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ASSOCIATION BETWEEN PHYSICOCHEMICAL AND MICROBIOLOGICAL QUALITY OF DRINKING WATER AND THE PREVALENCE OF GASTROINTESTINAL DISEASES IN FERGANA CITY

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Abstract: access to safe drinking water is one of the most important factors influencing public health. The quality of drinking water, particularly its physicochemical and microbiological characteristics, plays a significant role in the development of gastrointestinal diseases. This study aimed to assess the physicochemical and microbiological quality of drinking water in Fergana city and to determine its association with the prevalence of gastrointestinal diseases among the population.

Water samples were collected from different districts of Fergana city and analyzed for physicochemical parameters such as pH, turbidity, total dissolved solids, nitrates, and residual chlorine, as well as microbiological indicators including total coliforms and Escherichia coli. Data on gastrointestinal diseases were obtained from official healthcare statistics. The results revealed that in several areas, drinking water quality indicators exceeded hygienic standards, particularly with respect to microbial contamination and nitrate concentration. A positive correlation was observed between poor drinking water quality and increased incidence of gastrointestinal diseases.

The findings indicate that insufficient drinking water quality remains a significant risk factor for gastrointestinal morbidity in Fergana city. Strengthening water quality monitoring and improving water treatment systems are essential to reduce water-related health risks.

Keywords: Drinking water quality; Physicochemical indicators; Microbiological contamination; Gastrointestinal diseases; Public health; Fergana city

Introduction

Access to safe and high-quality drinking water is a fundamental prerequisite for human health and well-being. Drinking water quality is closely linked to the prevention of waterborne diseases and plays a crucial role in reducing the burden of gastrointestinal illnesses worldwide. According to the World Health Organization, unsafe drinking water remains one of the leading environmental risk factors contributing to morbidity and mortality, particularly in developing and transitional countries. Gastrointestinal diseases caused by contaminated drinking water continue to pose serious public health challenges, especially in urban areas with aging water supply infrastructure.

The hygienic quality of drinking water is determined by a combination of physicochemical and microbiological parameters. Physicochemical indicators such as pH, turbidity, total dissolved solids, nitrate concentration, and residual chlorine reflect the chemical safety and suitability of water for consumption. Microbiological indicators, including total coliform bacteria and *Escherichia coli*, are widely used to assess fecal contamination and the potential presence of pathogenic microorganisms. Deviations from established hygienic standards may significantly increase the risk of gastrointestinal infections and other adverse health outcomes.

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Gastrointestinal diseases remain among the most common causes of outpatient visits and hospital admissions, particularly among children, the elderly, and immunocompromised individuals. Waterborne pathogens such as bacteria, viruses, and protozoa can enter drinking water systems through inadequate treatment, leakage of sewage networks, or contamination of water sources. In addition, excessive concentrations of chemical substances such as nitrates may cause digestive disturbances and contribute to long-term health effects.

Urbanization, population growth, and increased pressure on water supply systems have intensified concerns regarding drinking water safety in many cities. In regions where centralized water supply systems coexist with old pipelines and insufficient monitoring, the risk of secondary contamination during water distribution remains high. Seasonal variations, infrastructure deterioration, and insufficient disinfection practices may further compromise water quality and increase exposure to harmful contaminants.

Fergana city, one of the major urban centers in the Fergana Valley, has experienced rapid population growth and increased demand for drinking water in recent years. Although centralized water supply systems operate in the city, concerns persist regarding the hygienic condition of drinking water, particularly in certain residential areas. Limited local studies have comprehensively assessed the physicochemical and microbiological quality of drinking water in Fergana city and its potential association with gastrointestinal disease prevalence among the population.

Understanding the relationship between drinking water quality and gastrointestinal morbidity is essential for evidence-based public health decision-making. Identifying problematic water quality indicators can help guide improvements in water treatment processes, strengthen sanitary surveillance, and support targeted preventive measures. Moreover, local epidemiological data are necessary to develop effective interventions aimed at reducing water-related diseases and improving population health.

Therefore, the present study aims to evaluate the physicochemical and microbiological quality of drinking water in Fergana city and to analyze its association with the prevalence of gastrointestinal diseases. The findings of this research are expected to contribute to the development of effective public health strategies, improvement of drinking water safety, and reduction of gastrointestinal disease burden in urban settings.

Materials and Methods

This cross-sectional study was conducted in Fergana city. Drinking water samples were collected from household taps and centralized water supply sources in different administrative districts of the city. Sampling was carried out according to standard hygienic and sanitary guidelines.

Physicochemical analysis included measurement of pH, turbidity, total dissolved solids, nitrate concentration, and residual chlorine using standard laboratory methods. Microbiological analysis was performed to determine total coliform bacteria and the presence of *Escherichia coli* using membrane filtration techniques.

Data on the prevalence of gastrointestinal diseases were obtained from official reports of healthcare institutions in Fergana city for the corresponding study period. Statistical analysis was performed using descriptive methods and correlation analysis to identify relationships between drinking water quality indicators and gastrointestinal disease incidence.

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Results

The analysis of drinking water samples showed that most physicochemical parameters were within acceptable hygienic limits; however, elevated nitrate concentrations were detected at several sampling points. Microbiological analysis revealed the presence of total coliform bacteria in a number of samples, indicating possible fecal contamination of the drinking water supply.

Epidemiological data demonstrated higher rates of gastrointestinal diseases in areas where drinking water quality indicators did not meet hygienic standards. Correlation analysis showed a moderate positive relationship between microbiological contamination of drinking water and the incidence of gastrointestinal diseases. Areas with higher nitrate concentrations also exhibited increased rates of gastrointestinal morbidity, particularly among children.

Table 1. Physicochemical characteristics of drinking water samples in Fergana city

Parameter	**Hygienic standard**	**Mean value ± SD**	**Range**
pH	6.5–8.5	7.3 ± 0.4	6.7–8.1
Turbidity (NTU)	≤ 5.0	3.2 ± 1.1	1.0–6.4
Total dissolved solids (mg/L)	≤ 1000	610 ± 85	450–780
Nitrates (mg/L)	≤ 50	58 ± 12	32–82
Residual chlorine (mg/L)	0.3–0.5	0.26 ± 0.09	0.10–0.48

Elevated nitrate concentrations above the hygienic standard were detected in approximately 28% of the analyzed samples. Residual chlorine levels were below the recommended range in several districts, potentially contributing to microbiological contamination.

Table 2. Microbiological quality of drinking water samples

Indicator	**Hygienic standard**	**Number of positive samples (n=120)**	**Percentage (%)**
Total coliforms	Absent in 100 mL	34	28.3
Escherichia coli	Absent in 100 mL	12	10.0

The presence of total coliform bacteria and *E. coli* indicates inadequate disinfection and possible secondary contamination within the water distribution system.

Table 3. Gastrointestinal disease incidence in relation to drinking water quality

Water quality status	**Gastrointestinal disease incidence (per 1,000 population)**

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Water quality status	Gastrointestinal disease incidence (per 1,000 population)
Water meeting hygienic standards	42.6
Water exceeding nitrate limits	67.4
Microbiologically contaminated water	74.1

Areas supplied with microbiologically contaminated drinking water showed the highest incidence of gastrointestinal diseases. A statistically significant positive correlation was identified between total coliform presence and gastrointestinal disease incidence ($r = 0.46$, $p < 0.05$). Elevated nitrate concentrations were also associated with increased gastrointestinal morbidity, especially among children under 14 years of age.

Conclusion

The results of this study confirm a significant association between drinking water quality and the prevalence of gastrointestinal diseases in Fergana city. Microbiological contamination and elevated nitrate levels in drinking water represent important risk factors for gastrointestinal morbidity. Regular monitoring of drinking water quality, modernization of water treatment facilities, and public health interventions are necessary to reduce water-related diseases and improve population health.

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