Original Article

BACTERIOLOGICAL EXAMINATION OF DRINKING WATER IN RAWALPINDI AND ISLAMABAD AREA

Wajid Hussain, Usama Ahmed, Gohar Zaman, Bushra Jamil, Umar Khursheed, Irfan Ali Mirza

Armed Forces Institute of Pathology (National University of Medical Sciences), Rawalpindi Pakistan

ABSTRACT

Objective: The purpose of the study was to assess bacteriological quality of drinking water in Rawalpindi and Islamabad-Pakistan by determining the presence of coliforms and *E.coli*.

Material and Methods: This cross-sectional descriptive study was conducted at the Department of Microbiology, Armed Forces Institute of pathology, Rawalpindi from Sep 2018 to Dec 2018. All samples submitted to AFIP from Rawalpindi and Islamabad areas for bacteriological examination of water were collected in sterile bottles under aseptic condition and were inoculated on MacConkey agar after being filtered through Millipore water testing system using 0.22 µm filter as per manufacturer instructions. Coliforms were identified by lactose fermentation, colony morphology, gram stain, motility, catalase, oxidase and indole test. Indole positive colonies were tested by API-20E to confirm the presence of *E.coli*. Results were interpreted according to WHO criteria for drinking water.

Results: A total of 462 water samples were analyzed, out of which 164 (35.5%) were declared unsatisfactory based on fecal coliforms contamination and rest of the samples were found satisfactory after bacteriological examination of drinking water. Out of 462 samples 362 (78%) were treated (filtered/chlorinated) and 100 (22%) were untreated. Out of 362 treated samples 98(27%) were found unsuitable for drinking. While out of 100 untreated samples 67(67%) were found unsatisfactory.

Conclusion: A high frequency of unsatisfactory drinking water samples was found among the specimens tested. Regular monitoring of water treatment processes and proper maintenance of already established water filter plants can markedly improve this situation.

Key Words: Bacteriological examination, Drinking water, Membrane filtration.

This article can be cited as: Hussain W, Ahmed U, Zaman G, Jamil B, Khursheed U, Mirza IA. Bacteriological examination of drinking water in Rawalpindi and Islamabad area. Pak J Pathol. 2019; 30(4): 101-104.

INTRODUCTION

Human or animal waste and sewage contamination is the most common and widespread risk associated with drinking water [1]. Fecal indicator organisms (FIOs) coliforms / *E.coli* are used to assess fecal contamination [2] as these organisms are easy to identify and are found in large numbers in human /animals gut flora [3-4]. World Health Organization (WHO) reported that 80% of all human illnesses in the developing countries are due to bacterial contamination of water [5]. Coliforms belong to the family Enterobacteriaceae and mainly include *Escherichia, Enterobacter, Klebsiella* and *Citrobacter*. These coliforms can ferment lactose at 35-37°C with the production of acid, gas, and aldehyde within 24-48 hours. These are called model organisms as they are indicative of presence of potential faecal pathogens [6].

Waterborne diseases contribute biggest disease toll in underdeveloped countries like Pakistan. Water pollution causes a number of diseases like diarrhea, dysentery, cholera, typhoid fever and infectious hepatitis. Almost 0.2 million children in Pakistan die every year due to diarrheal diseases alone. Whereas globally fourteen to thirty thousand people, mostly young children and the elderly, die every day from water related diseases. WHO has declared safe drinking water as basic human right and adopted 2005 to 2015 as International decade for action “Water for life” [5]. In Pakistan due to increased urbanization from 31% to 34%, the situation has aggravated and compromised the provision of safe drinking water from 60% to 40% [7].

This study will help to access not only the bacteriological quality of currently available drinking water resources at Rawalpindi / Islamabad area by monitoring the presence of Coliforms and *E.coli* as indicators for sewage contamination, but also sensitize the authorities regarding provision of safe drinking water.

MATERIAL AND METHODS

This observational cross-sectional study was done at Microbiology Department, Armed Forces Institute of Pathology (AFIP), Rawalpindi, from September 2018 to December 2018. Total 462 drinking water samples from different sources were selected by random sampling. For proper collection

Correspondence: Lt Col Wajid Hussain, Classified Pathologist, Department of Microbiology, Armed Forces Institute of Pathology, Rawalpindi Pakistan

Email: **hussain.wajid10@gmail.com**

Received: ***25 Sep 2019****; Revised:* ***29 Oct 2019****; Accepted:* ***29 Nov 2019***

from different sources, written instructions were provided as well as read to designated persons responsible for sample collection. Water specimens from different sources like bore, taps, and wells were collected in already provided sterilized glass bottles. Bottled water (sealed, unleaked and not expired) used for drinking purpose was also included. All those samples that were collected in un-sterilized or improperly sealed bottles were excluded. In addition, those samples having collection time more than one hour (less bottled water) were also excluded. Likewise, if the sample quantity was measured to be <125 mL, then it was also not included in the study.

RESULTS

During this study, 462 drinking water samples were analyzed. Out of 462 water samples, 298 (64.5%) were found satisfactory for drinking purpose according to WHO criteria (Figure-1).

Out of 282 tap water samples received, 200 (71%) were found satisfactory. Among all tap water samples, 251 (89%) were treated (Filtered / Chlorinated). Among treated samples, 183 (72.9%) were found satisfactory. Out of remaining 31 (11%) untreated samples, 17 (54.8%) were found satisfactory (Figure-2 and 3).

Among 40 water samples collected from different wells, 18 (45%) were found satisfactory. Out of these, 15 (37.5%) samples were treated (chlorinated / filtered), among which 10(66.6%) were satisfactory. Out of remaining 25 (62%) untreated samples, 8 (32%) were found satisfactory (Figure-2 and 3).

Among 100 water samples collected from Bore, 39 (39%) were found satisfactory. Out of these 100 bore water samples, 56 (56%) were treated (chlorinated / filtered) and among these 31 (55.3%) were satisfactory. Out of remaining 44 untreated samples, 8(18.1%) were found satisfactory (Figure-2 and 3).

All of 40 bottled water samples were found satisfactory for drinking purpose.

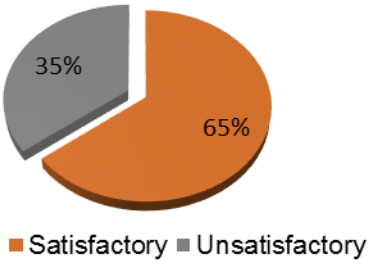

Figure-1: Frequency distributions of satisfactory and unsatisfactory drinking water samples (n= 462).

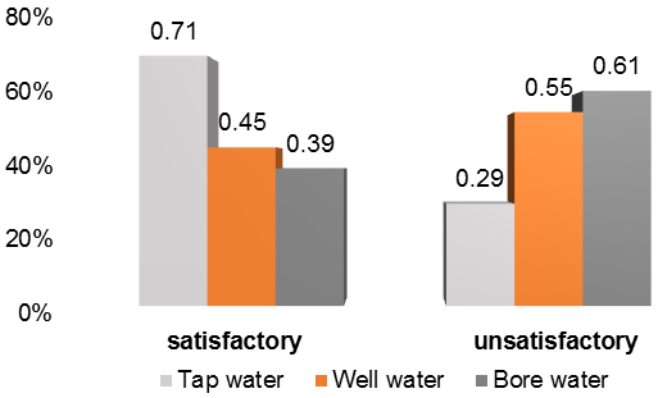

Figure-2: Satisfactory and Unsatisfactory water samples from different sources for drinking purpose (n=462).

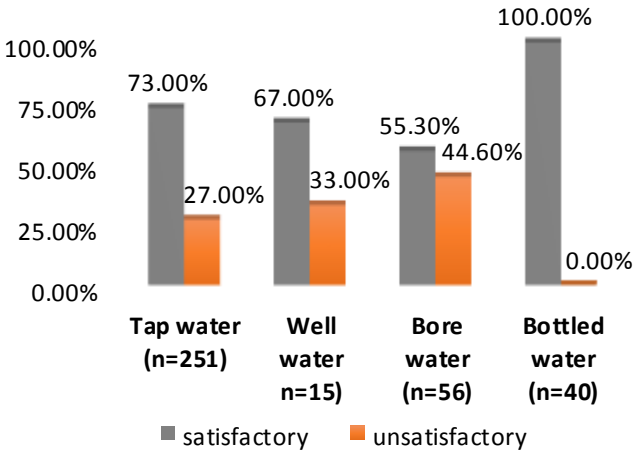

Figure-3: Bacteriological quality of treated (Chlorinated / Filtered) drinking water samples.

DISCUSSION

In the present study, it was found that among the total number of water samples submitted for analysis, 64.5% water samples were satisfactory according to WHO quality standard for drinking water. Safe and wholesome water has been defined as "water that is free from pathogenic agents, free from harmful chemical substances, pleasant to taste and smell" [8]. In developing countries, like Pakistan, majority of the population (60%) has no access to safe drinking water [9]. Moreover, Pakistan Council of Research in Water Resources has reported that 88% of the functional water supply schemes in Pakistan were providing unsafe drinking water [10].

In Pakistan, the bacteriological contamination of drinking water has been reported to be one of the most serious problems and massive part of population is currently consuming unsafe and polluted water for drinking [11]. The growth and dispersion of bacteria is at peak in rainy season

because the drainage goes in water bodies. Poor treatment facilities cause spread of waterborne diseases. Moreover, drinking water and drainage lines run in parallel, which causes leakages and intermixing resulting in deterioration of water quality. In Pakistan 20-40% of the hospital beds are occupied by the patients suffering from water related diseases e.g dysentery, typhoid, cholera and diarrhea. Situation of access to safe drinking water in neighbourhood and developing countries is also poor. In India, 68.9%, while in Indonesia 45.7% of water samples were found to be unfit for drinking [12, 13]. In an Iranian study, 30.2% of drinking water samples from rural areas were found contaminated with bacteria [14]. Studies from Makkah-al-Mukkaramah reported 31.2 to 37.5%, while from Sudan, 42.5% water samples were bacteriologically unfit for drinking purpose [15, 16]. Previous studies from Rawalpindi / Islamabad have reported 38 to 56.2% of drinking water samples to be bacteriologically contaminated [17]. These results showed higher rates of water contamination as compared to present study. Previous studies from Sindh province of Pakistan also reported still higher rates of bacterial contamination of water samples; 87% of tap water from Karachi, 82% from Sukkur city and 100% from Khairpur Mirs [18, 19]. This data revealed that provision of safe, portable drinking water, described as basic human right by WHO is a significant problem not only in Pakistan but also in other developing countries.

In our study population 64.5% water samples were satisfactory for drinking purposes. The most probable reason is that the Cantonment area of Rawalpindi is well developed and water supplies are maintained by Military Engineering Services. Moreover, residing people are well educated and aware about the proper sanitation and filtration system. The Chaklala Cantonment board also plays an important role in proper sanitation and water supply system. In our setup we observed that the majority of water samples were filtered. It shows the awareness regarding water filtration system among local bodies.

In our study we found that prevalence of coliforms / *E.coli* was 34.5% which was in accordance with another study done at Lahore in which out of 100 samples, 42% (n=42) revealed growth of *E.coli*. A similar study conducted at Peshawar indicates that 43% samples were contaminated with *E. coli* [20].

CONCLUSION

Bacterial contamination was observed in 35 % of the community drinking water samples from Rawalpindi / Islamabad. Majority of treated drinking water samples were found unsatisfactory, indicating failure of treatment process. Regular monitoring of water treatment processes and proper maintenance of already established filter plants can greatly improve the current situation. Proper routine monitoring system ensuring safe supply of drinking water to community must be adopted to prevent and decrease the chances of bacterial contamination.

AUTHORS CONTRIBUTION

Wajid Hussain: Principal author, paper writing and results compilation.
Usama Ahmed: Data collection, literature review.
Gohar Zaman: Overall supervision of project.
Bushra Jamil: Literature review.
Umar Khursheed: Result compilation.
Irfan Ali Mirza: Literature review and discussion.

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