Article

Contaminated Drinking Water and Its Effects on Human Health A Case Study of Rahim Yar Khan, Pakistan

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Abstract: Human health cannot be complete without access to safe drinking water and in most areas of Pakistan, contaminated water is a significant health issue to people. This paper has been discussing the perceived impact of contaminated drinking water on human health in Rahim Yar Khan, Punjab, Pakistan. The quantitative research design was applied. A purposive sampling was used to select 100 respondents who were used as the primary data with the help of a structured questionnaire. Descriptive and inferential statistics, such as frequencies, percentages, cross-tabulation, and chi-square analysis in SPSS were used to analyse the data. According to the results, a high percentage of the respondents deemed groundwater unfit to drink and thought the contaminated water causes severe health issues in the region of study. According to the respondents, there were various health complications that were linked to contaminated water, such as diarrhea, hepatitis, malaria, and other water-borne diseases. The fact that children are worse hit by the contaminated water was also felt by many respondents. Despite the descriptive findings that showed that there is high public concern about the health implications of unsafe drinking water, the chi-square test failed to demonstrate statistically significant relationship between perceived unsuitability of ground water to drink and perceived impact on human well being in the sample. The research ends by concluding that there is a strong perception of contaminated drinking water as a health hazard in Rahim Yar Khan. It suggests better water monitoring, installation and maintenance of the water treatment facilities, frequent testing of the drinking water sources, and awareness of the population to minimize the contact with the unsafe water.

Keywords: *Contaminated drinking water; human health; groundwater quality; waterborne diseases; Rahim Yar Khan; Pakistan*

Introduction

In developing nations, problems with water quality come first, then air pollution, solid waste, and waste water disposal. Due to urbanization, industrialization, global warming, population growth, and changes in residential uses, water volume is becoming insufficient with time, and its quality is declining (Gundry et al, 2004). The main issue in developing nations is poorer water quality, which is made worse by improper management, a lack of qualified personnel, and financial constraints (Muryani, 2021). Access to clean water is a basic right for all living creatures. Biggest issues facing all nations, particularly the developing ones, is the lack of clean water in the Globe. At least 25% of people on the planet do not currently have access to clean drinking water and as the global population grows, this issue will only become worse.

According to the UN report, a number of countries in Africa, the Middle East, and South Asia may experience a shortage in the next 20 years due to the growing global population and decreasing freshwater availability (Adelodun et al, 2021). In developing nations, the most common problems are with water quality, which is followed by air pollution, solid waste, and waste water disposal (Adelodun et al, 2021). Over time, the amount of water available is decreasing and its quality is getting worse because of factors like population growth, industry, urbanization, global warming, and shifting household needs. In underdeveloped nations, access to high-quality drinking water is sometimes hampered by inadequate management, a shortage of professionals, and financial constraints (Lin et al, 2022).

One of the main challenges is water contamination, which has been a problem for several centuries. It is among the majority of other types of environmental contamination that have arisen as a result of the development and expansion of industrial-urban areas during the last 60 to 70 years, especially the last 20 years. One naturally replenish able resource is water. It comes to us from the sky as rain, snow, fog, and compression, and it goes back by transpiring and evaporating (Fida et al, 2023). There are various types of water on Earth, including lakes, rivers, streams, and oceans. Growing plants are supposed to absorb it, incorporate it into the groundwater where it is stored, and eventually release it into streams, lakes or the oceans.

A basic necessity for every individual is access to an adequate amount of clean drinking water and fresh water. A healthy lifestyle absolutely requires access to clean water. However, millions of people around the world are deprived of this fundamental human right. For all of the nations in the globe, the decline in the availability of fresh water is a serious and worrying issue (Ighalo & Adeniyi, 2020). According

scientific research chemical contamination and water-borne diseases have been sharply rising. Many people in this world are lack of their basic needs especially the most wanted basic need clean drinking water is still out of their reach. However, these limited water supplies are under risk due to pollution, which is mostly brought on human activity. The mining, industrial, agricultural and power generation sectors ae just a few of the numerous factors that lead to the pollution of water bodies. People as a whole will eventually be impacted by this pollution (Hasan, 2019).

Numerous microorganisms, including bacteria, viruses, and protozoa, can cause diarrhea. A person with diarrhea loses electrolytes and fluids, which can result in dehydration and, in extreme circumstances, death. Approximately 4 billion instances of diarrhea annually result in 1.8 million deaths, with children under five accounting for approximately 90% of these cases (1.6 million deaths). Children who experience diarrheal illness on a regular basis are more susceptible to malnourishment and other illnesses. The most significant issue with public health that is directly linked to water and sanitation is diarrhea. Hand washing with soap and water can reduce diarrheal illness by thirty percent. According to experts, the second most important factor in preventing waterborne illnesses is having proper sanitation facilities.

Any chemical, physical, or biological agent that alters the water's quality and has a hazardous impact on any living thing that uses it is considered a source of water pollution (Habib et al, 2023). Human health may be seriously impacted when they consume water that has been contaminated. Water contamination can also make it unfit for the intended usage (Singh, 2020). A small amount of negligence on the part of municipal organizations may cause a number of diseases to spread. There are 160 million people living in Pakistan, a country in Southeast Asia that borders the Arabian Sea. Its total size is 796096 sq. km. The nation is endowed with sufficient supplies of surface and ground water. However, the quality and quantity of water are severely stressed as a result of the high rate of population expansion, urbanization, industrial and agricultural development, overexploitation of groundwater resources, and unsustainable water consumption patterns. Water resources are lost as a result of this. It is the duty of the government, science, and society to address the rapidly worsening conditions regarding the nation's water supply and quality. In much of Pakistan, groundwater use in both urban and rural areas is at its peak, which causes the water table to continuously decline.

A recent statistic states that the amount of water available per person is only 1100 cm3. The quality of groundwater varies depending on the region; in general, it ranges from fresh near large rivers with Total Dissolved Solids (TDS) less than 1000 ppm to severely salinize with salinity reaching 3000 ppm.

Recent investigations have revealed elevated levels of arsenic, fluoride, and nitrates in a number of groundwater samples from the provinces of Sindh and Punjab. Surface water frequently has pesticide residues found in it as a result of agricultural runoff.

As 37% of Pakistani families get their primary drinking water from piped water. The proportion in urban regions (62%) is greater than that in rural areas (21%). The districts within provinces with the

lowest percentage of households using piped water as their primary source of drinking water in Pakistan. In Pakistan's rural areas, hand pumps are the primary source of clean drinking water. The primary cause of death for children under five, worldwide is contaminated water and sanitary conditions. People are caught in a vicious cycle of illness and poverty without access to potable water or sanitary facilities. Millions of women waste their valuable time collecting contaminated water throughout the poor countries, and children are dying from treatable diarrheal infections (Leal Filho et al, 2022). In Pakistan, there is an inverse relationship between population increase and water supply per person. With 33.7 million people, there was 5650 each person's available cubic meter of water in 1951. Now, the population had nearly doubled, yet there was only 2800 water capacity in cubic meter per person available. Pakistan started to experience a water deficit (Zeshan, 2018).

According to a report, around 62% of Pakistan's urban residents and 84% of its rural residents do not consume treated water, which results in 100 million diarrheal illness cases being reported about 40% of fatalities being related to taking contaminated water (Fida et al, 2023). Rapid population growth exacerbates the issue by leading to inadequate management of water quality. The nation lacks programs for monitoring and supervision of the quality of drinking water. The situation has gotten worse due to inadequate institutional setup, a dearth of well-equipped laboratories, and a lack of a legislative framework addressing problems with drinking water quality. As a result, many ailments can arise from drinking water, counting as hepatitis, typhoid and intestinal worms (Zeshan, 2018).

In Pakistan, water-borne illnesses are thought to be the cause of 250,000 infant deaths annually. There is talk about the effects of arsenic and mercury from industrial effluents on drinking water by (Ahmed et al, 2020). Both anthropogenic activities and natural sources of toxins support the environment. Every person's health is seriously endangered by the presence of harmful substances in the environment (Kalid et al, 2020). Mercury is a recognized carcinogen that can cause a wide range of symptoms, such as headaches, dizziness, exhaustion, altered personality, nausea, vomiting, abdominal pain, respiratory distress, lung impairment, renal failure, glycosuria, narrowed visual fields, seizures, ataxia, coordination issues and metallic mouth tastes (Fida et al, 2023).

According to the scientific research, groundwater contamination with arsenic has developed as significant public health issue in numerous portions of Pakistan. According to (Amin et al, 2019), the massive population growth and challenges brought on by the individuals moving from rural to urban areas are the main causes of ground water contamination. Increases in the number of algae in the water have caused a drastic decline in oxygen levels, which is one of the main causes of water pollution. The majority of river systems have been contaminated by forestry, urbanization, and agricultural growth. Although some come from natural sources, humans are the main cause of water pollution. The amount of dissolved oxygen in surface water is influenced by chemicals, fertilizer used in agriculture, and industrial wastewater. Drinking contaminated water can have a negative impact on a person's heart and kidneys, as well as lead to poor blood flow, skin rashes, nausea, and nervous system impairment. Waste management, water contamination, and air pollution from industrial emissions are few of them. The main issue posing a risk to the public's health is drainage and sewerage (Masood et al, 2021).

Materials and Methods

The current research was on the impacts of polluted drinking water on human health in Rahim Yar Khan, Punjab, Pakistan. The quantitative research design was used since the study would describe and analyze the perception of the respondents using numerical data. The target population of the study was adults who were deemed to be aware of the problem of polluted water and its potential health consequences.

Rahim Yar Khan was used as the primary data source, and a structured questionnaire was used to collect it. The questionnaire was created in order to obtain the information about the perceived quality of drinking water, the appropriateness of groundwater to use as a drinking water, and the perceived health outcomes of polluted water. The respondents aged 18 years and above were the target population.

The respondents were selected by a purposive sampling method. In this method, 100 respondents were selected in the study area based on their relevance to the subject and their capability to give information on the situation of drinking water and health related issues.

The questionnaire was pre-tested before the final data collection to enhance clarity and relevance. The pre-test was followed by necessary changes to make sure that the items were comprehensible and suitable to the respondents. The data obtained were processed in the Statistical Package of Social Sciences (SPSS). The responses were summarized using descriptive statistical methods such as frequencies and percentages. The inferential statistical methods, such as cross-tabulation and chi-square, were employed to test whether there was a relationship between perceived contaminated

drinking water and perceived human health effects. Ethics were taken into account in the course of the study. During the study, respondents were advised of the purpose of the research, as well as participation was voluntary and confidentiality of the responses ensured.

Results and Discussion

The findings of the research are indicated below as per the purpose of analysing the perceived impacts of the polluted drinking water on human health in Rahim Yar Khan, Pakistan. The study is conducted on the answers of 100 individuals and it consists of both descriptive and inferential statistics. On the whole, the results indicate that the people are very concerned about the quality of groundwater, health-related issues related to contaminated water and children are at risk of unsafe drinking water.

Table 1
Distribution of Usage of Groundwater for Drinking Purpose

Category	Frequency	Percentage
To great extent	23	23.0
To some extent	66	66.0
Not at all	11	11.0
Total	**100**	**100.0**

Table 1 indicates the perceptions of the respondents concerning the degree to which the available ground water is utilized in drinking. Among 100 respondents, 23 percent answered to great extent, 66 percent answered to some extent and 11 percent answered not at all. These results suggest that groundwater continues to be consumed by a significant percentage of the population, and most of them stated that they use it at least in part. This implies the reliance on groundwater in the study area although there are issues with the quality of water. The importance of the finding is that the frequent use of ground water enhances the health consequences of the contamination in case the water is not treated or monitored. In an environment whereby the residents rely on the water available locally, any degradation of the quality of groundwater can have a direct impact on the daily drinking habits and the health hazard of the population.

Table 2
Distribution of Social Problems Faced due to Contaminated Water

Category	Frequency	Percentage
Health issue	46	46.0
Educational problem	12	12.0
Financial problem	21	21.0
All of the above	21	21.0
Total	**100**	**100.0**

Table 2 shows the opinions of the respondents about the key issues connected with polluted water. The statistics indicate that 46 percent of them cited health problems as the primary concern, 12 percent cited educational problems, 21 percent cited financial problems, and the remaining 21 percent cited all of the above. This implies that the most reported consequence was health issues, and a significant percentage of the respondents also considered contaminated water to have an impact on several aspects of life simultaneously. These results suggest that the impacts of polluted water are not seen as confined to disease only. Although health issues are obviously the most prominent, the respondents also link contaminated water to financial strain and learning challenges, presumably due to the fact that the disease may raise healthcare costs and decrease the capacity of the members of the household, including children, to continue with their daily routine.

Table 3
Distribution of Relationship between Human Health Problems and Water Contamination

Category	Frequency	Percentage
To great extent	31	31.0
To some extent	53	53.0
Not at all	16	16.0
Total	**100**	**100.0**

Table 3 demonstrates the opinions of respondents concerning the degree to which human health issues are associated with water contamination. The findings show that 31% felt that this relationship is great, 53% to some extent and 16% none whatsoever. The biggest group thus was the to some extent category with almost one-third of the respondents thinking that the relationship exists to great extent. Collectively, 84 percent of the respondents admitted that there was at least some association between polluted water and human health issues. This trend indicates that the perceived relationship between polluted water and bad health is common in the study region. Although the respondents varied in the magnitude of the intensity, a huge majority did not reject the relationship completely. This is in line with the argument that polluted water is generally perceived as a significant community health issue in Rahim Yar Khan.

Table 4
Distribution Showing that Children are More Affected by Contaminated Water

Category	Frequency	Percentage
To great extent	59	59.0
To some extent	32	32.0
Not at all	9	9.0
Total	**100**	**100.0**

Table 4 concentrates on whether children are worse hit by the contaminated water. The results indicate that 59 percent of the respondents thought that children are greatly, 32 percent to a lesser extent and 9 percent not affected in any way. This puts children as the most perceived vulnerable group to unsafe drinking water, with 91% of respondents acknowledging that it has at least some impact on children.

This is among the most evident findings in the study. It shows that respondents perceive contaminated water as a general public health problem, but a threat that is especially severe to children. This view is aligned with the wider public health issues, as children are generally more susceptible to diarrhea, dehydration, infection, and other diseases caused by water. Considering the situation in Rahim Yar Khan, the evidence indicates that child health is at the core of the way in which the residents perceive the effects of polluted water.

Table 5
Distribution Showing that Chemical Water Causes Different Health Diseases

Category	Frequency	Percentage
To great extent	37	37.0
To some extent	46	46.0
Not at all	17	17.0
Total	**100**	**100.0**

Table 5 shows the perception of the respondents on the issue of whether the chemically polluted water is the cause of various diseases or not. The findings indicate that 37% indicated this to a great degree, 46 percent to some degree and 17 percent not at all. The biggest group once more chose to some extent, however, combined, 83% of the respondents thought that chemical contamination in water causes disease in some manner.

This result supports the health issue that is represented by the previous tables. Not only did the respondents associate poor health with contaminated water in general, but also chemical contamination with disease in particular. This means that there is a social perception that water quality issues in the region are not just aesthetic and minor but may cause direct and severe health effects.

Table 6
Distribution of Diseases Caused by Contaminated Water to Human Health

Disease / Health Issue	Yes (f)	Yes (%)	No (f)	No (%)
Diarrhea	73	73.0	27	27.0
Hepatitis	61	61.0	39	39.0
Malaria	79	79.0	21	21.0
Small Pox	68	68.0	32	32.0
Other Human Health Issues	83	83.0	17	17.0

Table 6 shows the respective diseases and health problems that the respondents related with polluted water. These findings indicate that 73 percent of them claimed to have diarrhea as a water-borne disease, and 27 percent did not. Sixty-one percent of the respondents reported hepatitis and 39 rejected it. Malaria had the highest yes answer to the named diseases with 79 percent affirming the association and 21 percent denying the association. Small pox was recognized by 68 percent of the respondents and 32 percent did not. Moreover, 83 percent of the people interviewed thought that polluted water was the cause of other human health problems whereas 17 percent did not.

These results indicate that the respondents relate polluted water to a broad spectrum of diseases and not one health outcome. Malaria and other unspecified health issues were the most perceived to be linked, then diarrhea, small pox, and hepatitis. In the case of some disagreement, the majority of the respondents always perceived contaminated water as a significant cause of disease. This means that there is a wide and grave understanding of health danger in the study region.

Inferential analysis

In order to test the correlation between water quality and health further, the study employed the cross-tabulation and chi-square analysis.

Table 7

Cross-tabulation between Groundwater Unsuitability for Drinking and Human Well-being Affected by Polluted Water

Available Groundwater Not Fit for Drinking	Human Well-being Affected to Great Extent	Human Well-being Affected to Some Extent	Human Well-being Not Affected at All	Row Total
To great extent	45	21	2	68
To some extent	23	7	0	30
Not at all	1	0	1	2
Column Total	**69**	**28**	**3**	**100**

Table 7 cross tabulates the opinions on whether ground water is not suitable to drink with the opinions on whether human well being is influenced by polluted water. The table indicates that of the people who strongly held the view that ground water is not fit to drink, 45 people also held the view that polluted water had no impact on human well being at all, 21 had the view that it had some impact and 2 had the view that it had no impact at all. Out of the people who held the view that groundwater cannot be used as drinking water to some degree, 23 held the view that polluted water has a great impact on human well being and 7 to some degree. The number of respondents in the category of not at all with

regard to groundwater unfitness was only 2 with 1 indicating a great effect and the other indicating no effect whatsoever on human well being.

The cross-tabulation hence indicates a descriptive trend whereby, concern about unsafe groundwater is coupled with concern about adverse impacts on human well-being. Simply put, respondents that deemed groundwater inappropriate to drink were also more inclined to say that contaminated water is detrimental to health.

Table 8
Chi-Square Test

Test	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.170	3	.538
Likelihood Ratio	2.106	3	.550
Linear-by-Linear Association	1.151	1	.283
N of Valid Cases	100		

Table 8 however indicates that the chi-square test did not have a statistically significant value. The Chi-Square value was 2.170 having 3 degrees of freedom and a p-value of 0.538. Since the p-value is more than .05, the study fails to present the statistical evidence of a significant association between these two variables in this sample.

This point matters. The descriptive results are clear that there is strong concern of people regarding contaminated water and health but the inferential test cannot say that there is statistically significant relationship in the study based on the sample studied. As such, the results can be viewed primarily as an indicator of high levels of public perception and interest and not necessarily as statistical evidence of correlation.

General discussion of findings

Put altogether, the descriptive results have been consistent in demonstrating that in Rahim Yar Khan, the respondents view contaminated drinking water as a serious human health problem. The majority of respondents said that they still used groundwater in drinking, the majority of the respondents cited health issues as the leading challenge of contaminated water, and majorities of the respondents cited contaminated water as a source of human health problems, vulnerability of children, chemical related disease and specific illnesses like diarrhea, hepatitis, and malaria. These findings depict polluted water as one of the main perceived social health hazards in the study area.

Simultaneously, the inferential analysis puts a significant limitation to the analysis. Although respondents were highly concerned, the chi-square test result failed to provide statistically significant results on the relationship between perceived groundwater unsuitability and perceived impact on human

well-being. This implies that the study helps to support the conclusion that polluted water is generally considered as harmful, but it does not statistically prove the hypothesized relationship in the sample using chi-square tests.

In general, the findings indicate that polluted drinking water is considered by local citizens as an acute problem in Rahim Yar Khan, particularly due to its perceived impact on children and its connection to various illnesses. The results thus confirm the necessity of better water quality control, safer drinking water supply, and enhanced awareness of the population on the health hazards associated with water.

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