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Research Article

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Quality of drinking water and associated health risks in rural Ahmednagar, Maharashtra, India

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ABSTRACT

The quality of drinking water has always been a low priority issue for the rural community in developing countries like India. The poor attention accorded by the government as well as consumers towards the quality of drinking water leads to major health problems for humanity. To overcome this problem it is necessary to monitor and evaluate the quality of drinking water in rural areas on a regular basis and make the community aware of its consequences. This paper presents the ground realities of some important physical, chemical and biological quality parameters of 1728 drinking water samples drawn from both private and community water supplies from 216 villages of Ahmednagar district, Maharashtra, India through a cross sectional study during 2012. The selective water quality parameters which affect the health of the humanbeing were evaluated like Temperature, pH, Turbidity, Hardness, Iron, Fluoride, Nitrate, Chloride and Bacteria. The results indicate that a total of 41% water samples were unfit for consumption for varied reasons from the study area. Hardness was the major problem followed by chloride, bacteria and turbidity in the drinking water, which may lead to various health problems.

Keywords: Drinking Water, Health Risk, Water Quality

INTRODUCTION

Access to adequate quantity of potable drinking water is universally recognized as a basic human need and a fundamental right of every citizen. Over the years, it is an accepted fact that the supply of wholesome drinking water has become an unsolved challenge, especially in the rural areas. Millions of people in the developing world do not have ready access to adequate and safe supply of water [1]. The contaminated drinking water results in thousands of deaths every day, mostly children below five years in developing countries [2]. In addition, diseases caused through consumption of contaminated water and poor hygiene practices are the leading cause of death among children worldwide after respiratory diseases [3].

More than half of the world's population lives in villages and most of them without access to safe drinking water [4]. Quality of drinking water in rural parts of developing countries is still a neglected area. Injudicious, indiscriminate and extensive use of chemical fertilizers and pesticides in agriculture has led to chemical pollution of ground as well as surface water. Besides, in most of the areas, domestic sewage as well as improper solid waste resulted into biological pollution of water sources. In United States, contaminated, ground water is most commonly reported source of water-borne diseases with 64 % of the drinking water outbreak between 1989 and 2002 [5].

The current study was carried out in Ahmednagar district of Maharashtra state in India, which is geographically located on 19.9^0 N to 75.5^0 E and having population 40,40,642 as per 2001 census. The district experiences very

unbalanced climatic conditions. The temperature varies between 19.9^0C to 36.8^0C during December and May respectively. Ground water is the major source of drinking water in rural part of the district for around 80 % of people, which is being used through hand pumps, dug wells etc. In present investigation an attempt was made to asses the physical, chemical and biological quality of drinking water in the rural areas of Ahmednagar district, Maharashtra, India.

EXPERIMENTAL SECTION

A cross-sectional study was carried out in 216 remote villages of Ahmednagar district in Maharashtra state, India during a period of six months from October 2013 to March 2014. These villages were covered under a "Multi-sectoral Approach Model for Sustainable Health and Development" project initially funded by Swedish International Development Cooperation Agency (Sida), New Delhi, India (2006-10) and later on by Pravara Institute of Medical Sciences-Deemed University, Loni, Dist. Ahmednagar, Maharashtra, India. A stratified random sampling methodology was applied to collect the water samples from each village. All the water supply sources of the villages were initially stratified into two - community and private. The community water supply sources includes lakes, hand pumps, canal, dug well and bore wells owned by grampanchyat of the villages, however private water supply sources includes bore wells and dug wells owned by individuals As many as 8 water samples were selected from each village (4 from each water source), making the total sample size to 1728 from 216 villages, by the laboratory technician of the Mobile Medical Van during November 2013 to January 2014. All the collected water samples were analyzed qualitatively for Physical (Temperature, Turbidity, pH), Chemical (Hardness, Chloride, Fluoride, Nitrate, Iron) and Biological (Bacteria) parameters in the laboratory. Temperature was recorded with digital thermameter immediatly aftar sample collection. Other parameters were analysed using Water Testing Field Kit developed by All India Institute of Hygiene and Public Health, Calcutta in collabration with UNICEF [6].

RESULTS AND DISCUSSION

In rural part of India, the drinking water sources e.g. open wells, tanks and lakes are always found unprotected and uncovered, which increases the chances of physical contamination of water. From table 1, it is observed that, around 2.08% samples were turbid, perhaps contaminated due to one of the sources like soil particles, plant leaves, etc. This led to deterioration of quality of water as well as disturbed the aesthetic beauty of water. Mann et. al., reported association between turbidity in drinking water and gastrointestinal illness [7]. pH was recorded in around 0.29 % of water samples from the western hilly region of the Ahmednagar district.

Table 1 : Physical Indicators of Water Pollution (N = 1728)

S.N.	Parameter	Fit for Consumption	%	Unfit for Consumption	(%)
1	Temperature	1728	100	00	00
2	Turbidity (> 10 NTU)	1692	97.92	36	2.08
3	pH (6.5-8.5)	1723	99.71	5	0.29

Hardness was the major problem observed in the drinking water samples collected in the study area, which accounts to 28.07% of the total samples (Table 2). This was the major chemical pollutant found in the drinking water in present study. The health risk associated with the hardness in drinking water includes cardiovascular diseases. Magnesium which is contributing to the hardness is an element which is most responsible for association between cardiovascular mortality [8]. Nerbrand et. al., reported that calcium content in water could be a factor in the complexity of relationship and importance of cardiovascular risk factors; he also noticed positive correlation between the calcium content in household water and systolic blood pressure [9].

Table 2: Chemical Indicators of Water Pollution (N=1728)

S.N.	Parameter	Fit for Consumption	%	Unfit for Consumption	(%)
1	Hardness	1243	71.93	485	28.07
2	Chloride	1667	96.47	61	3.52
3	Fluoride	1715	99.25	13	0.75

S.N.	Parameter	Fit for Consumption	%	Unfit for Consumption	(%)
4	Nitrate	1715	99.25	13	0.75
5	Iron	1702	98.50	26	1.50

Chloride contamination attributed to 3.52% of total water samples in the study area, which lead to hardness to some extent and disturbs the taste of water. Fluoride levels in water which is one of the major sources for dental health problems were found more than the acceptable limits in around 0.75 % samples. Excessive fluoride content was noticed in the water samples drawn from the hilly region of the western Ahmednagar. Wang et. al. reported that exposure to fluoride in drinking water is associated with neurotoxic effects in children [10]. Nitrate, which is a form of nitrogen, was found in 0.75 % samples. This nitrate occurs naturally in soil containing nitrogen-fixing bacteria, decaying plants, septic system effluents, animal manures and use of nitrogenous fertilizers in agriculture and people who get water from shallow wells in area with drained soils and high nitrogen inputs (e.g. close proximity to agricultural areas) have an increased risk of exposure to nitrate rich ground water [11]. Principal concern about nitrogen in ground water is that nearly all of it is ultimately oxidized to nitrate, which is a causal agent of infantile Methamoglobinemia [12]. The Iron content exceeded its permissible limits in around 1.50% of water samples of the study area, which can be a corrosive agent for water supply pipes. The Iron in water can result in poor tasting and stains on clothes. When considering chemical quality of water it is always observed that, long-term exposure of these pollutants to an individual always results into serious damage to health.

The biological quality of water is always important for human health because it is a factor which can result in the sudden collapse of health. Identification and assessment of health risks associated with drinking water rely heavily on bacteriological analysis of water.

Table 3 : Biological Indicators of Water Pollution (N=1728)

S.N.	Parameter	Fit for Consumption	%	Unfit for Consumption	(%)
1	Bacteria	1668	96.53	60	3.47

It is reported that, 3.47 % (Table 3) water samples were found contaminated with either one of the biological pollutant. This can result in various diseases like Dysentery, Cholera and Typhoid.

CONCLUSION

It is concluded that around 41% of water samples from the study area were unfit for consumption and were either contaminated with one of the physical, chemical and biological pollutants. The findings of the study made it clear that hardness is the major problem in drinking water followed by chloride, microbial contamination and turbidity. Fluoride, iron and nitrate were also contributing to the pollution of drinking water which can lead to multiple health risk in the study area. The disinfection of community water supply along-with some treatment procedure to remove chemical pollutants in rural area needs to be improved to ensure the supply of wholesome water to rural community.

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