



CODEN [USA]: IAJPBB

ISSN : 2349-7750

**INDO AMERICAN JOURNAL OF  
PHARMACEUTICAL SCIENCES**

SJIF Impact Factor: 7.187

<http://doi.org/10.5281/zenodo.4394121>Available online at: <http://www.iajps.com>

Research Article

**TO EVALUATE FECAL CONTAMINATION AND PHYSICAL  
CHARACTERISTICS OF DRINKING WATER; A CROSS  
SECTIONAL STUDY**Dr Muhammad Junaid Qasim<sup>1</sup>, Asad Rahman<sup>2</sup>, Dr Muhammad Zeshan<sup>3</sup><sup>1</sup>Quaid e Azam Medical College, Bahawalpur, <sup>2</sup>Sheikh zayed Medical College Rahim Yar khan,<sup>3</sup>Sheikh zayed Medical College Rahim yar khan.**Article Received:** October 2020    **Accepted:** November 2020    **Published:** December 2020**Abstract:**

**Objective:** The purpose of our study was to evaluate fecal contamination and physical characteristics of drinking water.

**Study design:** A cross sectional study.

**Place and Duration:** This study was conducted at tertiary care hospitals of Southern Punjab Pakistan for the duration of five months April, 2020 to September, 2020.

**Methodology:** In our study we collected 145 samples of water from different places such as storage tanks, filtration plants, tube-wells and end-user points in out-patient and emergency from different hospitals for bacteriological examination of water. At the time of samples collecting, physical characteristics were scrutinized. We used Lovibond Comparator for the estimation of Chlorine. We scrutinized pH and temperature of water. We used multiple tube methods for the exposure of the E. coli. The fecal contamination results were confirmed in the Islamabad Diagnostic Centre. SPSS v.20 was used for the analysis of data.

**Results:** In our present study we collected 145 samples of water. In collected samples of water the ratio fecal contamination (55.86%) was found. Comparatively, 70 samples of water that were collected from private hospital the amount of fecal contamination was found 61.4% and the sample that were collected from public sector hospital the amount of fecal contamination was found 50.70% (P = 0.19). At the end of our study the result showed that coliform organisms were noticed in 17.9% samples while E. coli organisms were found in 37.9% samples.

**Conclusions:** At the end of our study, we concluded that in private and public tertiary care hospitals didn't supply safe drinking water to their attendants and patients. All samples of fecal contamination (50%) points towards the situation gravity and this situation demands that prominent measures must be taken by the concerned authorities.

**Keywords:** Cholera, Diarrheal Diseases, Potable Water, Fecal Contamination.

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Please cite this article in press Muhammad Junaid Qasim et al, *To Evaluate Fecal Contamination And Physical Characteristics Of Drinking Water; A Cross Sectional Study.*, Indo Am. J. P. Sci, 2020; 07(12).

**INTRODUCTION:**

Potable water is drinkable water that should be free from pathogenic microorganisms, harmful chemical substances, should be palatable and free of any color and odor [1,2]. Water forms the basis of all body fluids, acts as a solvent and a lubricant, helps in metabolism and regulates the body temperature. Adequate supply of clean and safe water is imperative to health to accomplish routine activities of life like drinking, cleaning, washing and bathing. Being a good solvent, it can dissolve any type of impurities [3,4]. According to World Health Organization, water should be colorless, odorless and tasteless. It should have less than 5 Nephelometer Turbidity Units [5]. pH should vary between 6.5 to 8.5 [6]. E. coli and fecal coliform bacteria must not be detectable in 100 ml sample of water [7]. Daily requirement of drinking water of an adult is about 2-2.5 liters that is equivalent to 10 -12 glasses per day. Requirement can be increased or decreased depending on the type of activity he/she is involved in and the climatic conditions [8]. Fecal contamination of potable water is a significant health hazard responsible for causation of waterborne diseases. Availability of safe and clean water in developing countries is a prime focus of WHO so as to reduce the burden of water borne diseases worldwide which are responsible for 801,000 deaths from diarrheal diseases per year occurring in children under five years of age [9].

Environmental, ecological and socioeconomic factors have a great impact on the occurrence of infectious diseases. Rapid population growth, extreme weather conditions and changes in climate influence the water resources regarding quality and quantity leading to emergence of water associated diseases. Most of the outbreaks are related to waterborne diseases. Pathogens involved are linked to fecal oral route, water, sanitation and hygiene [10,11]. Pakistan is blessed with sufficient surface water and ground water by nature. Due to rapidly increasing population with 2.6% per annum growth rate and industrialization with urbanization and anthropogenic activities, the availability of quality water is decreasing. It has decreased from 5600 m<sup>3</sup> per annum per capita in 1951 to 1000 m<sup>3</sup> in 2010. Only 20% of the population has access to safe drinking water due to scarcity of healthy water resources [12]. According to UNICEF 40% of diseases in Pakistan are waterborne. Contaminated water, lack of sanitation and inadequate hygiene are responsible for 90% of child deaths secondary to diarrheal diseases. Pakistan Standards & Quality Control Authority (PSQCA) has devised parameters following guidelines of World Health Organization and water sanitation and hygiene. Policies have been

devised and certain programs have been initiated to provide safe water to the population of Pakistan to ascertain Millennium Development and Sustainable Development Goals [13].

Tertiary care hospitals are hotspots where masses flock together and are thus exposed to contamination related diseases including waterborne ailments. Rawalpindi city, now a metropolis, plays important role in providing tertiary care health facilities to the people from all over Punjab and Pakistan. Both public and private sector services are heavily visited and therefore could spark outbreaks of potentially fatal diarrheal diseases. This study was conducted in public and private tertiary care hospitals of Rawalpindi. The purpose of the study was to assess the quality of drinking water made available to the patients and their attendants and to find out possible factors contributing to fecal contamination at various levels of distribution.

**METHODOLOGY:**

This cross-sectional study was conducted at tertiary care hospitals of Southern Punjab Pakistan for the duration of five months April, 2020 to September, 2020. 145 samples of water were collected from tube-wells, storage tanks, filtration plants and end-user points in emergency and outpatient departments from different hospitals. Physical characteristics were examined at the time of collection of samples i.e., color, odor, taste and turbidity. Chlorine estimation was done by Lovibond Comparator. Temperature and pH were examined. Presence of E. coli was detected by Multiple Tube Method. The test was done to detect the presence and estimation of most probable number of coliform organisms in 100 ml of water.

The data was collected using a predesigned proforma after seeking consent from the medical superintendents of the concerned hospitals. Samples were collected using full aseptic technique by trained laboratory staff of the Islamabad Diagnostic Centre. These samples were subjected to Multiple Tube Method in the Water Testing Lab by the staff of the laboratory under supervision of the supervisor of this research. Data was entered in SPSS version 20 and analyzed. Descriptive statistics were presented using frequencies & percentages for categorical variables and Mean±SD for continuous variables. Chi square was applied to compare categorical variables while student's t test was used to compare means of two groups. The p value of ≤0.05 was taken as significant.

**RESULTS:**

145 samples of water were collected to assess fecal contamination of water. These samples were taken

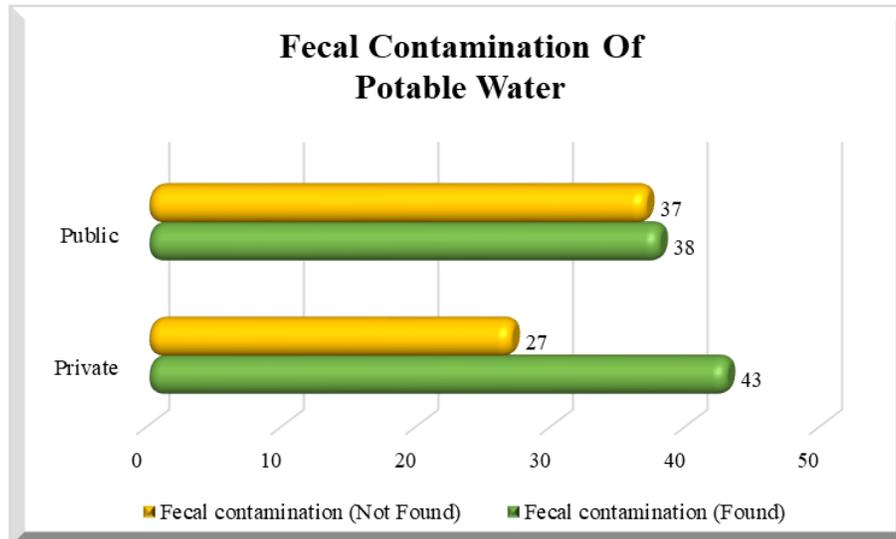
from tube wells, storage tanks and out-patient and emergency departments. Samples from filtration plants or reverse osmosis (R.O) plants were also taken where such installation was available. 51% samples were collected from public sector hospitals. 28% samples were taken from tube wells, 26.9% from tanks, 15.9% from emergency taps, 20% from OPD taps, 8.3% from filtration plants and 2.8% samples were taken from cafeteria or canteens.

The mean value of pH was  $7.91 \pm 0.197$  with a range of 7.2 to 8.4. The mean temperature was  $26.05 \pm 2.72$  °C

with a range of 17.2 °C to 29.7 °C. Mean free residual chlorine concentration was  $0.016 \pm 0.045$  mg/l with a range between 0.2 & 0.7 mg/l. Mean total chlorine concentration was  $0.27 \pm 0.122$  mg/l with a range between 0.2 & 1.0mg/l. Fecal contamination was present in 55.86% of all samples of water collected. Out of 70 samples of water taken from private hospitals, fecal contamination was present in 61.4% samples as compared to 50.7% samples taken from public sector hospitals ( $p=0.19$ ) (Table 01).

**Table No 01: Fecal Contamination of Potable Water in Public and Private Hospitals of Rawalpindi**

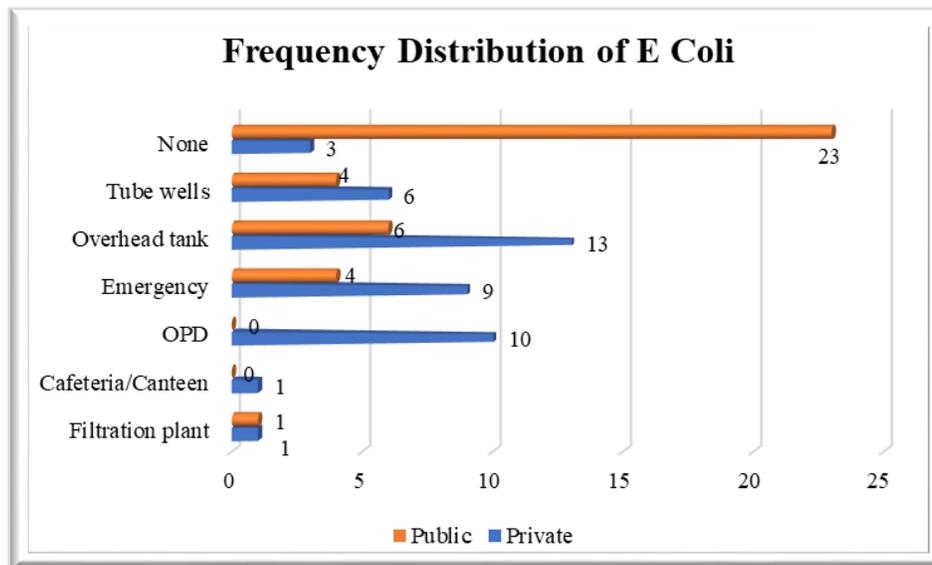
Category	Fecal contamination (Found)		Fecal contamination (Not Found)		Total
	Qty	%age	Qty	%age	
Private	Qty	43	Qty	27	70
	%age	61.4%	%age	38.6%	100%
Public	Qty	38	Qty	37	75
	%age	50.7%	%age	49.3%	100%
<b>P-vale = 0.192</b>					



E. Coli were detectable in 37.9% samples whereas coliform organisms were seen in 17.9% samples. Results of fecal contamination were confirmed in Bacteriology Laboratory of Institute of Public Health, Rawalpindi. E Coli were detected in 93% (40 out of 43) of the contaminated samples from private sector hospitals in comparison to 39.5% (15 out of 38) of contaminated samples from public sector hospitals ( $p < 0.05$ ). (Table 02)

**Table No 02: Frequency distribution of presence of E Coli in water samples obtained from public and private sectors**

Water source	Private		Public	
	Qty	%age	Qty	%age
Filtration plant	1	2.33%	1	2.62%
Cafeteria/Canteen	1	2.33%	0	0.00%
OPD	10	23.26%	0	0.00%
Emergency	9	20.93%	4	10.53%
Overhead tank	13	30.23%	6	15.78%
Tube wells	6	13.95%	4	10.53%
None	3	6.97%	23	60.54%
Total	43	100%	38	100%

**DISCUSSION:**

Accessibility and availability of safe and clean drinking water to an individual is of prime importance in both urban and rural areas of a country. Because of its relation with the increased incidence of waterborne diseases, significant efforts have been made for its provision to the This can be reflected in decreased global burden of waterborne diseases in developed countries by better planning, monitoring and implementing better technologies and maintaining a good surveillance system [13/14]. Being an urban metropolis, Rawalpindi has a population of more than eleven million spread over an area of 1772 km<sup>2</sup>. Multiple problems are emerging and one of them is the insufficient provision of safe drinking water to the citizens. Quality of water can be assessed partly by examining the physical characteristics of water. Clean and transparent appearance with colorless, odorless

and palatable taste was observed in all samples taken from all tertiary care hospitals of Rawalpindi including both public and private sectors. Turbidity of water is caused by suspended particles of organic material, silt and clay. All samples presented with less than 1 Nephelometer Turbidity Unit and pH ranged from 7.2 to 8.4 which reflected good quality of water by appearance. Studies done previously in Rawalpindi revealed physical characteristics within normal parameters formulated by WHO which states that safe drinkable water should be colorless, odorless, transparent and palatable to taste [1].

Fecal contamination was present in 55.86% of 145 water samples taken from both public and private hospitals. Out of these contaminated samples, 37.9% were positive for E. coli and 17.9% for total coliforms. Comparison of fecal contamination between public

(50.7%) and private (61.4%) hospitals was not statistically significant ( $p=0.192$ ). E Coli were detected in 93% (40 out of 43) of the contaminated samples from private sector hospitals in comparison to 39.5% (15 out of 38) of contaminated samples from public sector hospitals ( $p<0.05$ ). As is visible in table 2, all tube wells (06) in private sector were contaminated with E Coli, as compared to 4 (44.4%) of tube wells in the public sector. This finding was augmented by the fact that the mean depth of the tube wells in public sector was  $815.96 \pm 484.587$  feet as compared to  $371.25 \pm 221.856$  feet in the private sector ( $p<0.05$ ). The mean number of years since construction of public sector tube wells was  $11.8226 \pm 8.213$  years as compared to  $8.001 \pm 5.914$  years for private sector hospital tube wells ( $p= 0.078$ ). So, deeper the well, the lesser are the chances of fecal contamination. However, the same may not be true for the duration since construction.

### CONCLUSION:

The tertiary care hospitals, both public & private fail to provide safe drinking water to the patients and their attendants. Fecal contamination of more than 50% of all samples points towards the gravity of the situation and demands serious measures by the concerned authorities to address the issue. The results also highlight the need to monitor the quality of water provided to the rest of Rawalpindi and ultimately contribute towards prevention and control of potentially life-threatening diarrheal diseases. More than 55% samples of water positive for fecal contamination reflects some of the deficiencies which need to be catered. All samples of fecal contamination (50%) points towards the situation gravity and this situation demands that prominent measures must be taken by the concerned authorities.

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