tsawa, Libya

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INTRODUTION

Water quality plays a crucial role in human health, including development and progression of chronic kidney disease (CKD). CKD is a long-term condition in which the kidneys gradually lose their ability to filter waste products and excess fluids from the blood. Over time, this can lead to kidney failure and other serious health complications. [1].

Water is essential for kidney function as it helps flush out toxins and waste products through urine. When the water consumed is contaminated with harmful substances, it can increase the burden on the kidneys, potentially leading to damage [2]. Poor water quality can come from various sources, such as heavy metals like lead, mercury, and cadmium, as well as pesticides and industrial chemicals, which can be harmful when consumed over time. These toxins can accumulate in the body and cause kidney damage. Waterborne diseases caused by bacteria, viruses, or parasites can lead to kidney infections, dehydration, and other complications that may worsen pre-existing kidney conditions . [3].Water with high mineral content (particularly calcium and magnesium) can cause kidney stones, which may increase the risk of CKD. [4],[5].

Exposure to contaminants like lead, arsenic, or nitrates has been associated with an increased risk of kidney disease. These substances can damage kidney cells or interfere with kidney function, leading to inflammation and fibrosis (scarring). [6]. Dehydration and insufficient water intake can lead to dehydration, which places stress on the kidneys. Chronic dehydration may contribute to kidney stones and other kidney-related issues, further increasing the risk of CKD. Additionally, consuming water with high levels of dissolved minerals, particularly salts or metals, forces the kidneys to work harder to filter out these substances. Over time, this increased workload can result in kidney damage. Ensuring access to clean, safe drinking water and managing water quality are essential steps in preventing kidney disease. Filtration systems that remove harmful chemicals, regular water testing, and proper waste management help maintain water safety. Consequently, this study aimed to evaluate the connection between the use of well water and the elevation of chronic kidney disease (CKD) in Tsawa city[7].

MATERIALS AND METHODS

Biochemical analysis and microbiological tests of a sample of groundwater from different wells in Tsawa City were done in the laboratory to ensure accurate well water analysis results. Carefully follow these steps:

Preparation samples

Choosing the Right Containers:

-Use sterile containers (for bacterial tests) and clean plastic or glass containers (for chemicals).

- Some containers contain preservatives (such as nitric acid for mineral tests), so do not rinse them before use.

Well Cleaning (Purging):

-Removing Stagnant Water: Run the pump for 5-10 minutes (or until the temperature and water specifications stabilize) to ensure the sample is taken from the groundwater and not from the pipes.

Sample Collection:

-Sterilizing the Outlet Point: Clean the pump nozzle or faucet with alcohol or a flame before taking the sample.

- Filling containers carefully:
- For chemicals: Fill the container to the top (especially for oxygen-sensitive samples such as organic compounds).

-1 Avoid contamination: Do not touch the water with your hands, and do not allow dust or dirt to fall.

- Temporary storage:
- Store samples in a refrigerator (4°C) or on ice (especially for biological or organic samples).
- Some samples (such as minerals) require the addition of preservatives according to the laboratory's instructions.
- Complete the Chain of Custody form: To document sample transport to the laboratory.

Transport to the laboratory:

- speed: Transport samples within 24 hours (especially for bacterial analysis).
- Avoid exposure to sunlight or heat: Use insulated boxes with ice to maintain temperature

Used the instrument for analysis Atomic absorption spectrometer for heavy element analysis (Pb), cadmium (Cd), and iron (Fe).

RESULTS

This study explains the correlation between the prevalence of kidney failure among the people living in the Tsawa region, southern Libya, and the quality of the drinking water in that area. Some water quality parameters are assessed and correlated with markers of renal impairment to clarify possible environmental risk factors

The three primary focuses of this study were the total dissolved solids (TDS) in drinking water, heavy metals like iron, lead, and cadimum, and microbial analysis were studied to identify the presence of chemical and microbial contamination in different well in tsawa city western libya..

the results showed that 4 out of 24 wells had low level of bacterial contamination (E.coli), 20 sample were negative result of bacteria contamination, from the percentage of total dissolved salts (TDS) sample number five was significantly high percentage of TDS in comparison to WHO parameters for TDS level in drinking water, and the percentage of each well and the microbial analysis of 24 wells are shown in the following table

Table 1. Microbiological analysis of drinking water samples and total dissolved solids (TDS) measurements.

Wells. N	TDS analysis	Microbiology
1	148	-ve
2	155	-ve
3	150	+ve
4	213	-ve
5	1306	-ve
6	686	-ve
7	157	-ve
8	157	-ve
9	410	-ve
10	415	-ve
11	550	-ve
12	148	+ve
13	135	-ve
14	270	-ve
15	144	-ve
16	162	+ve
17	1035	-ve
18	205	-ve
19	175	+ve
20	175	-ve
21	164	+ve
22	170	-ve
23	10	-ve
24	10	-ve

The total dissolved solids (TDS) measurement indicates the concentration of various minerals and salts, including calcium, magnesium, sodium, potassium, harmful effects on health, as cadmium is a toxic substance connected to reduced kidney function when it builds up in the body, whereas elevated iron levels in water may cause additional health issues

The examination was likewise performed on the heavy metals in drinking water, specifically lead, cadmium, and iron, and the findings indicated that these metals were not present in the city's water.

Chloride, sulfates, and nitrates, along with some organic matter and heavy metals. The examination of Total Dissolved Solids (TDS) in groundwater from the Tsaoua area indicated that most of the sampled wells displayed TDS levels within the acceptable limits suggested by the World Health Organization (WHO), which is below 500 mg/L. Among the 24 wells assessed, only four wells had TDS levels surpassing the WHO recommended limit. Regarding heavy metals, the concentrations of elements like cadmium, lead, and iron are expected to be assessed. because of their

Table 2 shows the heavy materials

No	Cd	Pb	Fe
1	< 0.01	< 0.01	< 0.01
2	< 0.01	< 0.01	< 0.01
3	< 0.01	< 0.01	< 0.01
4	< 0.01	< 0.01	< 0.01
5	< 0.01	< 0.01	< 0.01
6	< 0.01	< 0.01	< 0.01
7	< 0.01	< 0.01	< 0.01
8	< 0.01	< 0.01	< 0.01
9	< 0.01	< 0.01	< 0.01
10	< 0.01	< 0.01	< 0.01
11	< 0.01	< 0.01	< 0.01
12	< 0.01	< 0.01	< 0.01
13	< 0.01	< 0.01	< 0.01
14	< 0.01	< 0.01	< 0.01
15	< 0.01	< 0.01	< 0.01
16	< 0.01	< 0.01	< 0.01
17	< 0.01	< 0.01	< 0.01
18	< 0.01	< 0.01	< 0.01
19	< 0.01	< 0.01	< 0.01
20	< 0.01	< 0.01	< 0.01
21	< 0.01	< 0.01	< 0.01
22	< 0.01	< 0.01	< 0.01
23	< 0.01	< 0.01	< 0.01
24	< 0.01	< 0.01	< 0.01

amount of water they were drinking was 1-2 liters, as the highest percentage about 57.93%.

The results obtained from the questionnaires show that the per
centage of people who drink well water in the study sample reached 65.75 and the

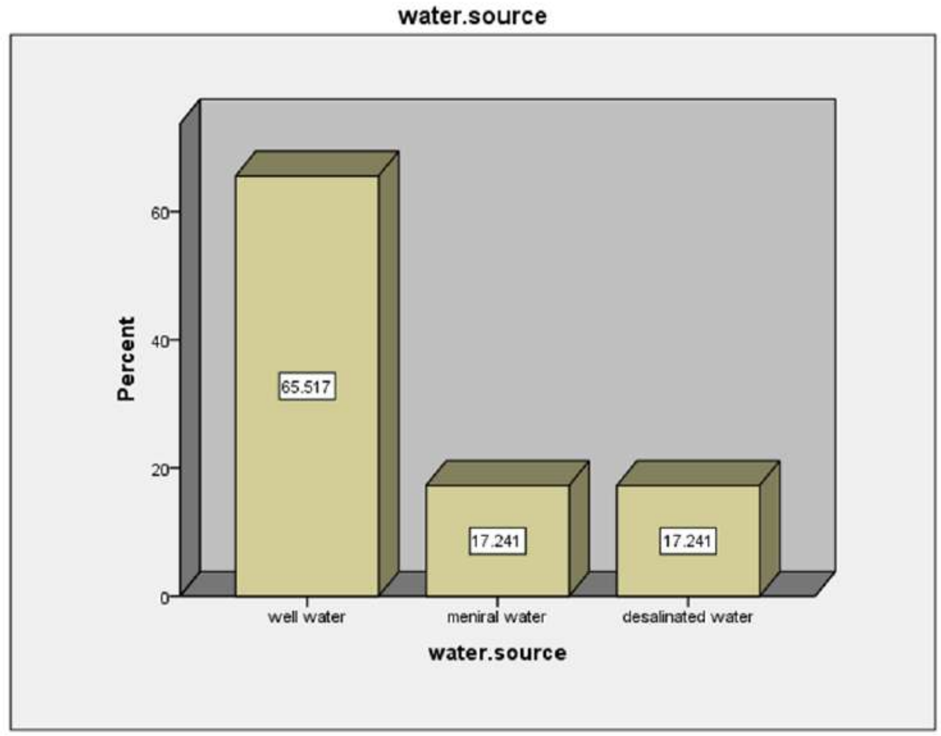

Figure 1: Shows the water source

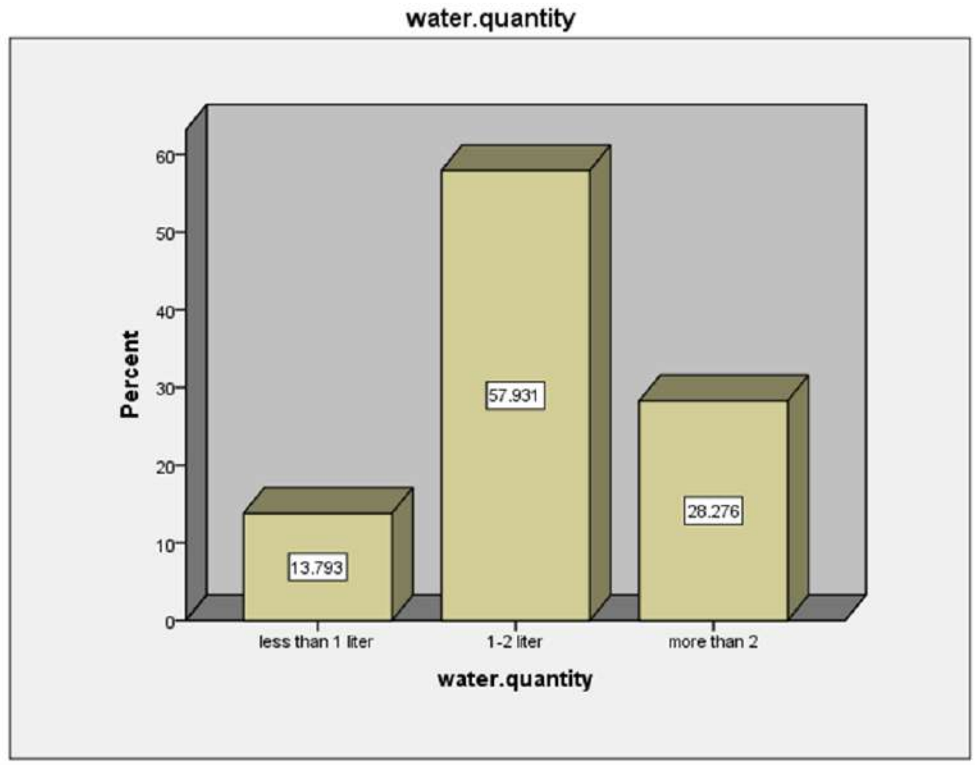

Figure 2: shows the water quantity

DISCUSSIN

The aim of this study on water quality in Tsawa City, south of Libya, was to determine whether drinking water could contribute to renal failure. Exposure to heavy metals like lead, cadmium, mercury, and arsenic has been associated with an increased risk of chronic kidney disease (CKD). These metals can cause direct nephrotoxicity by accumulating in kidney tissue, leading to inflammation, fibrosis, and glomerular damage. [8] Individuals with pre-existing health conditions like diabetes or hypertension may be more susceptible to the nephrotoxic effects of water contaminants. From the results obtained from this study, a weak relationship was concluded between water quality in Tsawa and the high incidence of kidney failure. Previous research from regions with known contamination of drinking water (e.g., areas with high arsenic levels in Bangladesh, India, and Chile) has demonstrated higher incidence and prevalence of kidney disease[9].

The physicochemical and biological parameters measured in groundwater wells were precisely analyzed and compared with the regulatory standards set by the World Health Organization. The total dissolved solids (TDS) value varied between 10 and 1306 mg/L in the tested groundwater wells. The lowest TDS was recorded in sample number 24 (10 mg/dL), while the highest level was observed in sample number 5 (1306 mg/dL). The palatability of water with a TDS below 600 mg/L is generally considered satisfactory; drinking water becomes unpalatable at higher TDS levels (i.e., >1000 mg/L). Previous findings reported by Mahmood et al. in their study conducted in Al Marj City, Libya, indicated that TDS ranged from 401 mg/L to 759 mg/L. Except for the Abo Shuisha groundwater well, the TDS value of the studied groundwater wells exceeded the allowable limit for drinking water (i.e., 500 mg/L) recommended by the WHO[10].Results of the one-way ANOVA showed significant differences among the TDS of the examined groundwater wells (p-value = 0.00). The concentrations of iron, cadmium, and lead in the groundwater wells were <0.001 mg/L, as shown in Table 19. The heavy metal levels in the groundwater wells were within the WHO's recommended limit for drinking water. Previous research suggests that cadmium, aluminum, fluoride, Na^+/Ca^{2+} ratio, algal toxins, and glyphosate complexation with water hardness are possible CKDu-causing factors in non-communicable disease (NCD) areas. Agricultural communities in CKDu endemic areas obtain drinking water mainly from shallow wells. A study by Tchounwou et al. (2012) reported that lead exposure can lead to renal dysfunction, especially when accumulated over time. Lead can cause direct nephrotoxicity by altering glomerular filtration rate (GFR) and causing tubular damage. Additionally, lead exposure is associated with an increased risk of hypertension, a key risk factor for CKD. Smith et al. (2006) demonstrated that long-term exposure to inorganic arsenic, primarily through contaminated drinking water, is linked to an increased incidence of CKD. Arsenic accumulates in the kidneys and can lead to kidney fibrosis, inflammation, and a decline in renal function. Chronic arsenic exposure has been identified as a significant risk factor for kidney cancer as well [11].

A previous study by Ravichandran et al. (2014) found that mercury exposure from contaminated water is strongly linked to kidney damage, including proximal tubular injury. Mercury can impair renal clearance, leading to an increase in the accumulation of waste products in the bloodstream. According to results obtained from a paper questionnaire collected from people visiting Tsawa Hospital, approximately 65.52% of participants reported drinking water from wells, and 57.93% of participants consumed about 1-2 liters of water daily[12].

Existing hypotheses suggest that exposure to occupational and environmental toxins in agriculture may serve as a primary trigger, with dehydration caused by inadequate fluid intake in a hot environment as a contributory factor for this disease. The quantity of water plays an important role in kidney health, and results suggest that most participants were in the normal range of daily water consumption necessary for kidney health [13]. Five groundwater wells were found to be affected by E. coli; our results revealed a low count of E. coli (about 3–6 counts), indicating low fecal contamination of groundwater in Tsawa City.

The presence of E. coli in groundwater wells raises significant public health concerns[14]. This microorganism affects groundwater wells due to malfunctioning sewage systems in the city, failing to prevent the discharge of fecal contamination from infected humans or animals into the groundwater wells. E. coli is the most commonly used indicator of fecal contamination. A previous study by Jauda R. Jauda Hamad (2021) assessing the quality of groundwater resources in Al-Marj, Libya, found that the prevalence of E. coli in the measured groundwater wells was 0.00–8.00 CFU/100mL[15].

CONCLUSION

groundwater wells in the study area were investigated to determine the extent of its exposure to chemical and biological contamination that causing kidney failure, in comparison with the international standard recommended by the WHO, and it was found that water in the tsawa city conforms to WHO standards for drinking water, according to this results we concluded that drinking water is not considred as risk factor for kidney disease in tsawa city. We need more accurate research to evaluate the water quality in southern Libya to ensure people is safety.

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