ORIGINAL ARTICLE

BACTERIOLOGICAL QUALITY OF DRINKING WATER IN SCHOOLS OF PESHAWAR, KHYBER PAKHTUNKHWA

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ABSTRACT

Objective: To determine bacteriological quality of drinking water in Schools of District Peshawar, Khyber Pakhtunkhwa, Pakistan.

Material and Methods: A cross-sectional study was conducted in the Department of Community Medicine, Khyber Medical College, Peshawar, Pakistan from January 2017 to May 2017. A total of 30 samples of drinking water from government and private schools were collected and analyzed for coliform count and E.coli in the Public Health Laboratory Khyber Medical College, Peshawar. Multiple test tube method was used to detect total coliform count while Mac-conkey broth media was used to detect E.coli

Results: Among all samples 19 (63.3%) were positive for E.coli. In samples from government schools, E.coli was detected in 11 (73.3%) out of 15 samples while in private schools samples E.coli was detected in 8 (53.3%) out of 15 samples to be contaminated with E.coli. Total Coliform count was alarming and was positive for 29 out of 30 samples.

Conclusion: E.coli was detected in water samples of government as well as private schools. Comparing quality of water in government and private schools, less samples were positive for E.coli in private schools.

Key Words: E.coli, Drinking water, Coliforms.

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INTRODUCTION

Water is a sign of life and without it life is not possible. Safe drinking water reservoirs are limited and about one billion people around the world is having no access to it[1-2]. Human life is endangered if contaminated water is used. Clean and contaminated water is therefore, a major issue all around the globe[3]. Water covers a large area of planet earth but in general 97% is sea water and fresh water reservoirs constitutes only 3% among which 2% consists of Glaciers and polar ice caps leaving only 1% of drinkable water[4-5].

Bacterial contamination of drinking water is worldwide phenomena. In developing countries a large number of diseases occurs due to lack of inadequate water. Unsafe water supply is a major cause of diarrheal diseases i.e. about 88%. A lot of schools serves as a source of diseases that are caused due to improper water supply, sanitation and hygiene. Schools in rural areas either having no drinking water or having poor quality and quantity of water[6].

Unsafe drinking water is a major cause of mortality and morbidity in Pakistan. Poor quality of water is a cause of about 30% of diseases and 40% deaths. It is estimated that every year more than three million people in Pakistan became victim of water borne diseases among which about one million people die. Main factors leading to poor water quality in Pakistan includes a lack of surveillance system to assess drinking water quality, absence of well-equipped laboratories for checking water quality and lack of legal framework concerned with issues related to safe water quality[7].

Khyber Pakhtunkhwa is having a population of about 18 million out of which 83% people lives in rural areas. According to the government statistics safe drinking water coverage is 72% but actual figures are 52% in rural areas leading to variety of preventable water borne diseases e.g. typhoid, diarrhea, worms infestation etc.[8] School environment has a social and

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health related influences on children, making schools an important sector to explore and making interventions for combating spread of infectious diseases[9].

The current study is therefore designed to determine quality of drinking water in the schools of Peshawar. In this study water quality of schools are targeted because children spend most of time in school environment and safe drinking water is vital for them. The present study will help the health care authorities and government to take necessary steps to save our future generation by providing them safe drinking water.

MATERIAL AND METHODS

A cross-sectional study was conducted to determine the bacteriological quality of drinking water from January 2017 to May 2017. A sample size of 30 was taken using 95% confidence interval and 5% margin of error using WHO sample size calculator. Simple random sampling technique was used to select schools therefore samples were not equal from a particular area. Water samples were collected in sterilized bottles. The samples were properly labeled with date, place and time and dispatch to the laboratory upright in a suitable container packed in ice.

Multiple test tube method was used according to standard procedure on all samples. After inoculation of water samples in different bottles, all the bottles and tubes were incubated at 37°C for up to 48 hours. The bottles or tubes with acid and gas were taken as positive for Coliforms. Positive tubes were further tested using Mackonkey's broth media to confirm presence or absence of E.coli. All results were analyzed using SPSS version 20 for windows.

RESULTS

A total of 30 samples were taken from government and private schools. Among 15 samples from government sector schools, 11 samples were positive for E.Coli while in private schools 8 water samples were positive for E.coli. Overall prevalence of E.coli was 63% as shown in Table 1. Filter is very important for purification of water which was present in 7 (23.3%) schools and absent in 23 (76.7%) schools. Although filter was present, still 4 samples were positive for E.coli as shown in Table 2.

Water samples taken from these schools were from different sources which included Tape Water, Water Cooler and Water Tank. Among these 30 schools Tape water source was on the top of the list which included 17 (65.7%) schools. Similarly water cooler being the second source of drinking water was present in 12 (40.0%) schools while Water tank was reported only in one school. Most contaminated samples were from tape water as shown in Table 3.

On the basis of locations Warsak Road was found the most contaminated area. Among all 11 samples from Warsak Road E.coli was reported in 7 samples while. City area was listed 2nd contaminated location because total 4 samples were taken and E.coli was reported in all of these samples. University area being 3rd contaminated location was reported positive with E.coli in 4 samples. Hayatabad area listed 4th in contamination where E.coli was present in 2 samples and was absent in 1 sample. Similarly Town area was on 5th number in contamination of water with E.coli because

Table 1: Comparison of Government and private schools for E.coli in drinking water

Type of school	E.coli confirm		Total	P-value
	Present	Absent		
Government school	11	4	15	0.256
Private School	8	7	15	
Total	19	11	30	

Table 2: Presence of Filters in schools and it's effect on E.coli Count

Presence of filter for drinking water	E.coli confirm		Total	P-value
	Present	Absent		
Yes	4	3	7	0.598
No	15	8	23	
Total	19	11	30	

Figure 3: Effect of source of drinking water on presence or absence of E.Coli

Source of drinking water	E.coli confirm		Total	P-value
	Present	Absent		
Tape water	13	4	17	0.118
Water cooler	5	7	12	
Water tank	1	0	1	
Total	19	11	30	

Table 4: Prevalence of E.coli on the basis of Location of schools

Location of schools	E.coli confirm		Total	P-value
	Present	Absent		
Hayatabad	2	1	3	0.321
Town	2	4	6	
University	4	2	6	
Warsak Road	7	4	11	
City	4	0	4	
Total	19	11	30	

here E.coli was reported in 2 samples while 4 samples were free of E.coli as shown in Table 4. P value in all cases is greater than 0.05 showing no association of selected variables on E.coli count.

DISCUSSION

Water is the basic need of life and access to safe drinking water is the right of each and every individual. Contaminated water is the main source of water borne diseases. Pollution is the main cause of contamination of water worldwide. Water supply in Pakistan is fulfilling the drinking needs of only 79% of its population and water from ground (boring) is the main source of water. Out of this, 59% water is contaminated and is unfit for drinking. Similarly 40% of all the diseases are caused by contaminated water, in which diarrheal diseases accounts for 14%. That is why it is important to keep water safe from fecal contamination and all other sources of pollution.[10]

Keeping World Health Organization (WHO) guidelines in mind it is very important to have no coliforms per 100ml of water but in the present study only one sample was free of coliforms per 100 ml, while remaining all other samples were contaminated with coliforms including E.Coli. Ground water is usually free of bacterial contamination but it gets contaminated while reaching to consumers.[11] Coliforms including E.coli are the main indicators of water quality and their presence in water shows its fecal contamination and other such debris. Contamination of water occurs because of poor sewage system. Hong and Liang (2010) reported a large amount of E.coli in Urban and industrial areas. Greece Venieri and his colleagues found 11% total coliform and 1% E.Coli in water whereas in Brazil 40% contamination was detected in bottled water[12].

Presai et al conducted a study in Nepal in which about 132 samples of drinking water were analyzed for bacterial count. Result showed that above 80% samples were crossing World Health Organization (WHO) reference values for safe drinking water quality[13]. Another study conducted in Kathmandu, Nepal showed sources of water to be contaminated with bacteria and bacterial count was more than standard WHO criteria[14]. Similar findings were reported in our study as well.

The result of this research based study is an agreement with a recent study in Iran but they used PCR method instead of Dilution method and worked for the detection of not only E.coli but also Salmonella and Vibrio Cholerae species. Here in total of 448 water samples 34 were positive for E.Coli, 4 had Salmonella species and 3 samples were positive for Vibrio Cholerae. Presence of these organisms in water is responsible for various diseases i.e; Hemorrhagic colitis, diarrhea, nausea, fever, vomiting, abdominal cramps and cholera. Similarly many of the studies has been carried out for checking bacteriological qualities of water and found out the gastrointestinal problems are on the top of the list in water borne diseases. E.coli and coliforms not only cause diseases in humans but also in animals[15].

Study conducted in Amritsar district in northern India on 1,317 drinking water samples from various water sources all the samples were analyzed to assess bacteriological quality of water for presumptive Coliform count by the multiple tube test. A total of 42.9% samples from various sources were found to be unfit for human consumption. Of the total 565 unsatisfactory samples, 253 were from submersible pumps, 197 were from taps of piped supply (domestic/public), 79 were from hand pumps and 36 were from various other sources. A significantly high level of contamination was observed in samples collected from submersible pumps (47.6%) and water tanks (47.3%), as these sources of water are more exposed and liable to contamination[16]. Our study results also showed more coliforms in samples that were supplied by open water sources like tanks.

Continuous protection of not only water but also whole environment is of prime importance for the health of people of the society. Regular examination and checking of water quality give information about its value for health. Water is easily contaminated and its examination for fecal coliform is very important. A research based study in Ethiopia closely resembles this study in which E.Coli was taken as indicator for checking water quality. In this study 24 drinking water samples were tested in laboratory in which 23 samples were reported positive for E.Coli. That is why disinfection of that water was recommended.[17]

A study conducted in District Charsadda, Khyber Pakhtunkhwa, for assessing drinking water quality showed water sample to be contaminated with coliform bacteria leading to various water borne diseases like viral hepatitis, dysentery, diarrhea, gastroenteritis[18]. Analysis on 23 water samples from different areas of Kohat and Mohmand Agency was also done in a study conducted by Ali et al. Seven out of ten samples collected from Kohat and three out of thirteen samples collected from Mohmand Agency were determined to be unfit for drinking due to the presence of E.coli. The result revealed that 10 (43.5%) out of 23 samples have microbial contamination and unfit for drinking[19]. In contrast to these findings our study results showed slightly high prevalence of E.coli.

Ali et al conducted a study in Khyber Agency valley. Quality assessment of drinking water was carried out by determining, total plate count, total Coliform bacteria, total Fecal Coliform, E. coli and Staphylococcus Aureus. The total plate count (TPC) was found in the range of 3600-190 CFU/ml which indicated that none of the samples were found in drinking water according to the WHO standards (100 CFU/ml). All the samples were found contaminated with total coliform bacteria and unfit for human consumption according to WHO standards. Total fecal coli form bacteria present in 80% samples. E. coli were present in 66% samples.[20] Certain limitations in our study included less sample size due to time and financial constraints. Present study should be

carried out on large scale and with collaboration with health and sanitation department.

CONCLUSION

There is a high total coliform and E.coli count showing that majority of drinking water in our study schools are unfit for drinking. Government should take stick action to save our new generation from devastating effect of such water.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

Khalil KuR: Planned study, statistical analysis.
Sarwar A: Data collection.
Humayun M: Manuscript writing.
Naeem W: Laboratory work.
Ahmad M: Referencing.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.