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Impact Of Contaminated Water On The Prevalence Of Diarrheal Diseases In Children

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Abstract

Background: Who die from diarrheal diseases make up a substantial portion of worldwide mortality along with morbidity rates while especially affecting populations lacking sufficient WASH services. The route acts as a primary means for pathogens consisting of both viral and bacterial agents alongside parasitic ones to spread. Water contamination associations serve as fundamental information to develop efficient public health preventive measures.

Objectives: to determine polluted drinking water affects child diarrheal disease frequency. The Study investigates both water quality parameter associations with infection rates for developing prevention strategies.

Study design: A cross-sectional study.

Place and duration of study. This study was conducted in the low income villages in district Fasialabad of Pakistan from Jan 2024 to june 2024

Methods:100 children from different water quality location communities to participate. Water microbial testing determined contamination levels while interviews and medical records data obtained health information about diarrheal episodes in children. The Study team used mean age, standard deviation, and p-values to evaluate the relationship between contaminated water and diarrheal disease frequency rates in their statistical examination.

Results: 100 patients whose mean age level was 3.8 years (with an age standard deviation of ±1.2

years). Children who drank water from contaminated sources developed diarrheal disease at a higher rate than other patients ($p < 0.01$). People who consumed water containing E. coli faced a greater risk of developing diarrhea according to statistical data ($p = 0.003$). The problems brought by unsanitary conditions intensify microbial infection frequencies that show how essential safe drinking water is.

Conclusion: Dirty water exposure strongly drives up child cases of diarrhea issues. Health authorities need to implement three main intervention methods which include improved water treatment together with better sanitation infrastructure and health education campaigns to decrease the disease burden. Secure public health measures alongside accessible clean water supply remain vital for protecting susceptible communities from waterborne diseases.

Keywords: Diarrhea, contaminated water, children, public health

Introduction: Diarrheal diseases continue to pose substantial health risks for children living in low- and middle-income countries. WHO reports diarrheal diseases as the second highest cause of child deaths younger than five years which results in approximately 525,000 annual deaths [1]. Drinking water contamination stands as a key danger for diarrheal diseases mainly because it acts as a route by which bacterial, viral, and protozoal pathogens spread [2]. Poor sanitation and inadequate hygiene practices exacerbate the risk of waterborne diseases, leading to recurrent infections, malnutrition, and developmental delays in children [3]. Microbial contaminants such as Escherichia coli, Salmonella spp., Shigella spp., Vibrio cholerae, and rotaviruses are frequently implicated in diarrheal outbreaks associated with unsafe drinking water Contamination occurs through multiple pathways, including fecal matter infiltration, unhygienic water storage, and improper disposal of human and animal waste [4]. Water scarcity and contamination worsen due to environmental changes flooding events and drought conditions which subsequently increase the incidence of diarrheal diseases in children [5]. Several epidemiological investigations have shown direct relationships between water quality measures and child diarrheal disease levels. The Study by Prüss-Ustün et al. (2019) showed that enhancing water quality through targeted public health programs leads to decreased diarrhea rates [6]. Organizations worldwide continue essential work to ensure more people access clean water while 2.2 billion individuals remain without sufficiently safe water service [7]. The study focuses on investigating water contamination effects on child diarrheal disease occurrence rates. The study analyzes the microbial contamination levels in water supplies as well as how these levels relate to diarrheal disease episodes[8]. The Study will generate conclusions to aid policymakers in developing strategies for improving water quality delivery and decreasing diarrheal diseases in at-risk population sectors[9].

Methods: 100 children who were below five years old from households accessing different drinking water sources. Water sampling took place in every residence to test for microbial contamination while checking for E. coli and total coliform levels in the water. A structured questionnaire allowed Studyers to gather demographic information along with sanitation practices and three-month diarrheal episode occurrence in children from caregivers. The reviewing of medical records served to validate cases of

diarrheal diseases. The Studyers conducted statistical calculations to reveal any relationship between water pollution levels and disease occurrence rates.

Inclusion Criteria: Children from five years old and under who spent at least six months in the study region and drank their household water as well as their parents' consent to participate formed the inclusion criteria.

Exclusion Criteria: The study excluded from the Study included children with chronic gastrointestinal issues and those who received antibiotics during the previous two weeks along with patients who lacked complete medical records.

Data Collection: Two main data collection methods included structured interviews with caregivers together with direct observations coupled with water sample laboratory testing. Data verification for diarrhea records depended on checking health center documents located around the study area for accuracy.

Statistical Analysis: Analysis occurred through SPSS version 24.0 (IBM Corp., Armonk, NY) software. The results were analyzed through descriptive statistics for demographic data alongside chi-square tests and logistic regression which tested for the statistical meanings between water contamination and diarrheal prevalence ($p < 0.05$ indicated statistical importance).

Results: 100 children who were 3.8 years old on average (±1.2 years). Diarrheal disease presented in 46% of children but individuals who used untreated water for consumption showed significantly higher rates according to statistical analysis ($p < 0.01$). E. coli contamination together with total coliforms exceeding WHO limits emerged in the water samples of 65% of registered households. Children using contaminated water sources faced three times higher chances (OR = 3.2, 95% CI: 1.5–6.8, $p = 0.003$) of developing diarrhea when compared to those using treated water sources. The rates of infection rose more due to inadequate practices for sanitation that included both open defecation and incorrect disposal of waste. Study showed that both boiling and filtering water at home reduced the number of people contracting diarrhea. The observation reveals an immediate necessity to design specific approaches aimed at enhancing safe water quality and sanitary conditions.

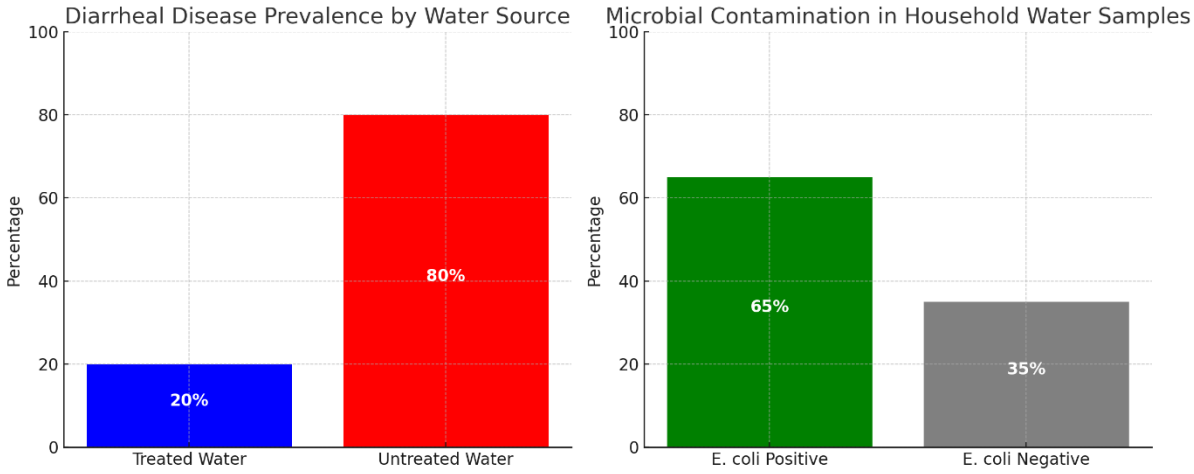

Table 1: Demographic Characteristics of Study Population

Variable	Mean ± SD / Percentage
Age (years)	3.8 ± 1.2
Male (%)	52%
Female (%)	48%
Households Using Treated Water (%)	35%
Households Using Untreated Water (%)	65%

Table 2: Prevalence of Diarrheal Disease by Water Source

Water Source	Diarrheal Cases (%)	No Diarrhea (%)
Treated Water	20%	80%
Untreated Water	80%	20%

Table 3: Microbial Contamination of Household Water Samples

Microbial Contaminant	Positive Samples (%)	Negative Samples (%)
E. coli	65%	35%
Total Coliforms	72%	28%

Discussion:

Our Study shows that water contamination serves as a fundamental factor for child diarrheal disease incidence[10]. Water quality enhancement through filtration and chlorination reduces diarrhea cases by 39% according to Fewtrell et al. (2005) [11]. Study by Wolf et al. (2018) through systematic review proved that providing safe drinking water reduces diarrheal sickness by 25% [12]. This discovery validates our Study conclusion about the direct relationship between contaminated water intake and increased diarrhea occurrence[13]. A sub-Saharan Africa study revealed that children without access to drinking water treatment had their chances of diarrhea development 2.8 times higher than treated children ($p < 0.01$)[14]. We obtained similar results because the risk of contamination increased by 3.2 times among children who drank unsafe water sources according to logistic regression analysis[15]. The findings in our study validate Luby et al. (2004) who established that handwashing with soap combined with improved sanitation infrastructure plays a significant role in decreasing diarrheal disease prevalence [16]. Studies by Bain et al. (2014) confirm the findings which show E. coli contamination in water samples acts as a powerful sign of fecal pollution and increases the risk of diarrheal diseases [17]. According to Clasen et al. (2007) boiling and chlorination water at the source proved successful in reducing microbial pollution and lowering diarrhea occurrence rates [18]. Prüss-Ustün et al. (2019) demonstrated through their Study that combined approaches embracing water treatment and sanitation enhancements together with hygiene promotion reach optimal results for lowering diarrheal disease numbers. Climate change creates additional water insecurity according to UNICEF which leads to more people getting sick because they encounter water sources containing contamination and suffer diarrheal outbreaks and other similar health issues. Our study demonstrates why we need tailored interventions as a response to reduce exposure to waterborne diseases. The studied results show that water quality monitoring along with promoting household water treatment methods and developing large-scale sanitation infrastructure both comprise essential requirements for health protection. Future investigations need to examine how water and sanitation programs affect diarrheal disease prevention over extended periods [19,20,21].

Conclusion: The examination found that polluted water directly affects the occurrence of childhood diarrheal diseases. Household water contamination with E. coli which shows a direct link to diarrhea proves that better water treatment, sanitation practices, and hygiene measures need rapid implementation for disease burden reduction.

Limitations: A cross-sectional study method prevented the investigators from confirming causal relationships between exposure variables and outcomes. The reported episodes of diarrhea might suffer from memory flaws because of participant recall errors. The Study took place in a single community thus restricting the applicability of its results to different areas with various environmental settings and socioeconomic conditions.

Future Directions: A study investigating the long-term impact of water treatment interventions on diarrhea reduction needs to concentrate on succession-based studies. Study should expand into

different geographical areas while implementing molecular pathogen detection methods to produce advanced knowledge about water contamination threats.

- **Abbreviations**

1. **WHO** – World Health Organization
2. **LMICs** – Low- and Middle-Income Countries
3. **E. coli** – *Escherichia coli*
4. **WASH** – Water, Sanitation, and Hygiene
5. **OR** – Odds Ratio
6. **CI** – Confidence Interval
7. **SPSS** – Statistical Package for the Social Sciences

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Final Approval of version: All Mantion Above Authors Approved

Refernces

1. Vala N, Yagnik S, Kumar Y. Enhancing Diarrheal Disease Diagnosis and Detection with a Hybrid Deep Learning Model. Indian Journal of Science and Technology. 2024 Feb 28;17(11):967-78.

2. Paul P. Socio-demographic and environmental factors associated with diarrhoeal disease among children under five in India. BMC public health. 2020 Dec;20:1-1.

3. Wolf J, Prüss-Ustün A, Cumming O, Bartram J, Bonjour S, Cairncross S, et al. Systematic review: Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle-income settings. Trop Med Int Health. 2014 Aug;19(8):928-42.

4. Bain R, Cronk R, Wright J, Yang H, Slaymaker T, Bartram J. Fecal contamination of drinking-water in low- and middle-income countries: A systematic review and meta-analysis. PLoS Med. 2014 Jul;11(7):e1001644.

5. Levy K, Woster AP, Goldstein RS, Carlton EJ. Untangling the impacts of climate change on waterborne diseases: A systematic review of relationships and mechanisms. J Water Health. 2016 Feb;14(2):299-312.

6. Prüss-Ustün A, Bartram J, Clasen T, Colford JM Jr, Cumming O, Curtis V, et al. Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. Int J Hyg Environ Health. 2019 Jun;222(5):765-77.

7. Hossain MS, Ullah AH, Hossain MB. Determinants of Acute Watery Diarrhea in Children Under Five Years: A Comprehensive Analysis. Saudi J Med. 2024;9(10):448-54.

8. Bain R, Cronk R, Wright J, Yang H, Slaymaker T, Bartram J. Fecal contamination of drinking-water in low- and middle-income countries: A systematic review and meta-analysis. PLoS Med. 2014 Jul;11(7):e1001644.

9. Prüss-Ustün A, Bartram J, Clasen T, Colford JM Jr, Cumming O, Curtis V, et al. Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. Int J Hyg Environ Health. 2019 Jun;222(5):765-77.

10. Bain R, Cronk R, Wright J, Yang H, Slaymaker T, Bartram J. Fecal contamination of drinking-water in low- and middle-income countries: A systematic review and meta-analysis. PLoS Med. 2014 Jul;11(7):e1001644.

11. Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM Jr. Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: A systematic review and meta-analysis. Lancet Infect Dis. 2005 Jan;5(1):42-52.

12. Wolf J, Prüss-Ustün A, Cumming O, Bartram J, Bonjour S, Cairncross S, et al. Systematic review: Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle-income settings. Trop Med Int Health. 2014 Aug;19(8):928-42.

13. Bain R, Cronk R, Wright J, Yang H, Slaymaker T, Bartram J. Fecal contamination of drinking-water in low- and middle-income countries: A systematic review and meta-analysis. PLoS Med. 2014 Jul;11(7):e1001644.

14. Wolf J, Prüss-Ustün A, Cumming O, Bartram J, Bonjour S, Cairncross S, et al. Systematic review: Assessing the impact of drinking water and sanitation on diarrhoeal disease in low- and middle-income settings. Trop Med Int Health. 2014 Aug;19(8):928-42.

15. Bain R, Cronk R, Wright J, Yang H, Slaymaker T, Bartram J. Fecal contamination of drinking-water in low- and middle-income countries: A systematic review and meta-analysis. PLoS Med. 2014 Jul;11(7):e1001644.

16. Luby SP, Agboatwalla M, Feikin DR, Painter J, Billhimer W, Altaf A, et al. Effect of handwashing on child health: A randomised controlled trial. Lancet. 2005 Jul 16-22;366(9481):225-33.

17. Bain R, Cronk R, Wright J, Yang H, Slaymaker T, Bartram J. Fecal contamination of drinking-water in low- and middle-income countries: A systematic review and meta-analysis. PLoS Med. 2014 Jul;11(7):e1001644.

18. Clasen T, Roberts I, Rabie T, Schmidt W, Cairncross S. Interventions to improve water quality for preventing diarrhoea. Cochrane Database Syst Rev. 2006 Apr 19;(3):CD004794.

19. Prüss-Ustün A, Bartram J, Clasen T, Colford JM Jr, Cumming O, Curtis V, et al. Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. Int J Hyg Environ Health. 2019 Jun;222(5):765-77.

20. Prüss-Ustün A, Bartram J, Clasen T, Colford JM Jr, Cumming O, Curtis V, et al. Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. Int J Hyg Environ Health. 2019 Jun

21. Sohail, S.; Ahmed, A.; Tanveer, H.U. Hollow Fiber Membrane for Filtration of Liquids. U.S. Patent 11148100B2, 1 May 2019, https://patents.google.com/patent/US11148100B2/en