EPIDEMIOLOGICAL JOURNAL OF INDONESIA
Volume 3, Number 2, October 2024, pp. 72~75
Online ISSN: 2964 - 9471
Website:https://journal.paei.or.id
Email:jurnal@paei.or.id

RISK QUOTIENT OF EXPOSURE TO IRON, MANGANESE, AND ZINC LEVELS IN CLEAN WATER AT HOSPITAL AREA

Ria Agustine,[1] **Fitri Mayasari**[*2]
[1] Mental Hospital of Pangkal Pinang, Bangka Belitung, Indonesia
[2] Public Health Program, University Kader Bangsa, Palembang, South Sumatera, Indonesia
e-mail Correspondence Author: Fitri Mayasari, mayasarifitri311@gmail.com

ARTICLE INFO

Article History:
Received : 22 June 2024
Revised form: October 2024
Accepted: October 2024
Published online: 31 October 2024

Keywords:
Risk Quotient;
Iron;
Manganese,
Zinc Level

ABSTRACT

Background: Poor water quality can cause health problems for all hospital residents, both people with low immunity and healthy people. The purpose of this case study is to analyze the risk level of exposure to iron, manganese, and zinc metal levels at the Bangka Belitung Islands Province Mental Hospital. **Methods:** This study is a quantitative descriptive study with an analytic approach to environmental health risk analysis. The study design is cross-sectional. The sample is the quality of iron, manganese, and zinc in clean water, the result of a clean water quality examination at a mental hospital in Pangkalpinang. **Results:** The results of the case study showed that the non-carcinogenic (intake) value in individuals for iron metal was 0.00074 mg/kg/day, manganese was 0.00024 mg/kg/day, and zinc was 0.00098 mg/kg/day. The risk quotient obtained is less than one. **Conclusion:** The concentration of iron, manganese, and zinc is below the environmental quality standard, so it is safe for employees who consume it. Hospitals are advised to maintain clean water quality by complying with regulations and conducting regular water quality checks.

Correspondence Author: Fitri Mayasari,
mayasarifitri311@gmail.com,
Public Health Program,
University Kader Bangsa,
Palembang, South Sumatera,
Indonesia

INTRODUCTION

Hospitals, in addition to being able to produce positive impacts in the form of good health service products for patients, can also cause negative impacts in the form of bad influences on humans, such as environmental pollution, sources of disease transmission, and inhibiting the healing and recovery process of patients. In the future, environmental health problems faced will increase and become more complicated, one of which is due to uncontrolled activities in hospitals.

Water is the most important resource that cannot be separated from human life in order to survive, therefore the provision of water is very necessary, especially clean water to meet the needs of living things (WHO, 2022). Water is a primary need that plays an important role in the life aspects of all living creatures on earth, including humans. (Maksuk et al., 2022). Water sanitation in hospitals includes sanitation of drinking water, hygiene and sanitation needs, water for special use (hemodialysis), and laboratory activities. (Permenkes RI, 2023).

The presence of metal levels in water can cause environmental pollution and health problems for water users (Nora et al., 2022; Ramadhan et al., 2022). Heavy metal exposure can cause nervous system disorders, developmental problems in children, and increased risk of chronic diseases (Butarbutar et al., 2024).

The previous studies have calculated the potential dose and risk level of the presence of metals in clean water but in different locations, namely around residential areas, final waste disposal areas or other industries (Kapsi et al., 2019; Maksuk et al., 2023). Several hospitals have problems with high iron and manganese content. The presence of iron, manganese, and zinc in the water gives the water a sour taste and smell and will cause brownish-yellow stains on equipment and clothes that are washed. From the results of the inspection, it was found that the quality standards are exceeded (Panggei et al., 2023). The results of a study at Medan Hospital showed that the parameters of iron, chromium, zinc, lead, and other parameters examined were still below the quality standards (Bakara, 2023).

The difference between this research and previous research is that previous studies only explained the results of chemical parameter examinations, including Fe, Mn, and Zn, but did not calculate potential doses and risk levels to estimate risks in the next few years. Furthermore, this research was to analyze the risk level of exposure to iron, manganese, and zinc levels in clean water in hospitals in the Bangka Belitung Islands.

METHODS

This study is a descriptive analytical study with an environmental health risk analysis approach with four steps, namely: hazard identification, exposure analysis, dose-response assessment and Risk Characteristics. The risk level is calculated using the parameters of iron, manganese and zinc levels in clean water used in the Bangka Belitung Islands Mental Hospital. This study was conducted at the Bangka Belitung Mental Hospital in 2023. The dose-response assessment and Risk Quotient (RQ) were calculated using the formula from Louvar and Louvar (Louvar & Louvar, 1998).

RESULTS

The results of the examination of Iron, Manganese, and Zinc levels in clean water at the Bangka Belitung Islands Province Mental Hospital are presented in Table 1 below:

Table 1. Concentration of Iron, Manganese, and Zinc in Clean Water at the Bangka Belitung Islands Province Mental Hospital

Parameters	Mean	Quality Standards
Iron (Fe)	0,0545 mg/l	0,3 mg/l
Manganese (Mn)	0,0172 mg/l	0,4 mg/l
Zinc (Zn)	0,0709 mg/l	0,5 mg/l

Table 1, it shows that the results of laboratory tests of Fe, Mn and Zn levels in clean water at hospitals are still below the quality standards.

The References Dose (RfD) value of Fe, Mn and Zn levels are presented in the Table 2 below:

Table 2. Reference Dose (RfD) Value (EPA, 2017)

Parameters	**RfD**	**Health Effects**
Iron (Fe)	0,3 mg/kg/ day	Causes disruption of oxygen absorption in the blood, marked by symptoms of dizziness, nausea. If consumed in high amounts can damage the nerves.

Manganese (Mn)	1,4E- 1 mg/kg/day	Hypercholesterolemia, epilepsy, exocrine pancreatic insufficiency, multiple sclerosis, cataracts, osteoporosis, maple syrup kidney disease.
Zinc (Zn)	3E-1 mg/kg/day	Decreased erythrocyte Cu and Zn superoxide dismutase activity in male and female volunteers.

Table 2 describes the reference dose values quoted from EPA's IRIS, these values will be used to calculate the potential dose.

Table 3. Intake and Risk Quotient (RQ) Calculation Results

Parameters	Potensial Dose	Risk Quotient
Iron (Fe)	0,00074 mg/kg/ day	0,123
Manganese (Mn)	0,00024 mg/ kg/ day	0,0017
Zinc (Zn)	0,00098 mg/kg/day	0,0033

Table 3 describe that the results of the potential dose calculation are less than the reference dose value and the risk quotient obtained a value of less than 1. It means that the calculation of the three parameters, Fe, Mn, and Zn, was still within safe limits for use.

DISCUSSION

The results of the study show that the levels of Fe, Mn, and Zn are still below the quality standards; however, this cannot be allowed to continue if regular checks are not carried out, as it is possible that the three metal parameters could increase. The presence of this metal is also caused by the source of water for hospital needs coming from groundwater, where this metal element is naturally found in nature.

This study is in line with research conducted at Medan Hospital that showed that the parameters of iron, chromium, zinc, lead, and other parameters examined were still below the quality standards. (Bakara, 2023). Another study found that the presence of iron, manganese, and zinc in clean water was found to exceed the quality standards. (Panggei et al., 2023). The risk quotient of lead metal in the final waste disposal area has exceeded environmental quality standards; this condition is risky for children and the surrounding community (Maksuk, 2019).

The findings from this study are that the potential dose and risk quotient of Fe, Mn, and Zn in clean water in hospitals are still safe. The results of the calculation of the potential dose and risk level of the presence of Fe, Mn, and Zn in this water are in line with the results of calculations of the presence of metals in dug wells of the community around the landfill (Maksuk et al., 2023). The Risk Quotient calculation are also in accordance with research conducted in Depok which reported that in each age group, the RQ for Mn and iron was less than 1 ($RQ \leq 1$) (Rosdiana et al., 2023).

The limitations of this study are that physical and biological parameters have not been presented and chemical parameters are only limited to three metal elements, namely Fe, Mn, and Zn.

CONCLUSION

The findings from this research are that the Fe, Mn, and Zn concentrations of clean water at the hospital in Bangka Belitung Island were still within quality standards. The potential dose shows less than the reference dose value, and the risk quotient is less than one and is still safe for use by hospitals.

Hospitals need to conduct regular checks on the quality of clean water in hospitals and water sources used by the community around the hospital.

CONFLICT OF INTEREST

The author declare that no conflict of interests in this study.

ACKNOWLEDGMENTS

The author would like to thank the hospital for helping to complete this research.

REFERENCES

Bakara, M. A. (2023). *Analisis Hasil Uji Lab untuk Kelayakan Pengadaaan Air Bersih pada Rumah Sakit Regina Maris Medan*.

Butarbutar, A. R., Dewi, R. D. L. P., Auliani, R., Farlina, B. F., Oktavia, S., Wiranti, B., & Apsari, D. A. (2024). Evaluasi risiko kesehatan akibat paparan logam berat dalam air minum: studi epidemiologi lingkungan. *Jurnal Review Pendidikan Dan Pengajaran (JRPP)*, *7*(1), 3078–3086.

EPA. (2017). *IRIS Assessments | IRIS | US EPA*. https://iris.epa.gov/AtoZ/?list_type=alpha

Kapsi, M., Tsoutsi, C., Paschalidou, A., & Albanis, T. (2019). Environmental Monitoring and Risk Assessment of Pesticide Residues in Surface Waters of the Louros River (N.W. Greece). *Science of The Total Environment*, *650*, 2188–2198. https://doi.org/https://doi.org/10.1016/j.scitotenv.2018.09.185

Louvar, J. F., & Louvar, B. D. (1998). *Health and Environmental Risk Analysis* (Vol. 2). Prentice Hall.

Maksuk, M. (2019). Risk Quotient of Lead Concentration in Dug Wells Water at Community Arround Sukawinatan Dumping Site in Palembang City Maksuk. *Seminar Nasional Hari Air Sedunia*, *2*(1), 10–17. http://www.conference.unsri.ac.id/index.php/semnashas/article/viewFile/1365/790

Maksuk, M., Oktarini, D. U., Harahap, T. E., Amin, M., Sopianti, M., Anwar, K., & Kamsul, K. (2023). Risk Quotient of Zinc (Zn) and Chromium (Cr) Level in Dug Well Water in The Community Living Around Landfill Site. *Epidemiological Journal of Indonesia*, *2*(2), 42–49.

Maksuk, M., Priyadi, P., & Anwar, K. (2022). Pengolahan Air Sungai Sebagai Sumber Air Bersih Masyarakat Di Kawasan Pertanian Dengan Penyaringan Air Sederhana. *Abdi Dosen: Jurnal Pengabdian Pada Masyarakat*, *6*(2), 398–404.

Nora, N., Maksuk, M., & Amin, M. (2022). Analisis Pencemaran Logam Berat Timbal (Pb) pada Air Sumur Gali Masyarakat di Sekitar Tempat Pembuangan Akhir Sukawinatan. *Jurnal Sanitasi Lingkungan*, *2*(2), 79–84.

Panggei, Y., Lisangan, M. M., & Sarungallo, Z. L. (2023). *Tinjauan kualitas air bersih di Rumah Sakit Umum Manokwari*.

Permenkes RI. (2023). *Peraturan Menteri Kesehatan RI No. 2 Tahun 2023 tentang Peraturan Pelaksanaan Peraturan Pemerintah Nomor 66 Tahun 2014 Tentang Kesehatan Lingkungan*.

Ramadhan, A. D., Maksuk, M., & Yulianto, Y. (2022). Kadar Logam Berat Kadmium (Cd) pada Air Sumur Gali Masyarakat di Sekitar TPA Sukawinatan. *Jurnal Sanitasi Lingkungan*, *2*(1), 45–50.

Rosdiana, D., Hastiaty, I. A., Hartomy, E., Kango, I., Simbolon, P. T., Pradapaningrum, P. G., Indriasih, M., & Paramasatya, A. (2023). Kontaminasi Kimia dan Biologi pada Air dan Udara dengan ARKM: Analisis Risiko Kesehatan Masyarakat. *Public Health Risk Assesment Journal*, *1*(1).

WHO. (2022). *Drinking-water. https://www.who.int/news-room/fact-sheets/detail/drinking-water*.