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WATER QUALITY AND ITS EFFECTS ON COMMUNITY

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Abstract

Water purification and water management are global concerns for human survival and development as it is the basic resource, necessary for sustaining all human activities. So, it is required in desired quantity and quality. Water pollution is a main course as it affects drinking water, rivers, lakes and oceans all over the world and consequently harms human health and the natural environment. We have studied on the quality of drinking water and its effects on human health. Physical, chemical and microbiological analyses were carried out on the water. The water samples were found to have high pH (alkalinity of the water), high chromium content and microbial abuses. While the community were not suffering from water borne diseases. Therefore, it is concluded that there was recently the need and importance of water purification and water management systems.

***Keywords*:** Water Purification, Water management, Water quality, Chromium, pH and Microbial.

Introduction

Water is a very important natural resource for people and it covers nearly 75% of the earth's surface (NERC, 2007) But, surprisingly only 2.5% of the earth's water is fresh and consumable. Out of the aforesaid 2.5%, more than two-thirds is locked away in glaciers and not usable for society (Ward, 2003). Living beings need pollution free water for survival as contaminated water affects drinking water, rivers, lakes and oceans all over the world and harms human health and the natural environment. Water pollution include sewage and waste water, industrial waste, oil pollution, marine dumping, atmospheric deposition, radioactive waste, underground storage leakages, global warming, eutrophication etc (Gambhir *et al*., 2012).

Polluted water causes fatal effects on the health of the living being. The heavy metals drained from industrial processes accumulate in nearby lakes and rivers, proving harmful to the marine animals, other animals consuming this toxic water and humans using animal products. The effect of toxins from industrial waste cause immune suppression, reproductive failure or acute poisoning. The one more serious problem is microorganisms in sewage often result in infectious diseases like cholera and typhoid fever which are the primary cause of infant mortality (Water Pollution Guide). Water pollution damages to the economy as it can be expensive to treat and prevent contamination because waste that does not break down quickly accumulates in the earth's waters and eventually makes its way to the oceans as per Water Pollution Guide date given in Table 1.

Diarrheal diseases are a major health issue in developing countries and also a high risk to travelers visiting these countries. Conservative estimates place the global death toll from diarrheal diseases at about two million deaths per year (1.7 to 2.5 million deaths), ranking third among all causes of infectious disease deaths worldwide (WHO, 2012). Most of these deaths occur in children under five years of age. An average morbidity attack rate of 3.2 episodes of diarrhoea per year per child has been reported, but in some settings in developing countries, this number can be as high as 12 episodes per year per child. Moreover, outbreaks of cholera, shigellosis and typhoid fever most often occur in resource-poor countries, adding to the burden of disease among the most vulnerable such as refugees, internally displaced populations and groups living in shanty towns. There are a number of water treatments to prevent pollution such as biological filters, chemical additives and sand filters, which are cheaper. In the current study, we assessed the water quality and its effect on the health of individuals pertaining to water.

Methodology

Study area

A cross-sectional study was carried out in Jaipur to assess the health status of the individual pertaining to water borne diseases in the rural areas of Rajasthan.

Study tool

Nearly 300 participants were interviewed with the help of a questionnaire. The questionnaire was designed to elicit descriptive accounts of the informants' everyday life, water usage, water storage habits, personal hygiene habits and experiences with diseases. Data collected was statistically analyzed using Statistical Package for Social Sciences (SPSS 10).

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Study period

The study was carried out in a period of 06 months involving May 2019 to November 2019. The samples of water were collected from the different areas of Jaipur with the help of sterilized test tubes. For the microbiological sampling, water samples were brought to the laboratory in clean sterile test tubes and analyzed within 24 h. These samples were taken from common water sources like water tank, tube wells, wells and common water taps.

To ascertain the physical, chemical and microbiological quality of drinking water of the selected areas, a total of 9 water samples were collected, one from the households (selected randomly), one from common taps (selected randomly) and one from the water tanks of each area. The household sites were chosen randomly using a random sampling technique. Physical parameters were measured directly at the water surface by conventional methods. Standard photometric analysis was employed for determination of chemical concentration of copper, chromium and Zinc. Microbiological assessment using Nutrient agar and MacConkey agar were used for presumptive and confirmed coliform counts, using the colony count and most probable number techniques.

Results

The detail of age of people interviewed is given in Table 2. The education status of the population is given in Figure 1. According to the data collected, most of the people were illiterate (41%) or below metric pass (38%), so the level of literacy was very poor among the people under study and the subjects (65.0%) were from lower income socio-economic group, earning a monthly salary of 0 to 5,000 rupees only. Mean salary of the studied population was Rs. 5,175 only.

Sources for drinking water

Various sources for drinking water were tap (15.5%), well (13.0%), tube well (13.0%) and community water source supply (58%). Methods used for purification of drinking water included boiling (4.0%) and muslin cloth (7.5%), while 88.5% did not use any method for purification of drinking water.

Storage of drinking water

The people stored drinking water about 92.5% in earthenware pots, 6.5% in stainless steel containers, 0.5% in plastic buckets as indicated in Figure 3. Most of them did not use any separate glass for taking out water from the containers in which water was stored. Inhabitants of the area, especially children, did not use basic hygiene measures like washing hands before taking out water from the storage container. Most of the villagers informed that they wash their water-storage utensil once a month while some of them washed it once every 2 to 3 months. Most of them were not aware of various precautions to be taken before and after storing water and to prevent water-borne diseases.

Medical illness of the subjects

About 20% suffered people from medical illnesses like diarrhoea, vomiting, headache, stomach ache, dizziness, fever etc. while 80% did not have any such symptoms as shown in Figure 2.

Laboratory results

Physical, chemical and microbiological test results are shown in Table 3. Most probable numbers (MPN) is a suitable and widely used method to determine the extent of microbiological quality of water. Most of the areas showed infinite number of microbial contents, with the worst being slums. This might be due to the favourable conditions like temperature, pH etc. High value of MPN indicates that water is not suitable for drinking purpose. Most bacteria grow between pH 4 to 10 and exhibit optimum growth in the range of pH 6.5 to 7.5.

Discussion

The slums areas 1, 2 and 3 have around 472, 476 and 550 households respectively. The district has a population of nearly 3.0 lacs, congested area and a population density of 500 persons per km². Jaipur is supplied by mainly municipal tap water, hand pumps, bore well etc. According to sources depth of ground water is between 20-100 m. The region receives an annual rainfall of about 300-500 mm. As shown in the result of the above study also, the ground water is alkaline type, having pH value more than 7.

In India, majority of the rural population (approximately 72%) does not use any method of water disinfection and have no sanitary toilets (74%) (IIPS & Macro International, 2007). Open air defecation is also a common practice among slums and may lead to contamination of the water supply system resulting in outbreaks of diarrheal diseases (Bora *et al*., 1997; Sarkar *et al*., 2007). According to the above study also, majority of villagers (89.0%) did not use any method for purification of drinking water and had poor knowledge about the need and availability of safe drinking water.

The commonest form of disinfection in slums India is single-point chlorination, using bleaching powder. How-ever, this may not be effective because of the possibility of multiple sites of contamination (Propato and Uber, 2004). Alternative point-of-use disinfection methods such as solar water treatment (Kang *et al*., 2006; Rose *et al*., 2006) or point-of-use chlorination (Arnold and Colford, 2007) and storage of water in narrow-mouthed vessels (Mintz *et al*., 1995) need to be explored. Considering the contamination of all water samples at the household level, end-user disinfection with chlorine is likely to be more effective in such settings (Clasen *et al*., 2006) according to the WHO standards (WHO, 1993). It has been estimated that diarrheal morbidity can be reduced by an average of 6-20% with improvements in water supply and by 32% with improvements in sanitation (Ida, 2012). Educating people and mass media campaigning can be used to popularize these methods. However, sustainability of these methods over longer periods or cost-effectiveness in rural India is still questionable. In the present study, use of chlorine for water purification was not prevalent.

The study areas had no organized sewage system, open drains were common site and there was localized collections of waste water. Animal faecal matter was interspersed around houses and on the streets. Children were seen defecating on the streets. Also at certain points, faeces were visible in the sewage drains and around the localized waste water collection spots. There was no system for collection and disposal of garbage. In certain places, garbage was inseparable from human and animal faeces, so the chances of diarrheal diseases were even more, but on the contrary 80% of people living in these areas did not report any symptom of diarrheal diseases. The reasons for this may be that they have developed immunity towards various water-borne bacterial and viral infections. The other reason could be that people are unaware about these symptoms, their relevance and why reporting these symptoms is important. So their ignorance about these symptoms and diseases could have been responsible for under reporting of the same.

The study also indicated that the accumulation of heavy metals over large areas and long periods of time resulting in gradual damage to living organisms necessitates careful monitoring of the input, movements and effects of such pollutants (Ida, 2012). Other studies also came out with similar results like a study of drinking water quality of desert affected area of Jhunjhunu district in Rajasthan which was carried out to find out water pollutants and to test the suitability of water for drinking and irrigation purpose in study area. In this study, it was found that nitrate fluoride and total dissolved solids (TDS) were higher and water of study area was found to be hard. In the study on heavy metal contamination in ground water at outer skirts of Kota city, Rajasthan India, researchers analyzed 72 ground water samples for determination of contamination level of Fe, Pb, Ca, Zn, Mn, Cr and it was found that lead and chromium concentrations were high (Patil and Ahmed, 2011).

Zinc

Zinc is a very essential micronutrient in human being but if at very high concentrations, it may cause some toxic effect. Zinc compounds (Donovan *et al*., 2016) are astringent corrosive to skin, eye and mucous membranes. They cause special types of dermatitis known as “Zinc pox”. Zinc is also irritating to digestive tract, causing nausea and vomiting. The maximum permissible concentration of zinc in drinking water is 15 ppm according to World Health Organization (WHO). The values of zinc content in all water samples of the study were below the maximum permissible limit ac-cording to WHO (1996) norms.

Chromium

Chromium is also essential to organisms as a micro-nutrient, in traces from fat and carbohydrate metabolism. Chromium (Moffat *et al*., 2018) is also more harmful in its lower oxidation state (III). Chromium and chromates are potential carcinogens. The limit of chromium in drinking water is 0.01 ppm according to WHO. The values of chromium content in all water samples were higher than maximum permissible level according to WHO (1996) norms. This is a serious health risk and should be looked upon by the concerned authorities.

The limitations of study are the low sample size of the study; fluoride, chlorine and other heavy metals levels were not tested due to resource constraints. Long term effects of these results were not studied in the sample population.

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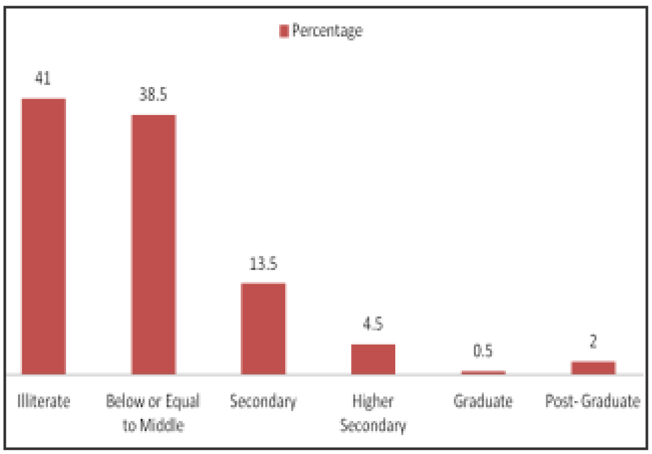

Figure 1: Educational status of the subjects

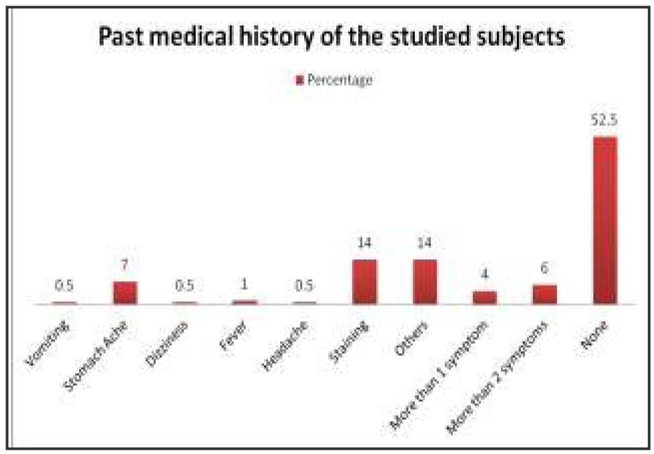

Figure 2: Past medical history of the subjects

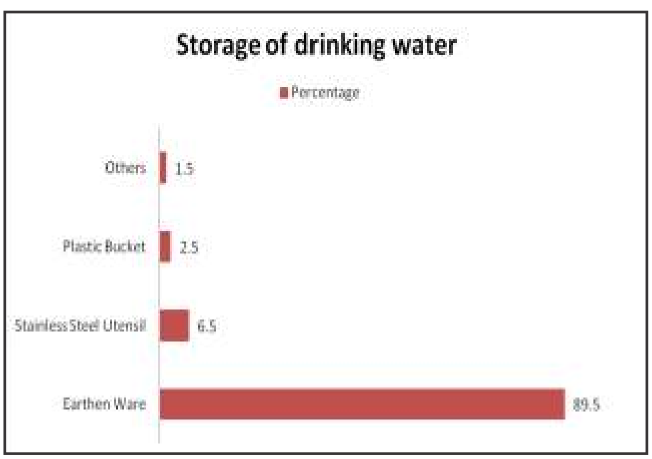

Figure 3: Storage of drinking water

Table 1: Indian data and statistics

Year	No. of diarrheal deaths in 0-6 years	No. of diarrheal deaths in 6+ years
2006	1,68,896	3,15,818
2011	1,81,986	3,40,296
2016	1,95,046	3,64,716

Source: National Commission on Macroeconomics and Health (Ministry of Health and Family Welfare, Government of India, 2005)

Table 2: Age distribution of the people

Age group	Percentage
16 -20	10.5
21 -25	28.5
26 -30	17.0
31 -35	14.5
36 -40	10.0
41 -45	5.5
46 -50	5.0
51 -55	2.5
56 -60	6.5

Table 3: Physical parameters

Characteristic	Slum Area 1	Slum Area 2	Slum Area 3
Taste	Agreeable	Agreeable	Agreeable
Odour	Unobjectionable	Unobjectionable	Unobjectionable
Temperature (°C)	26.0	27	27.0
Turbidity	No turbidity	No turbidity	No turbidity
Clarity	Clear	Clear	Clear
Chemical assessment			
pH	8.4	8.8	8.3
Heavy metal			
Copper (ppm)	Nil	Nil	Nil
Chromium (ppm)	0.118	0.112	0.080
Zinc (ppm)	0.250	0.270	0.230
Microbiological assessment			
Villages	**Nutrient agar (Colonies/100 ml of water)**	**Mckonkey agar (Colonies/100 ml of water)**	
+Control	Infinite	Infinite	
Control	Nil	Nil	
Slum Area 1	Infinite	Infinite	
Slum Area 2	7	Nil	
Slum Area 3	Infinite	7	
Pond water	Infinite	In finite	