Research Article

Health risk attributed to poor microbial quality of drinking water from rural area of Peshawar, Pakistan

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Abstract

Waterborne diseases caused by potentially fatal microorganism is a major public health concern and impart severe health consequences in form of morbidity while severe cases lead to mortality. The current study aims to determine the microbiological quality of drinking water from the rural area of Peshawar Pakistan. A total of 600 samples were collected from budhni, chamkani and muslim town in 2018. This cross-sectional was approved by the National Institute of health and management sciences Peshawar. A sterile water container was used for a sample collection from both tap water and hand pump by adapting standard microbiological practices. Out of 600 samples, 275 (45.7%) samples were positive for potential microorganisms including *Salmonella* (15%), *Shigella* (32.8%), and *E. coli* (11.7%) respectively. A significant number of growth of *Shigella*, *Salmonella* and *E. coli* from a source of hand pump were observed in comparison to tap water. The presence of potential fatal microorganisms indicates poor quality of drinking water in the study setting which impart severe health consequences. Public health measures are required for reducing the prevalence of waterborne diseases in such areas.

Keywords: Contamination; Drinking water; Public health; Water borne diseases

Introduction

Water is a basic need for all living things and important for life survival. Sufficient, safe, and accessible supply must be needed to all and have detrimental benefits to health [1]. Safe drinking water is currently a major public health concern as human morbidity is closely tied to the quality of water [2]. Water quality gets poor due to an increase in population, industrial development, and

unhygienic conditions in all parts of the world [3]. In developing countries, water pollution is one of the alarming issues, especially caused by animal waste, industrial, household effluent, and heavy metals [4]. In the USA it has been predicted that 560,000 per year people are suffering from waterborne diseases causing approximately 12000 deaths per year. According to WHO in their report on World in danger of missing

sanitation target; reported that more than 1.1 billion peoples currently lack access to safe drinking water in both rural and urban areas and about 2.6 billion lacks access to basic sanitation [5]. Another report by (WHO/UNICEF 2019) reported that about 4.2 billion people lack basic sanitation services and 297,000 children less than five years of age die because of poor hygiene, unsafe drinking water, and poor sanitation [6] whereas 2 billion people live in a high water stress area. Besides many efforts, a safe water supply is still a challenging task for stakeholders. Unsafe water is one of the reflective reasons behind illness especially intestinal disease i.e. diarrhea and dysentery. A variety of pathogenic enteric bacteria such as Enterotoxigenic *Escherichia coli*, *Salmonella* spp, and *Shigella* sp contribute to such illness [7]. Many studies reported a higher prevalence of water-borne pathogens in Pakistan previously. A study conducted in Lahore reported a 37.2% prevalence of water contamination by pathogenic bacteria [8].

An extensive study conducted previously in all provinces of Khyber-Pakhtunkhwa Pakistan demonstrated the high prevalence of bacterial contamination in urban areas [9] however there is scarce of literature on the microbial quality of drinking water in many rural areas of Peshawar Pakistan. Keeping in view the context of deleterious effects of water-borne pathogens on human health, the current study was designed to determine the bacteriological quality of drinking water contamination with pathogenic bacteria of rural areas of Peshawar city.

Material and Methods

Sampling site and collection

About 600 samples were collected from the rural area of Peshawar i.e. budhni, Chamkani, and shaheen Muslim town. All the mention places were away from Peshawar on the East with a distance of 10 Km. About half of the samples were collected from budhni, Chamkani having six thousand homes while

rest were from Muslim town having three thousand homes. The sources of drinking water supply in these areas were probably closed systems (bore wells, hand pumps, and taps).

Study design and technique

This study was cross-sectional and a non-probability convenient sampling technique was used for sample collection. This study was approved by the National Institute of Health and management science Peshawar. Water samples for bacteriological analysis were collected aseptically in Sterile 125 or 150 mL plastic bottle. All samples were analyzed within 6 hours of its collection followed by bacterial analysis.

Sample processing

Spread plate techniques were used after obtaining inoculum from each sample. The glassware and other tubes were sterilized in an autoclave for 15 min at 121°C. All samples were cultured on MacConkey and S.S agar. Both MacConkey and S.S agar plates are prepared according to the manufacturer's instructions. After inoculation, the media were incubated for 24 hours at 37°C and processed further for identification of bacteria.

Bacterial identification

Samples were processed for colony morphology and gram staining. Biochemical properties were also tested using biochemical tests i.e. Triple Sugar Iron, Indole, citrate, and urease test.

Data analyses

Data were analyzed using SPSS version 19 using the descriptive statistical tool. Data were presented in the form of tables.

Results

About 600 samples of water from hand pumps and tape water all around the areas of Budni, chamkani, and Muslim town were screened for different waterborne bacteria like *Shigella*, *Salmonella*, and *E. coli*. out of 600 samples, 145 samples were observed for the growth of *Shigella* (24.1%), 105 samples

for the growth of *Salmonella* (17.5%) while 25 samples have growth of *E. coli* (4.1%) respectively. The (Table 1) shows the growth status of the analyzed sample along with the organism type.

The (Table 2) shows the high number of growth for *Shigella*, *Salmonella* and *E. coli* from the source of hand pump 160 (26.67%) in comparison to tap water 115 (19.12%) respectively.

The percentage of *Shigella* was 53.4% from the sample collected from hand pumps and 22.1% in tape water while the prevalence

of *Salmonella* was found to be 40% in hand pump water and 10.2% in tape water. *E. coli* was least prevalent with the percentage of 0.8% in hand pump water and 4.9% in tape water isolated in budhni and chamkani as shown in (Table 3).

The prevalence of *Salmonella* was 42.1% in hand pump while 4.8% in tape water followed by *Shigella* having the percentage of 22.1% in hand pump and 10.7% in tape water. The percentage of *E. coli* was 1.1% in hand pump and 6.8% of tape water isolated in shaheen Muslim town as shown in (Table 4).

Table 1. Prevalence of shigella, Salmonella and E. coli in water samples

S. No.	Organism	Positive samples	Percentage
1	Shigella	145	24.2%
2	Salmonella	105	17.5%
3	E.coli	25	4.1%
4	No growth	325	54.2%
	Total	600	100%

Table 2. Percentage wise distribution of positive sample from different sources

S. No.	Source	Number grown bacteria	Percentage
1	Hand Pump	160	26.7%
2	Tape	115	19.1%
3	No growth in both	325	54.2%

Table 3. Prevalence of Shigella, Salmonella and E. coli from tape water and hand pumps in budhni and chamkani

S. No.	Total samples	Source	Organism	Positive sample	Percentage
1	115	Hand pump	<i>Shigella</i>	61	53.4%
	185	Tap water		41	22.1%
2	115	Hand pump	<i>Salmonella</i>	46	40.0%
	185	Tap water		19	10.2%
3	115	Hand pump	<i>E.coli</i>	1	0.8%
	185	Tap water		9	4.9%

Table 4. Prevalence of *Shigella*, *Salmonella* and *E. coli* from tape water and hand pumps in Muslim town

S. No.	Total samples	Source	Organism	Positive sample	Percentage
1	95	Hand pump	<i>Shigella</i>	21	22.1%
	205	Tap water		22	10.7%
2	95	Hand pump	<i>Salmonella</i>	40	42.1%
	205	Tap water		10	4.8%
3	95	Hand pump	<i>E.coli</i>	1	1.1%
	205	Tap water		14	6.8%

Discussion

Pathogenic microorganisms have been a major public health challenge. One of the major sources of human infections is due to drinking of contaminated water. Microbial quality of water is guided by the water quality guidelines [10] or standards of the Department of Water Affairs and Forestry (DWA, 1996). In light of such guidelines for drinking water quality, the results of the present study indicated that the water source tested was of poor microbiological quality.

Poor microbiological quality of water possesses deleterious health effects on single intake in comparison to chemical contaminants as it leads to potential health consequences like diarrhea [11]. Our study revealed the growth of *Shigella* with a frequency of 24.1%, *Salmonella* with 17.5%, and *E. coli* with 4.1% respectively. Sample sources from hand pumps have observed growth of 26.7% while in tape water accounts for 19.1%. The study conducted previously reported the prevalence of (40%) microbial contamination which is quite similar to our study [9].

Our study indicates 54.2% of water sample are satisfactory for drinking purpose. The rest of the samples were not satisfactory for drinking purposes having microbial contamination. A study previously conducted reports similar findings which indicate the poor quality status of drinking water. Another study conducted in Lahore, Pakistan by Shoaib *et al.* [12] reported the high prevalence of water-borne pathogen with the

percentage of 37.2% as Lahore is also an industrialized and highly populated area which makes the condition favorable for the rapid spread of water-borne pathogens like *Salmonella*, *Shigella*, and *E. coli* [8]. A study conducted by Shoaib *et al.* [12] reported contamination of 56.1% which is in line with our findings.

In our study percentage of *Shigella* was 32.8% in tape water while the prevalence of *Salmonella* was 15% followed by *E. coli* with a percentage of 11.7% from the samples collected in budhni, chamkani, and muslim town. A similar study conducted by Din M *et al* from Quetta Pakistan reported a high percentage of pathogenic bacteria. Out of their 125 samples, 110 samples were contaminated and the most prominent bacteria was *E. coli* with the percentage of 28.8 followed by salmonella having a percentage of 04% respectively [13].

Conclusion

The presence of potential bacteria in drinking water in the present study attracts public health action as water-borne diseases caused by potentially fatal bacteria have drastic effects on consumers. Three major bacteria i.e *Salmonella*, *Shigella*, and *E.Coli* were most prevalent in the study setting which might be the etiologic factor behind water-borne diseases such as diarrhea and dysentery.

Authors' contributions

Conceived and designed the experiments: Sh Ahmad & Fa Shan, Performed the experiments: Fa Shan, Wa Ahmad & MK

Khan, Analyzed the data: Na Ali, SB Ali & SH Ahmad, Contributed materials/ analysis/ tools: FA Shan & MK Khan, Wrote the paper: SH Ahmad.

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