World Journal of
Experimental Biosciences

Volume 12, Number 1: 7 - 10
ISSN: 2313-3937
2024

Research article

Indication of Heavy Metals and Coliform Bacteria in Tap Water of Al-Karkh Side Hospitals-Baghdad, Iraq

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ABSTRACT

The correlation between the quality of drinking water provided to healthcare facilities and the quality of healthcare services rendered to individuals is crucial. The objective of this present investigation is to assess the presence of heavy metals and coliform bacteria (indicating contamination with pathogenic bacteria from fecal matter) in the tap water distributed to the Al Karkh area of Baghdad. Specifically, tap water samples were collected from four hospitals situated in the Al Karkh region of Baghdad, namely Al Karama Teaching Hospital, Albishara private hospital, Al-karkh private hospital, and Karkh Hospital For Childbirth. The levels of heavy metals, including copper (Cu), zinc (Zn), lead (Pb), and cadmium (Cd), were evaluated, as well as the presence of coliform bacteria (a marker for pathogenic contamination). The findings revealed that the levels of heavy metals complied with the standard values in all hospitals under study, except Cd, which exceeded the standard level in the tap water collected from Albishara private hospital and Karkh Hospital for Childbirth. Moreover, no coliform bacteria were detected in any of the tap water samples obtained from the hospitals investigated. As such, it can be inferred that the quality of water, in terms of heavy metal levels, supplied to these four hospitals adhered to the standard regulations, and all samples were free from coliform bacteria, which indicates the absence of fecal contamination in the water provided to these healthcare facilities.

Keywords: Al Karkh/side, Coliform, Drinking water, Heavy metals, Hospitals, Pathogenic bacteria.

Citation: Zgair HK. (2024) Indication of heavy metals and coliform bacteria in tap water of Al-Karkh side hospitals-Baghdad, Iraq. *World J Exp Biosci* **12**: 7 - 10.

Received July 11, 2023; Revised December 22, 2023; Accepted: January 30, 2024.

1. INTRODUCTION

Water quality is straightforwardly related to community health. Water plays a main function in the occurrence of many infectious diseases and epidemics. Therefore, maintaining the feature of drinking water accompanying good qualifications will indicate the health of the population [1]. The World Health Organization stresses the significance of water education, as it is a main determinant in communicating many diseases and it prints any of the periodicals at which point it sets appropriate principles for drinking water [2]. The obligation of incidental and concerning city organizations to these qualifications indicates the level of health management in municipalities. The standards selected apiece Planet Energy Institution devote effort to something the synthetic requirements of water apart from the microbial contamination of water [2]. Many studies have proved a direct equivalence between the level of microbial contamination of water and the spread of hazardous epidemics [3]. The quality of water is not only had connection with the strength aspect but is likewise had connection with the financial aspect, as water contamination can pressure and influence the health whole, that will then influence the budgets of nations, particularly in Iraq, since health management in Iraq is promoted apiece state. Apart from what was noticed, the spread of water-related epidemics influences the result of fish, farms, poultry, and cows, this will straightforwardly influence the economies of nations [5-6].

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The most crucial factors to consider are the quality and requirements of the water that is provided to hospitals, even if paying attention to the quality of the water that is distributed to homes is vital. This is because hospitals treat injured patients, house cleaning labs, and operating rooms, and water is involved with the majority of medical activities there since it is utilized to clean and maintain hospital infrastructure. As a result, the degree of medical treatment offered by hospitals is significantly influenced by the water quality supplied to them [7, 8]. The contamination of the water that supplies to the hospitals will greatly affect the healthcare system in Iraq. The present study focused on the quality of water supplied to hospitals because these kinds of studies are very scanty in the literature. That is why, the current study focused on the quality of water supplies to the number of hospitals located in Al Karkh/side of the city of Baghdad.

2. MATERIALS AND METHODS

2.1. Study area and samples

Four hospitals located on the Al Karkh/side of the city of Baghdad were included in the current study. The samples were collected from Al Karama Teaching Hospital, Albishara Private Hospital, Al-Karkh Private Hospital, and AL-Karkh Hospital For Childbirth. The tap was sterile by flam before sample collection. It was taken 50 ml of tap water was collected in sterilized screw universal glass. The water was transferred immediately to the lab for chemical, physical, and microbiological examination. The samples were collected from March 2023 to May 2023.

2.2. Bacteriological examination

The standard method of Al-Bayatti et al, (2012) was followed to isolate and identify bacterial isolates from tap water samples [8]. Total bacterial species were determined by standard coliform fermentation technique including presumptive, confirmed, and completed tests. For identification of pathogenic enteric bacteria water samples were spread on nutrient agar, MacConkey agar. The plates were incubated overnight at 37°C, and after incubation, cultures were examined for distinct colonies.

2.3. Chemical Tests

The standard method of AL-Dulaimi and Younes, (2017) was followed to check the heavy metals [copper (Cu), Zinc (Zn), lead (Pb), and cadmium (Cd)] [9].

2.4. Drinking water guidelines

World Health Organization guideline (2017) was used to identify the quality of tap water in the hospital at Al Karkh/side of the city of Baghdad, Iraq because it is widely used by various countries and used to determine the quality of drinking water.

2.5. Statistical analysis

The mean value has been obtained using all values, and the standard deviation has also been computed. Using the program Origin version 8.0, the differences were examined using Student's t-test and chi-square test. A P value of 0.05 or below was regarded as statistically significant.

3. RESULTS

3.1. Heavy metal and bacteriological

Fig. 1 shows the average values of the heavy metals in tap water collected from different hospitals in AL-Karkh/ Baghdad/ Iraq. The results showed that the Cu, Zn, and Pb were acceptable values to compare with the standard values of the WHO. While the Cd was higher than the standard values of the WHO-published reports of WHO. The current study showed that out of tap water samples collected from four hospitals at Al-Karkh side/ Baghdad, no samples were positive for coliform examination test. The results of this study confirm that the microbial contamination that occurred in some areas of the study was caused by cracks and erosion in some drinking water distribution pipes, fortunately, this erosion was far from the sewage network, so the contamination that occurred was from soil near the corroded pipes.

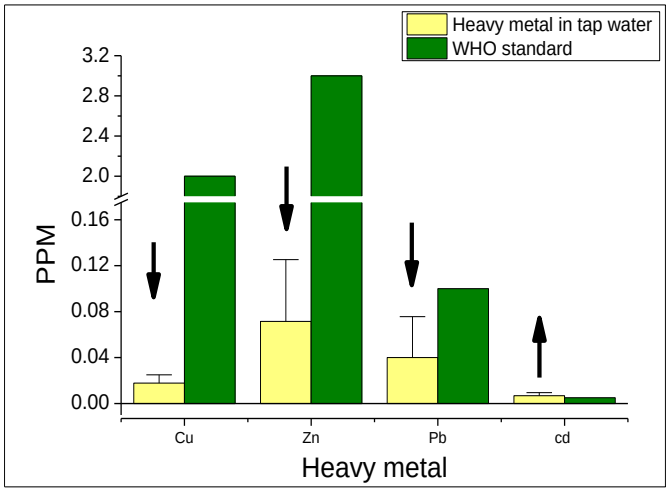

Fig. 1. Mean values of the heavy metal (Cu: coopered, Zn: zinc, Pb: Lead, cd: cadmium) of tap water collected from different hospitals at Al-Karkh, Baghdad, and the WHO limits.

3.2. Heavy metal and bacteriological contains in the tap water of Al Karama Teaching Hospital

Fig. 2 shows the average values of the heavy metals in tap water collected from Al-Karama Teaching Hospital/ Baghdad/ Iraq. The results showed that all values were under the standard values of the WHO. The microbiological study showed that no samples were positive for the coliform examination test. This confirms that the tap water supplied to Al-Karama Teaching Hospital is within the standard of healthy water in terms of studied heavy metals and coliforms.

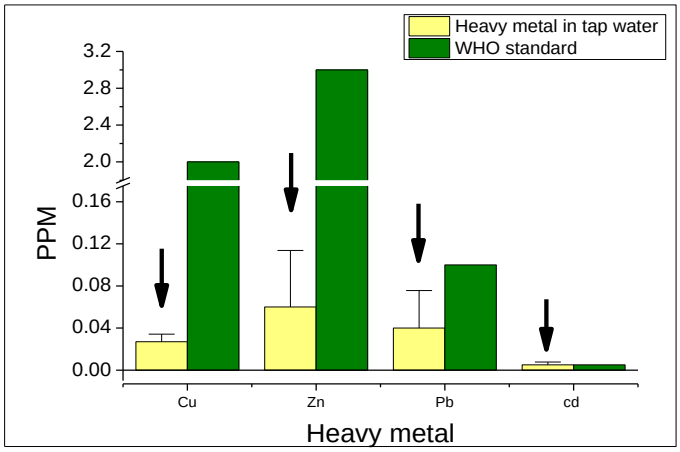

Fig. 2. Mean values of the heavy metal (Cu: coopered, Zn: zinc, Pb: Lead, cd: cadmium) of tap water collected from Al-Karama Teaching Hospital, Baghdad, Iraq, and the WHO limits.

3.3. Heavy metal and bacteriological contains in tap water of Albishara Private Hospital

The average values of the heavy metals in tap water collected from Albishara Private Hospital/ Baghdad/ Iraq are shown in Fig. 3. The results reveal that all values were under the standard values of the WHO except the value of Cd was higher than the standard value of Cd that reported by WHO. The microbiological study showed that no samples were positive for the coliform examination test. That confirms the tap water supplied to Albishara Private Hospital was within the standard of healthy water in terms of studied heavy metals and coliforms.

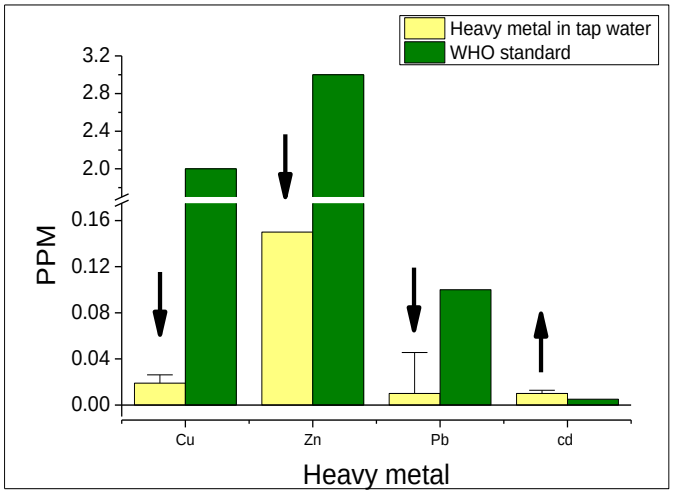

Figure 3. Mean values of the heavy metal (Cu: coopered, Zn: zinc, Pb: Lead, cd: cadmium) of tap water collected from Albishara Private Hospital, Baghdad, Iraq, and the WHO limits.

3.4. Heavy metal and bacteriological contains in tap water of Al-Karkh Private Hospital

The average values of the heavy metals in tap water collected from Al-karkh Private Hospital/ Baghdad/ Iraq are shown in Fig. 4. The results reveal that all values were under the standard values of the WHO. The microbiological examination to confirm the presence of coliform bacteria showed that no samples gave positive for the coliform examination test. That confirmed the tap water supplied to Al-karkh Private Hospital was healthy water in terms of studied heavy metals and pathogenic bacterial contamination.

3.5. Heavy metal and bacteriological contains in tap water of Karkh Hospital for Childbirth

Fig. 5 shows the average values of the heavy metals in tap water collected from Karkh Hospital for Childbirth / Baghdad/ Iraq. The results reveal that all values were under the standard values of the WHO except the value of Cd was higher than the standard value of Cd published by WHO. The microbiological study showed that no samples gave positive for coliform examination test. That confirms that the tap water supplied to Karkh Hospital for Childbirth was within the standard of healthy water in terms of studied heavy metals and coliforms.

4. DISCUSSION

Numerous studies have verified the connection between the standard of public health and the water quality provided to hospitals. Since the quality of water influences the degree of medical care offered by hospitals, pollution of the water supply to hospitals will have a negative and considerable impact on both the quality of medical treatment and the prevention of communicable illnesses [8].

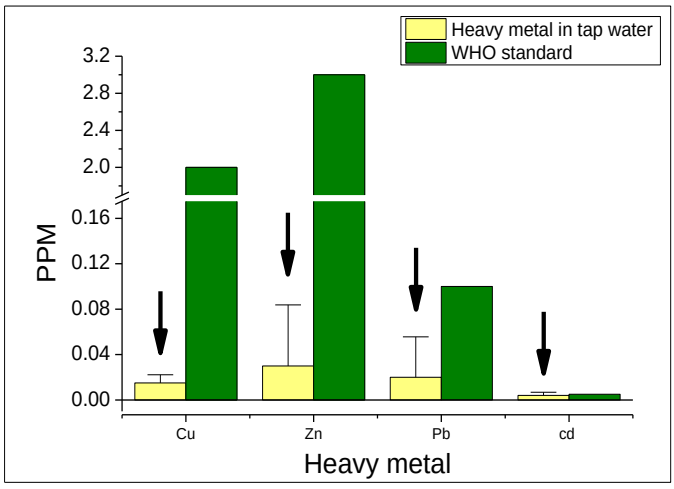

Fig. 4. Mean values of the heavy metal (Cu: coopered, Zn: zinc, Pb: Lead, cd: cadmium) of tap water collected from Al-karkh private hospital, Baghdad, Iraq, and the WHO limits.

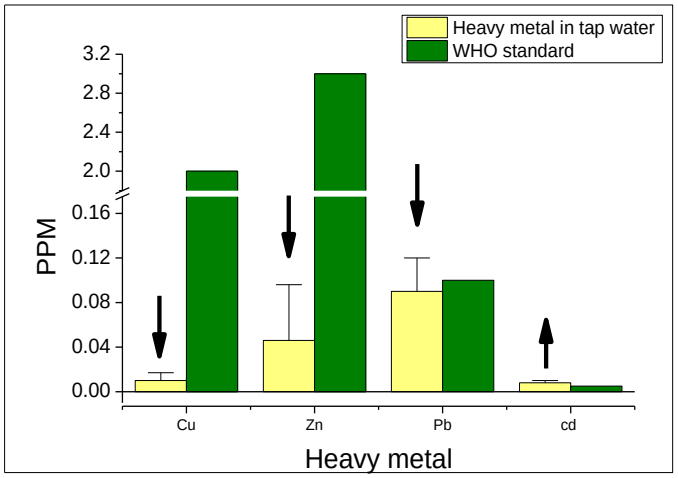

Fig. 5. Mean values of the heavy metal (Cu: coopered, Zn: zinc, Pb: Lead, cd: cadmium) of tap water collected from Al-Karkh Hospital for Childbirth, Baghdad, Iraq, and the WHO limits.

The present study included a survey of the quality of tap water supplied through the pipes to four major public hospitals in the Al Karkh/side of the city of Baghdad. The current study sheds light on the levels of heavy metals and the presence the contamination of water with stool (indicating by presence of coliform bacteria). The study showed that despite the old pipe network, the level of main heavy metals in tap water supplied to the four hospitals was within the standard specifications approved by the World Health Organization except for the Cd. The study demonstrated that the water provided to hospitals was not polluted with fecal bacteria since non-fecal bacteria were responsible for the detected microbial contamination. This demonstrates that the water provided to these hospitals is not polluted with feces, supporting the claim that the World Health Organization-permitted requirements and ranges were met for the water supplied to the hospitals included in the research.

The present study is the pioneer study, as the focus on the quality of water supplied to the hospital in Baghdad is very scanty that is why we were not able to compare the present study with the previous similar study. However, the previous

study done by other investigators about the quality of water in Baghdad showed data similar to the data present in the current study [10-13].

The reduction of the presence of coliform in the tap water supplied to the hospital was due to the high level of chlorine that was estimated in water supplied to hospitals [14, 15]. The high levels of chlorine play a major part in killing pathogenic microorganisms, particularly fecal microscopic organisms, as fecal microbes separate from people and creatures [16], it is characterized by their low resistance to chlorine as compared with natural microbes in soil and water, which have adjusted to difficult natural conditions [17-19] and this clarifies the separation of non-fecal coliform microbes within the drinking water provided to these healing centers.

5. CONCLUSION

It can be concluded from the current study that the quality of the tap water provided to public hospitals is almost within the standard reported by WHO. That proved that the water that supplied to the Al Karkh/side of the city of Baghdad is almost good quality especially in terms of heavy metals and non-contaminated with pathogenic bacterial indicator (coliform bacteria).

Acknowledgments

At this stage, I would like to thank the staff of Rusafa Third Directorate of Education, Ministry of Education, Baghdad, Iraq and the staff of all hospitals that provided the water sample especially Al-Karama Teaching Hospital, Albishara Private Hospital, Al-karkh Private Hospital, Al- Karkh Hospital for Childbirth.

Funding information

This work received no specific grant from any funding agency.

Conflict of interest

The authors declare that they have no conflict of interests.

Ethical Approval

This review was approved by the Ethical Committee of the Ministry of Education, Baghdad, Iraq (No 102, 2023).

Hameda K. Zgair: Conceptualization; Data curation; Formal analysis; Investigation; Resources; Supervision; Validation; Visualization; Roles/Writing - original draft; and Writing - review & editing.

6. REFERENCES

[1] **Mirlohi S.** (2022) Characterization of Metallic Off-Flavors in Drinking Water: Health, Consumption, and Sensory Perception. *Int J Environ Res Public Health*. **19**:16829. doi: 10.3390/ijerph192416829. PMID: 36554714; PMCID: PMC9778853.

[2] **Guidelines for Drinking-Water Quality**: Fourth Edition Incorporating the First Addendum. Geneva: World Health Organization; 2017.

[3] **Grilc E, Gale I, Veršič A, Žagar T, Sočan M.** (2015) Drinking Water Quality and the Geospatial Distribution of Notified Gastro-Intestinal Infections. *Zdr Varst* **54**(3):194-203. doi:10.1515/sjph-2015-0028. PMID: 27646727; PMCID: PMC4820156.

[4] **Barnhart B, Flinders C, Ragsdale R, Johnson G, Wiegand P.** (2021) Deriving Human Health and Aquatic Life Water Quality Criteria in the United States for Bioaccumulative Substances: A Historical Review and Future Perspective. *Environ Toxicol Chem* **40**:2394-2405. doi: 10.1002/etc.5130. Epub 2021 Jul 7. PMID: 34062012.

[5] **Foysal MJ, Fotedar R, Siddik MAB, Chaklader MR, Tay A.** (2021) Lactobacillus plantarum in black soldier fly (*Hermetica illucens*) meal modulates gut health and immunity of freshwater crayfish (*Cherax cainii*). *Fish Shellfish Immunol* **108**:42-52. doi: 10.1016/j.fsi.2020.11.020. Epub 2020 Nov 21. PMID: 33232807.

[6] **Panta G, Richardson AK, Shaw IC.** (2021) Quality of water for reprocessing of medical devices in healthcare facilities in Nepal. *J Water Health* **19**:682-686. doi: 10.2166/wh.2021.071. PMID: 34371503.

[7] **Nakayama H, Kawaguchi K, Kato A, Morishima H, Nagashima G, et al.** (2019) Quality Control of Medical Instruments and Cleaning Water. *No Shinkei Geka* **47**:845-850. *Japanese*. doi: 10.11477/mf.1436204035. PMID: 31477627.

[8] **Al-Bayatti KK, Al-Arajy KH, Al-Nuaemy SH.** (2012) Bacteriological and physicochemical studies on Tigris River near the water purification stations within Baghdad Province. *J Environ Public Health* **2012**:695253. doi: 10.1155/2012/695253. Epub 2012 Dec 24. PMID: 23365587; PMCID: PMC3540770.

[9] **Al-Dulaimi GA, Younes MK.** (2017) Assessment of potable water quality in Baghdad City, Iraq. *Air, Soil and Water Research* **10**: https://doi.org/10.1177/1178622117733441

[10] **Flaieh HM, Mohammed-Ridha MJ, Abdul-Ahad MY.** (2014) Assessing Tigris River Water Quality in Baghdad City Using Water Quality Index and Multivariate Statistical Analysis. *Int J Engineering Sci Res Technol* **3**:687-699.

[11] **Abdul Jabar MAB, Thabit JA.** (2021) Chemical Pollution Risks for Many Drinking Water Sources in Baghdad City, Iraq. *Pol J Environ Stud* **30**:1203–1214. DOI: doi.org/10.15244/pjoes /120767

[12] **Al-Adili AS, Maatooq JS.** (2008). Hydrochemical study of Rain Water In Baghdad city-Iraq. *Eng Tech* **26**:408.

[13] **Fisher I, Kastl G, Sathasivan A.** (2017) New model of chlorine-wall reaction for simulating chlorine concentration in drinking water distribution systems. *Water Res* **125**:427-437. doi: 10.1016/j.watres.2017.08.066. Epub 2017 Aug 30. PMID: 28892770.

[14] **Bertelli C, Courtois S, Rosikiewicz M, Piriou P, Aeby S, et al.** (2018) Reduced Chlorine in Drinking Water Distribution Systems Impacts Bacterial Biodiversity in Biofilms. *Front Microbiol* **9**:2520. doi: 10.3389/fmicb.2018.02520. PMID: 30405577; PMCID: PMC6205969.

[15] **Korajkic A, McMinn BR, Harwood VJ.** (2018) Relationships between Microbial Indicators and Pathogens in Recreational Water Settings. *Int J Environ Res Public Health* **15**:2842. doi: 10.3390/ijerph15122842. PMID: 30551597; PMCID: PMC6313479.

[16] **Luo LW, Wu YH, Yu T, Wang YH, Chen GQ, et al.** (2021) Evaluating method and potential risks of chlorine-resistant bacteria (CRB): A review. *Water Res* **188**:116474. doi: 10.1016/j.watres.2020.116474. Epub 2020 Sep 28. PMID: 33039832.

[17] **Saifur S, Gardner CM.** (2021) Loading, transport, and treatment of emerging chemical and biological contaminants of concern in stormwater. *Water Sci Technol* **83**:2863-2885. doi: 10.2166/wst.2021.187. PMID: 34185685.

[18] **Zgair, H. K. (2022)** Quality of drinking water in al-Sadr city in Baghdad city. *Journal of the College of Basic Education* **28**:1-12

[19] **Zhang T, Lv K, Lu Q, Wang L, Liu X.** (2021) Removal of antibiotic-resistant genes during drinking water treatment: A review. *J Environ Sci (China)* **104**:415-429. doi: 10.1016/j.jes.2020.12.023. Epub 2020 Dec 30. PMID: 33985744.

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