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Health Risk Assessment of Exposure to Iron in Gravity Feed System Water among Indigenous People

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ABSTRACT

This study aims to determine the health risk exposure of iron level in drinking water from gravity feed system among residents at Sungai Mas village, Sungai Lembing, Kuantan Pahang. A cross-sectional research was carried out based on inclusion and exclusion criteria. The purposive sampling method was used to select respondents of Jakun and Semaq Beri tribe. This research had two parts;questionnaire,as well aswater sample collection and analysis. The iron level was determined using Hanna Instruments HI801-02 iris Visible Spectrophotometer, while pH level was determined using EUTECHC Cyberscan pH 310 Series Meter. Median and IQR of iron were 0.080 and 0.030 mg/L, respectively.There was no relationship between iron and pH levels of drinking water samples in the study area. There was no significant difference between iron levels in drinking water and the National Standard for Drinking Water Quality, and the value ranged between 0.030-0.550 mg/L. There was no health risk of iron exposure among respondents. The HQ was <1. Generally, drinking water containing iron had no adverse health effects. The iron in drinking water in this study was not influenced. So there are no carcinogenic effects on the community in Sungai Mas Village, Sungai Lembing.

Keywords: Iron, Gravity Feed System Water, Health Risk Assessment, Chronic Daily Intake (CDI) Hazard Quotient (HQ).

INTRODUCTION

Sungai Mas Village, Sungai Lembing, relies primarily on gravity feed for drinking water. Human activity may contaminate water sources. Additionally, gravity-feed catchment systems provide refreshing drinking water for country side communities with no access to clean piped water from any water authorities (Shakeran, 2004). Indigenous people are communities that have inherited links to the land or assets on which they live. A strong connection exists between their identities, customs, livelihoods, physical and spiritual well-being, and the land. They often look to traditional leaders and groups for representation different or unique from mainstream society or culture. The history of injustice and isolation that indigenous peoples have experienced has made them particularly vulnerable to climate change and natural disasters (The World Bank, 2022).

According to the Governor (2022), the earth's crust contains more than 5% iron, making it a plentiful resource. During rainfall, iron dissolves in the land and causes geological structures, allowing it to flow into aquifers, which supply healthy water. It is rare for iron levels in drinking water to exceed ten milligrams per litre (mg/L) or ten parts per million (ppm). Water can change to red-brown with as small as 0.3 mg/L of iron. Typically, iron appears in water in two forms: soluble ferrous iron, and insoluble ferric iron. Water can dissolve and transfer these minerals into groundwater when it percolates through soil and rock. Iron pipes can also corrode and leak iron into the water supply (McFarland & Dozier, 2019).

Furthermore, iron will give drinking water an unpleasant flavour and colour. Deteriorated pipelines, the supply of potable water, and unsanitary drinking water practices cause heavy metal pollution in drinking water. Iron is found naturally in soils and will permeate into water catchments. Heavy metal pollution is caused by anthropogenic operations such as inadequate wastewater treatment and fertilizer runoff such as mining, industrial, and agricultural activities. On the other hand, iron is generally removed during the water treatment process, as the bulk of heavy metals is in the surface and groundwater. Moreover, the Ministry of Health Malaysia has incorporated heavy metal characteristics in the National Drinking Water Quality Standard (NDWQS), which water authorities must meet to guarantee that the drinking water they give consumers is safe.

Even though a gravity-feed system water is a safe and dependable drinking water supply, geogenic pollutants such as iron can pollute it. There has been an association between long-term iron exposure and detrimental health outcomes in some regions due to increased groundwater use (Ghosh et al., 2020).

According to Kamble (2020), high concentration of iron consumption also can lead to hemochromatosis, which is characterised by chronic weariness, arthritis, heart disease, cirrhosis, diabetes, thyroid sickness, dysfunction, and sterility. In addition, it spreads hepatitis B and C, as well as malignant colon, liver, stomach, and kidney tumours. Not only that, as a result, high iron levels can cause amenorrhea, cancer, constipation, diabetes, dizziness, emotional problems, fatigue, headache, heart damage, heart failure, hepatitis, high blood pressure, hostility, hyperactivity, infections, insomnia, irritability, joint pain, liver disease, weight loss, mental problems, metallic taste in the mouth, myasthenia gravis, and nausea (Afolabi et al., 2011).

Furthermore, the water supply system that uses the Gravity Feed System does not undergo any treatment before being delivered to the residence (Roslan & Fadhil, 2017). As a result, indigenous people who rely on Gravity Feed System water as their principal supply of water, which may have a presence of iron without their knowledge, have a high risk of being exposed. Therefore, this study aims to determine whether the public's well-being is in danger due to iron levels in drinking water from gravity feed systems in Sungai Mas village, Sungai Lembing, Kuantan, Pahang, in order to decide whether gravity feed systems are safe to consume.

Few objectives were looked at; first is to determine the iron and pH levels of drinking water from gravity feed system water samples. Secondly, to determine the relationship between Iron levels and the pH level of gravity feed system water samples. Thirdly, to determine whether there is a difference between the Iron level of gravity feed system water samples in Sungai Mas Village, with acceptable Malaysian standards of iron in drinking water. Lastly, to determine the health risk with the study population of indigenous people in Sungai Mas Village, from ingesting iron in drinking water from a gravity feedsystem by calculating Hazard Quotient (HQ).

METHOD

Description of Study Area

The research location was in Sungai Mas Village, Sungai Lembing, Kuantan, Pahang, Malaysia (Lat/Long 3.912753, 103.032744). Sungai Mas Village was located in the sub-district of Kuantan in the state of Pahang. Health Inspector Ministry of Health stated that the "Sungai Mas Village sources of drinking water are from gravity feed system water" (Fauzi, personal communication, March 16, 2022). The total number of households in Sungai Mas village is 104.

Study Design

A cross-sectional study design was conducted in Sungai Mas Village, Sungai Lembing, Kuantan, for a health risk assessment exposure to Iron in gravity feed system water among Sungai Mas Village, Sungai Lembing, Kuantan population.

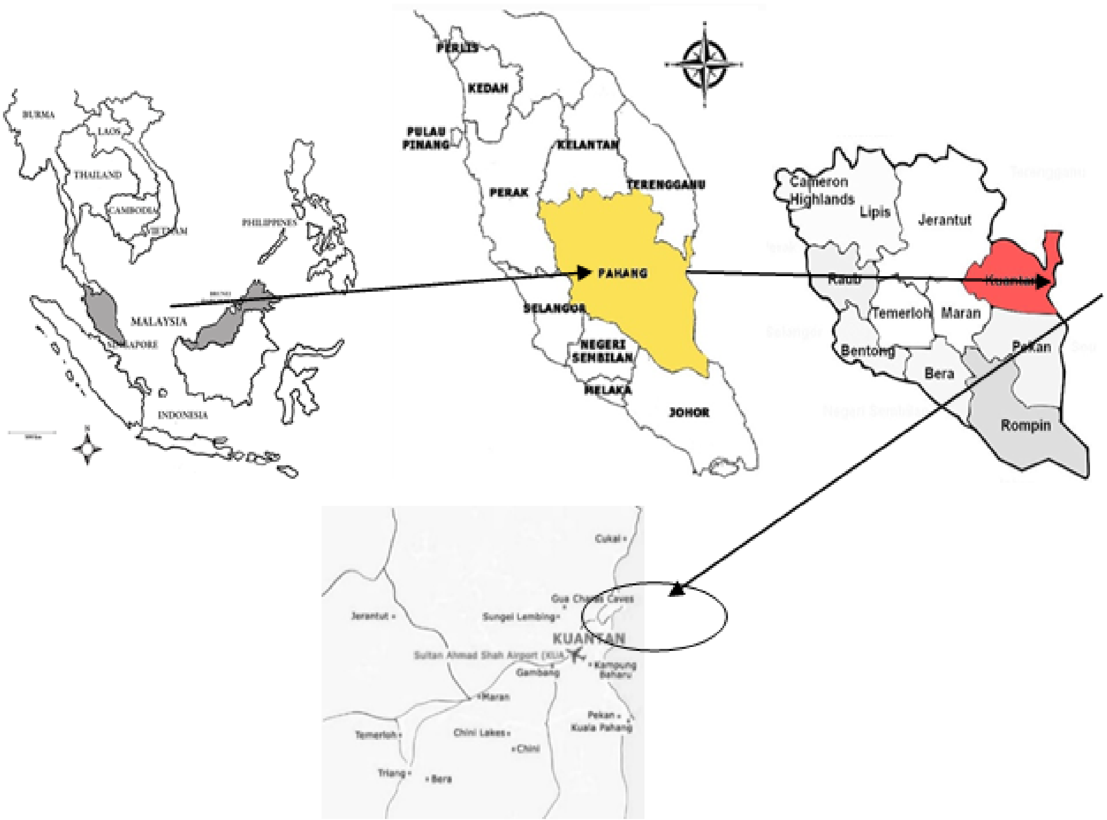


Figure 1
Description of Study Area

Study Population

This research's study population consists of either male or female indigenous people which from Jakun and Semaq Beri tribe who drank treated gravity feed system as their main source of drinking water.

There were few inclusion criteria. The inclusion criteria were indigenous people of 18 years old and above who live in Sungai Mas Village, Sungai Lembing, Kuantan. Furthermore, the respondents must use gravity feed system as drinking water and the residents shall lived at least a year in Sungai Mas Village, Sungai Lembing. Thereason for residents to live the least a year is that hemochromatosis is more frequent in elderly adults since iron toxicity takes years to develop (Cleveland Clinic Medical Professional, 2021).The exclusion criteria was respondents who were using a water filter system at home.

Sampling Methods

The purposive sampling method was used to select respondents for this study. All respondents' names were obtained from the village head. Purposive sampling was used because the respondents were chosen based on inclusion criteria. Moreover, a limited number of primary data sources may contribute to the study, and it is the only relevant approach available. Also, purposive sampling was the most cost- and time-effective way. The water sample and questionnaire review for health riskassessmentwere taken at the respondent's house who fulfilled the inclusion criteria after receiving approval from JKEUPM and consent from the Department of Orang Asli Development (JAKOA) to conduct the study.

Water Sampling

In this study, tap water was stored in 250 mL high-density polyethene (HDPE) bottles. Many researchemployed HDPE bottles to collect water samples for heavy metals analysis (Ghosh et al., 2020). Each house's tap water was collected straight from a pipe in the kitchen. The faucet was turned on, and the water was allowed to flow for 1-2 minutes before collecting the samples.Water samples were taken from many houses, although all came from the same gravity feed system. First, thebottles' gases were evacuated by filling them, then dumping them over the source and refilling them. Lastly, pH and temperature were measured at the study location.

Study Instrumentation and Data Collection Questionnaire

The questionnaire was adapted from the National Human Exposure Assessment Survey (NHEXAS) conducted in Arizona (Lebowitz et al., 1995). A questionnaire was administered among the indigenous people of Sungai Mas village, Sungai Lembing, to analyse the respondents' health risk assessments. Representative respondents were chosen from 104 households. Male and female respondents with primary education were included in the research. The ages of the adults ranged from 18 to 60 years old. Age, body weight, occupational exposure, waterborne infections, daily water intake, and other health concerns were obtained throughout the questionnaire survey. Respondents from the study area carefully filled out the questionnaires. Survey team members also questioned residents personally, and the questions were worded carefully to minimise misinterpretation. In addition, the questions were occasionally explained in their native language by survey team members. The questionnaire also provided an area for comments to encourage respondents to answer freely and contribute their thoughts. This survey is done throughout the research region, with all questions coming from the users of each water source. The questionnaire was based on a study by Singh and Sharma (2019), and divided into three sections:

Section A: Socio-demographic factor and information on family background.

Section B: Health status

Section C: Information on drinking water at home

Iron Analysis

Hanna Instruments HI801-02 iris Visible Spectrophotometer, that can measure all visible light wavelengths, was used to analyse iron. Iron detection limits in this method ranged from 0.00 to 5.00 mg/L as Fe. The iron high-range reagent was also utilised, with a resolution of 0.01 mg/L. For natural and treated waters, the method adapts the EPA Phenanthroline method 315B (Hanna Instruments,2022).

pH analysis

A pH meter, the EUTECH Cyberscan pH 310 Series, was used to determine the pH. By dipping the probe into the water and reading it fast, this apparatus could test the pH from -2.00 to 16.00 with an accuracy of 0.01 (Rshydro,2022). pH may be tested both outdoors and in the lab. However, the pH must be determined within 2 hours after the sample was collected, if it is examined in the lab. This is becausecarbon dioxide from the air dissolves in water, causing the pH to climb toward 7.

Body Weight

A digital body weighing equipment of Omron Body Composition Monitor with Scale was used to determine each respondent's body weight.

Statistical Analysis

Data analysis was conducted using SPSS version 27.0. Descriptive analysis was performed to provide raw and essential statistical data on the demographic characteristics of respondents as well as iron levels in drinking water. The data were presented as mean, median, variance, standard deviation, interquartile range, and maximum and minimum values.

All continuous variables were tested for normality using Kolmogorov-Smirnov statistics. After that, the data was evaluated in two steps. The first step is to conduct a univariate analysis. The hypothesis was then tested using bivariate analysis, separated into two parts: statistically significant difference testing and relationship or association testing.

The Spearman correlation test was used to determine the relationship between Iron levels and the pH level of gravity feed system water samples. In addition, a non-parametric test (one-sample t-test/sign test was used to determine whether there is a difference between the Iron level of gravity feed system water samples in Sungai Mas Village, with acceptable Malaysian standards of iron in drinking water.

Health Risk Assessment

Persons who consume heavy metals from groundwater in their daily lives may undergo health risk assessments to identify potential health effects. Nonetheless, only a few studies have considered the seasonal variations in Fe contents in alluvial aquifers (Huanget al.,2015).

According to the Division of Toxicants and as recommended by the United States Environmental Protection Agency, Fe is not a carcinogen (USEPA). Because there are only few pathways in this study, only oral intake channel was considered danger to human health, which is from drinking water containing Fe (Huang et al., 2015). Based on the study by Ghosh et al. (2020), population is exposed to iron in water via ingestion. According to the US EPA division of toxicants, iron is non-carcinogenic. Therefore, the hazard quotient (HQ) is used to quantify the non-carcinogenic danger of iron ingestion to human health:

Eq (1): $HQ = CDI / RfD$

Eq(2) : $CDI = C \times IR \times EF \times ED / BW \times AT$

where RfD (mg/kg/day) is the US EPA's recommended iron dosage (0.7 mg/kg/day for iron), The chronic daily iron consumption (mg/kg/day) is determined using C which is the iron concentration in groundwater (mg/L), IR is the human water ingestion rate in litres per day (1.684 litres per day for adults), ED is the exposure duration in years (35 years for adults), EF is the exposure frequency in days/year (365 days for adults), BW is (58.417 kg for adults), AT stands for average time. AT denotes theaverage time (AT = 365 ED (d)). The substance's non-carcinogenic effects are insignificant if the HQ score is less than one.

RESULTS AND DISCUSSION

Overall, there were no health risks for individuals in the study region due to the low health index values. However, specific populations with high Fe levels in groundwater necessitate scientific investigation and the implementation of suitable treatments (Huanget al., 2015).

According to the author observations, the iron does notexceed the limit. However, if the iron is inadequate, it may have a few detrimental health consequences. Iron is a secondary or cosmetic contaminant, even without health risks. Iron is also necessary for health because it helps the blood transport oxygen.

Socio-demographic Information

According to Table 1, there were a total of 104 respondents. They were females (59 respondents – 56.7 %), while the remainder were males (45 respondents – 43.3 %).

Table 1 correspond to the age and water consumption of the source of iron (tap water). Table 1 also demonstrates that the respondents aged from 18 to 28 years old (45 respondents-43.3%). This was followed by the 29 to 38 years old group (24 respondents – 23.0 %), 39 to 48 years old (13 respondents

Table 1
Socio-demographic Information

		Frequency	Percent (%)
Gender	Male	45	43.3
	Female	59	56.7
Age (years old)	18-28	45	43.3
	29-38	24	23.0
	39-48	13	12.5
	49-58	15	14.5
	>58	7	6.7
Water Intake (per day) (litre)	1-3	77	74.0
	4-6	17	16.4
	7-9	5	4.8
	>9	5	4.8

n=104
Source: Data Processed

– 12.5 %) group, 49 to 58 years old group (15 respondents - 14.5 %) and lastly, 59 years old group and above (7 – 6.7 %). The amount of water intake by respondents was between 1 to 3 litres per day (77 respondents -74.0 %). This was followed by 4 to 6 litres (17 respondents- 16.4 %), and the least numberofrespondents drinking water was more than 7 litres.

Range and Median ± IQR for Iron and pH Level in Gravity Feed System Water

As the respondents complied with the inclusion criteria, 104 respondents were picked. The iron concentration varied from 0.030 to 0.55 mg/L, with a median and interquartile range of 0.080±0.030 mg/L Table 2.

The pH level for water samples in Sungai Mas village, Sungai Lembing, Kuantan was also measured from 7.60 to 9.08. The median and IQR value was 7.89 ±0.16 (Table 2) and (Figure 3).

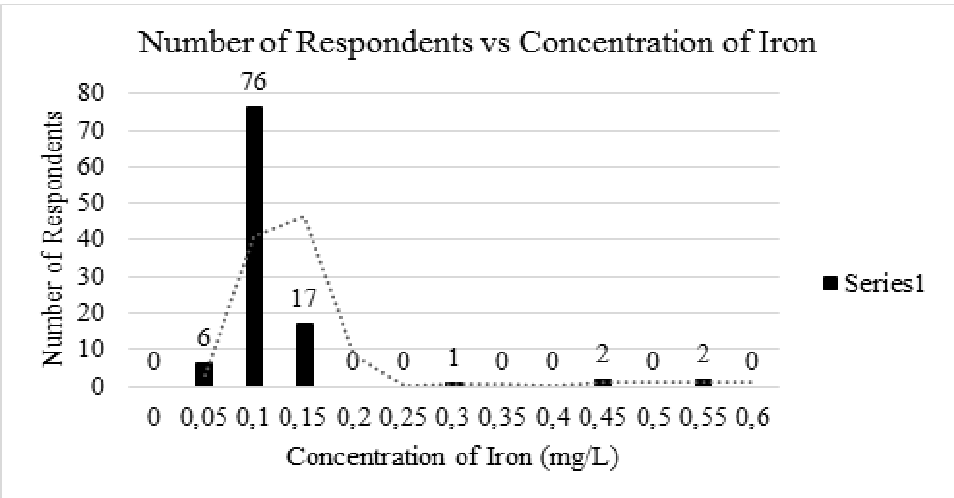
The Relationship Between Iron Level and pH Level in Water Samples

As previously stated, the iron and pH levels weredetermined. However, the Kolmogorov-Smirnov test revealed that the iron level in Sungai Mas Village, was not normally distributed, nor was the pH level ($p<0.001$). Consequently, a non-parametric Spearman's correlation test was used to demonstrate the relationship between Iron level and pH level. There was no relationship between Iron and pH since the significant p-value is >0.05. Spearman's rho was used since the data was not normally distributed.

Table 2
Parameter Information

Parameter	Range (mg/L)	Median (mg/L)	±IQR
Iron in drinking water	0.030 -0.550	0.080	0.030
pH in drinking water	7.60 to 9.08	7.89	0.160
CDI[1]	1.967x10-4 to 4.681x10-3	2.230 x10^{-3}	2.078 X 10^{-3}
HQ[2]	2.810x10-4 to 0.110	3.186x10^{-3}	2.968 X 10^{-}

n=104
CDI[1]= Chronic Daily Intake
HQ[2]= Hazard Quotient
Source: Data Processed



Source: Data Processed

Figure 2
The Distribution of Iron Levels in Drinking Water in Sungai Mas village, Sungai Lembing, Kuantan

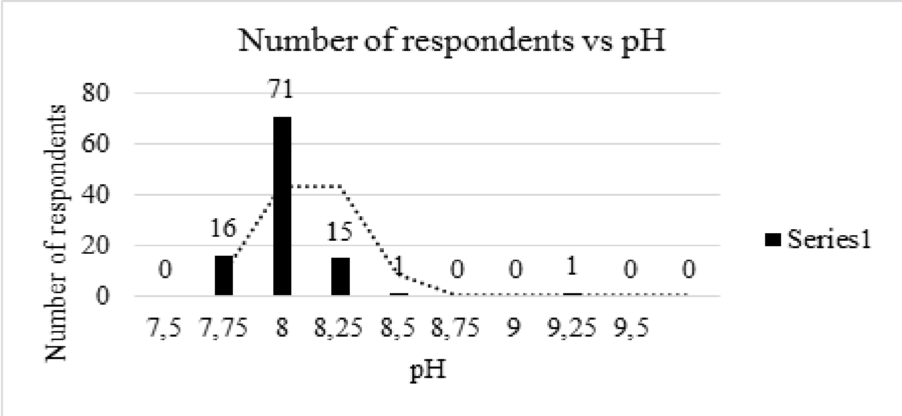


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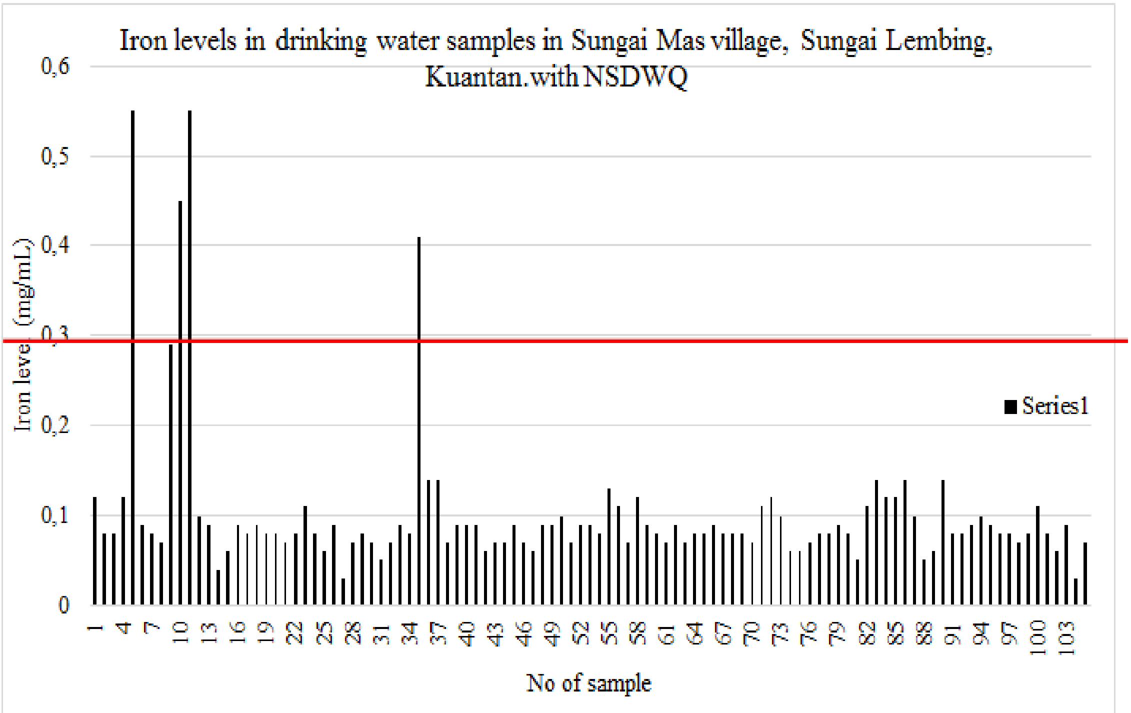
Figure 3
The Distribution of pH lLvel in Drinking Water of Sungai Mas Village, Sungai Lembing, Kuantan



Source: Data Processed

Figure 4
Comparison of Iron Concentration with the National Standard of Drinking Water Quality, (NSDWQ)

Difference Between Iron Levels in Drinking Water Samples with NSDWQ

According to the study's findings, the iron levels in drinking water in Sungai Mas Village, ranged from 0.030 mg/L to 0.550 mg/L, with a median value of 0.080 ± 0.070 mg/L. The mean iron levels in drinking water exceeded the National Standard of Drinking Water Quality, NSDWQ, with just a few water samples surpassing the criterion. Four water samples were positive for the NSDWQ acceptable 0.3mg/L. Figure 4 shows that four water samples (3.85%) out of 104 exceeded the drinking water quality requirement.

To compare the iron concentration in drinking water from Sungai Mas Village, with NSDWQ, a non-parametric test (one-sample t-test/) with a reference value of 0.3 mg/L was utilised.

Range and Median ± Inter Quatile Range for CDI in Sungai Mas village, Sungai Lembing, Kuantan

Chronic Daily Intake (CDI) was computed for each respondent using their actual Daily Intake (DI) and Body Weight (BW). Respondents CDI ranged between 1.967x10-4 mgday-1kg-1 to 4.681x10-3 mgday- 1kg-1. CDI from the respondents investigated was median ± IQR 2.230 x10-3 ± 2.078 x 10-3 day-1 kg-respectively. The CDI distributions is presented in Figure 5.

Range and Mean ± Standard Deviation for Hazard Quotient (HQ) in Gravity Feed System Water

The computed minimum HQ was 2.810x10-4 mg/L, and the highest was 0.110 mg/L. The median ± IQR HQ of Sungai Mas village, Sungai Lembing, Kuantan respondents were 3.186x10-3 ± 2.968 X 10-3, respectively. The HQ of all respondents is shown to be less than 1 (Figure 6).

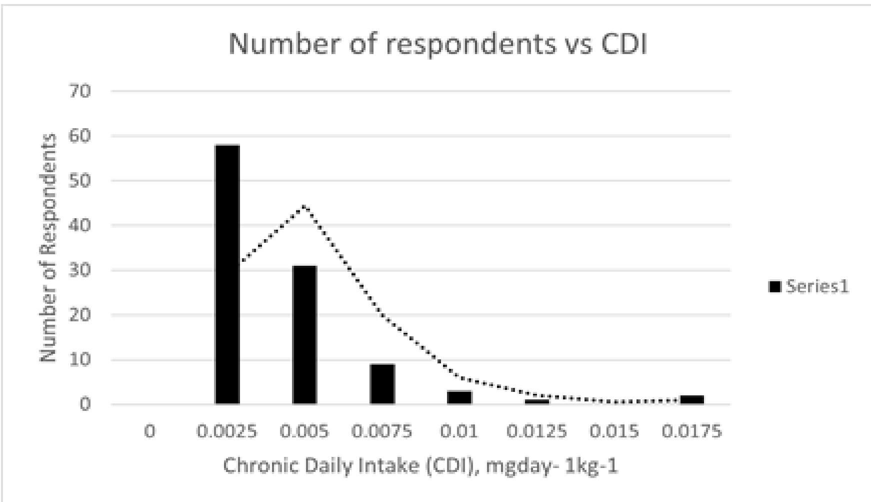
DISCUSSION

Iron Level and pH Level in Water Samples

Fe levels in drinking water varied from 0.030 – 0.550 mg/L, with a median and IQR of 0.080 ± 0.030 mg/L at Sungai Mas village, Sungai Lembing, Kuantan. Table 2 displays the range and mean± standard deviation for iron levels. The mean Fe level in Sungai Mas village, Sungai Lembing, Kuantan, does not exceed the Ministry of Health's upper safe limit (0.3 mg/L) for NSDWQ.

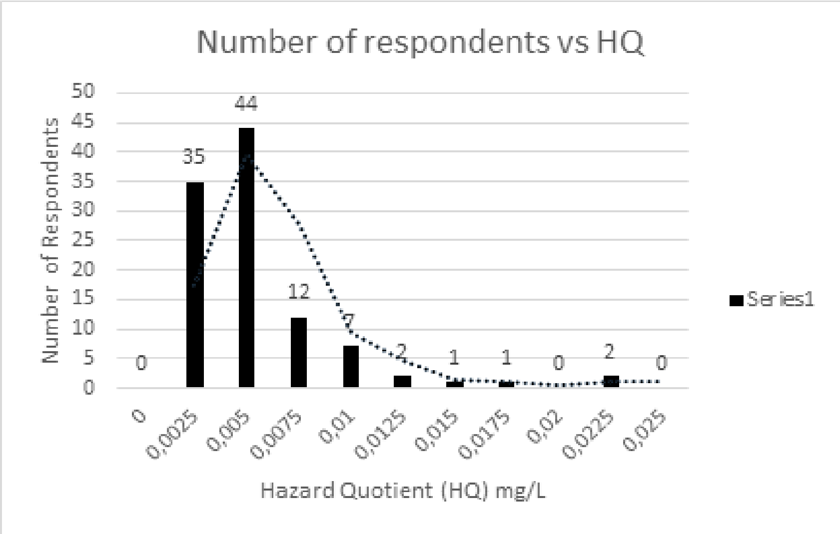
Iron in the water system is present due to rain falling on the land surface and water leaking through soil containing iron (Minnesota Department of Health, 2022).

According to Kamble (2020), the standard highest iron concentration in Ballarpur, India, is 18.213 mg/L and 0.081 mg/L in Gunjewahi, India. The greatest concentration of groundwater iron is found in Ballarpur in India (3.825 mg/L), followed by Gondpipari in India (3.548 mg/L) and Dabgaon (Tukum) in India (3.084 mg/L). Ballarpur, India, has the highest groundwater iron content in winter and summer. In addition, the Fe concentration in drinking water in Islamabad, Pakistan was 0.616 mg/l.



Source: Data Processed

Figure 5
Distribution of CDI in Drinking Water in Sungai Mas village, Sungai Lembing, Kuantan



Source: Data Processed

Figure 6
Distribution of HQ in Drinking Water in Sungai Mas village, Sungai Lembing, Kuantan

According to Ghosh et al. (2020), the average (minimum, maximum) iron concentration (mg/L) in Jashore, Bangladesh, was 2.81. (0.027, 10.5). The iron (Fe) concentration in water, soil, and plant samples was measured by Khan et al. (2013). The Fe contents in tap and sewage water were determined to be 0.090 and 0.115 mg/L, respectively.

The pH of water was often considered an essential measure (Kamble,2020). Many studies have revealed that pH influences heavy metal precipitation and dissolution processes in sediments. In five locations, the pH of the tap water varied a little, ranging from 7.3 to 8.0. Tap water had a median Fe level of 0.0515 mg/mL.

Relationship Between Iron and pH Levels in Water Samples

As demonstrated in Table 3, there was norelationship between the iron and pH levels of water samples from Sungai Mas Village, ($r=0.045, p>0.05$). Finally, the pH level in Sungai Mas Village, does not impact iron solubility in water. It is because soluble iron remains in the treated water as opposed to insoluble iron, which may be removed following the coagulation and flocculation processes of water treatment.Itcontradicted with Ibrahim (2016)'s statement, the link between pH and iron levels shows that iron concentration increases with increasing pH values. Conversely, lower pH values below 6.5 tend to maintain iron deposits in solutions, causing corrosion difficulties.

Difference Between Iron Levels in Water Samples and NSDWQ

The average iron concentration in drinking water was lower than the NSDWQ allowable values. Four water samples exceeded the NSDWQ maximum permissible limit of 0.3 mg/L. Iron levels in gravity feed system water from Sungai Mas village, Sungai Lembing, Kuantan, and NSDWQ differed significantly. The non-parametric one-sample t-test, also known as the one-sample Wilcoxon signed rank test was done to see this difference.

In winter (47.100 mg/L), summer (3.825 mg/L), and post-monsoon (4.022 mg/L), groundwater iron concentrations are all high (Merrill et al., 2010). Several sample spots have iron levels that exceed the permitted limit, in agreement with (Chetia et al., 2008). However, the iron water level did not exceed at Sungai Mas Village.

Respondents' Chronic Daily Intake (CDI) and Hazard Quotient (HQ)

Several factors, including iron levels in water and body weight, might influence respondents' CDI. The CDI of the respondents was calculated using these data. According to the findings of this study, the CDI of respondents from Sungai Mas village, Sungai Lembing, Kuantan varied from $1.967x10^{-4}$mg/kg/day to $4.681x10^{-3}$mg/kg/day. The Iron Reference Dose (Rfd) of 0.7 mg/kg/day was lower than the CDI of the study participants.

This was primarily due to low iron levels in drinking water. Iron levels were the most crucial contributing component in the CDI equation, rather than other factors such as respondents' body weight and length of exposure to iron in drinking water.

The HQ was used to assess respondents' risk of iron exposure in Sungai Mas village, Sungai Lembing, Kuantan. An HQ number of less than one suggests an improbable likelihood of harmful health consequences. However, a HQ value more than one indicates a worry about harmful health impacts or the need for additional research.

According to this survey, the HQ for Sungai Mas Village, Sungai Lembing, Kuantan respondents varied from $2.810x10^{-4}$mg/L, and the highest was 0.110 mg/L. Because the respondents' HQ mean was less than one, they were not in danger of iron exposure. Therefore, due to low CDI values, the respondent's HQ mean was less than 1. According to Liu et al. (2019), all studied components had HQ values well below one, suggesting that water intake posed minor non-carcinogenic risks to occupants of adults and children.

According to Kamble (2020), the CDI was 1.940 mg/kg/day for iron, which was much higher than this research. In northern Pakistan, the hazard quotient value for iron from oral ingestion was morethan one (Begum et al., 2015). According to Huang et al. (2015), residents' health may be affected if they ingest groundwater with a greater iron concentration. Seasonal influences on iron distribution were discovered using WHO, JECFA, and IOM guidelines.

According to Ghosh et al. (2020), simple oral consumption of iron through drinking tube well water was examined forassessing people's health risks. The findings of the hazard quotient (HQ) are displayed. The median HQ iron level was 0.161, and the interquartile range was 0.063 to 0.576 in adults.

CONCLUSION

Mean iron levels in Sungai Mas village, Sungai Lembing, Kuantan did not exceed the NSDWQ upper safe maximum value of 0.3 mg/L. There was no relationship between iron levels and pH levels. Furthermore, the HQ value was less than one, suggesting that the danger of iron exposure in drinking water was lower than an acceptable level. Therefore, respondents in Sungai Mas village, Sungai Lembing, Kuantan were found to have an acceptable level of non-carcinogenic hazard of iron in drinking water.Since four samples (3.846 %) are over the limit, NSDWQ breaches in Sungai Mas Village, Sungai Lembing, Kuantan, additional action is required to minimize the iron content in drinking water by considering water treatment authority Malaysia to provide safer treated water for the community. In addition, a monitoring program and health education should be implemented in regions where drinking water is likely to be contaminated with iron, such as mining zones. To reduce pollution, it is advised that a water filtration system be used. Health authorities, such as the Ministry of Health (MOH), must survey the iron content of drinking water regularly tested to ensure that the water being supplied to the public meets the drinking water standards. In addition, heavy metals in drinking water may be analyzed using biomarkers such as blood, urine, hair, and nails to obtain more accurate results. However, HRA applicability in heavy metal ingestion studies in Malaysia is relatively limited. Nevertheless, HRA is crucial to include in drinking water studies because it may be used to quantify the potential for unfavorable health effects in people. In addition, other researchers may consider doing a health risk assessment for iron in food owing to ingesting more iron than needed. There are a few limitations in this study. No biological samples were obtained from the study participants to assess their bodies' accurate iron content. Furthermore, iron bioaccessibility in groundwater was not assessed, making it impossible to determine actual iron exposure. Bioaccessibility is the quantity of an eaten nutrient available for absorption in the stomach after digestion. It can be assessed using solubility, realizability, or gastrointestinal models.

ACKNOWLEDGEMENT

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CONFLICT OF INTEREST

The authors guarantee that this article, in part or in whole, has not been published in any other journals.

ETHICAL CONSIDERATION

One of the requirements for conducting a research study was that the researcher received permission from their university's ethical committees. The respondents in this study were a group of indigenous people from Sungai Mas village in Sungai Lembing, Kuantan, who participated in the research study.

After getting clearance from the Ethics Committee for Research Involving Human Subjects (JKEUPM) (JKEUPM-2022-405), the study and data collection began. Since the research involves indigenous people, the researcher obtained permission from the Department of Orang Asli Development (JAKOA). The questionnaires were distributed to respondents, as well as an explanationwas given. Respondents completed a consent form, and their information was kept private.

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