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Risk Assessment for Microbial Pollution in Drinking Water in Small Community and Relation to Diarrhea Disease

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Abstract: Object of this study is evaluating of health risk in usage of polluted drinking water in small community, located around of Qazvin, Iran and its relative with prevalence of diarrhea diseases. Word health organization has reported that annually 4 billion cases of diarrhea take place world wide, whereas 88 percent of those outbreaks are ascribed to contaminated drinking water [5]. In this study 183 small communities with 10 to 4500 people and total populations of 71171 people were investigated. Results of microbial examinations of drinking water samples, as total coliform, have shown that 73.1 percent of populations have been used contaminated water from march 2005 to February 2006, in 12 months. Investigations in this limited domain were showed that rates of diarrhea outbreak in communities with usage of safe water was 5.3 percent and 8.54 percent in populations with contaminated water. Results were shown that outbreak rates of diarrhea were 69.2 cases in 1000 people in each year and 0.189 in each day. Whereas this rate was 8.94 times fewer than WHO estimated. Also, it was distinguished that rates of diarrhea incidence will be increased with evaluating of environmental temperature. Studying of risk factors was shown that no disinfection had highest role in causing of diarrhea incidence. So in 68 percent of communities chlorination was not performed. It is anticipated that 58605 cases of diarrhea will take place in this domain in next year, if source sanitation and water disinfection do not perform.

Key words: Drinking water · microbial contamination · diarrhea · risk assessment

INTRODUCTION

Epidemiological investigations can provide strong evidence linking exposure to the incidence of diarrhea disease in a population and estimate the magnitude of risk related a particular level of exposure. Also they can specify relation between chance factors and can control risk factors causing gastrointestinal disease [1].

So in this study epidemiology is used as a tool for the assessment of risk. Object of this study is evaluating relation between contaminated water and occurrence of diarrhea in a domain, with usage of epidemiology as a tool for the assessment of risk. Employing risk assessment to control undesirable effects of pollutants on human and environment began before 2 decades ago and it has applied in very cases. Gorter *et al*. [2] has studied effects of water supply and sanitation with outbreak of diarrhea in Nicaragua and they have specified that this rate in children with 500 m distance from source of water in home. Payment *et al*. [3] have used a randomized controlled trail to investigate whether excess gastroenteritis was being caused by potable water supplies. Result of this study estimated the annual incidence of GI illness among tap- water drinker to be 0.76 versus 0.50 among filtered water drinkers. In addition, the result of this study estimated that 35% of the total reported gastroenteritis among tap- water drinker was water- related [4].

Diarrhea occurs in the world-wide and it causes 4% of all deaths and 5% of health loss to disability. It was estimated each year there are 4 billion cases of diarrhea word wide [5]. Agents of water-related diarrhea are very different. They potentially present in contaminated water and are included bacteria, protozoa and viruses [6, 7].This study was designed to determine relationship between temperature of environment, rate of contaminated water in each season of year and verifying incidence of diarrhea in each situation. To attain this object, epidemiological methods, especially risk assessment, was employed.

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MATERIALS AND METHODS

Number of 183 small community was investigated with populations of 10 to 4500 peoples and total populations of 71171 peoples. Then 507 samples of water that microbiologically examined were investigated due to Total Coliform (TC) and Termo Tolerant Coliform (TTC). To reveal total cases of incidence of diarrhea among one year, data from health and curing centers is collected. To elevate accuracy numbers of peoples polluted to diarrhea, domain of study divided to 10 sub-domains and questionnaires was completed. In this questionnaire information about number of peoples polluted, situation of water supply, source of potable water, disinfection, no disinfection and unsatisfactory control of disinfection was investigated. After that, cases of diarrhea were compared in communities with safe water and contaminated water and incidence of diarrhea. Total samples were grab and selection of sampling places were accidentally. Examinations on samples were achieved on Standard Methods for water and wastewater examinations [8].

RESULTS

To recognize water-related diarrhea outbreak in a domain items such as 1) complaint about water quality, 2) non- potable water found by routine sampling, 3) an increase of GI disease in the community and 4) an increase of positive laboratory result indicating possible waterborne agents, can help [9]. In this study second item guided us. So from 517 samples in 183 small communities, populations in 135 communities had habited in locations with contaminated water, with total populations of 36045 peoples.

Table 1 has shown risk factors causing incidence of diarrhea. No disinfection has highest rate of risk. As in 98% of communities with contaminated water, chlorination is not achieved. Table 2 shows results of qualify analysis of water. Maximum of water contamination take placed in interval of Jun to Aug. In that, indicator of microbiological examinations is total coliform, reproducing of this microorganisms increased in high temperature and so increasing contaminated samples in the warm months will be anticipated [10]. Also rates of diarrhea incidence is shown in this table. Data from this table shows that 60% of diseases take placed in interval Jul of to Oct. Especially, 100% cholera incidences there were in Aug and Sep. In Fig. 1 is shown effects of environmental temperature in contaminating of water. Peak of

Table 1: Effective risk factors in incidence of diarrhea in this study

	Parameter		
Risk factors	Communities with safe water %	Communities with contaminated water %	In total communities %
No disinfection	16.7	98.0	68.0
Unsatisfactory control of disinfection	3.7	0.0	3.0
Breakage in water supply	10.1	63.2	35.0
No sanitation water source	3.6	46.0	27.0
Wastewater pipes close to water source	16.0	69.3	40.0

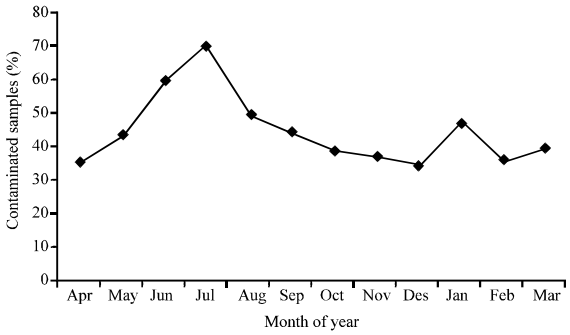

Fig. 1: Effect of season and environment temperature on water quality

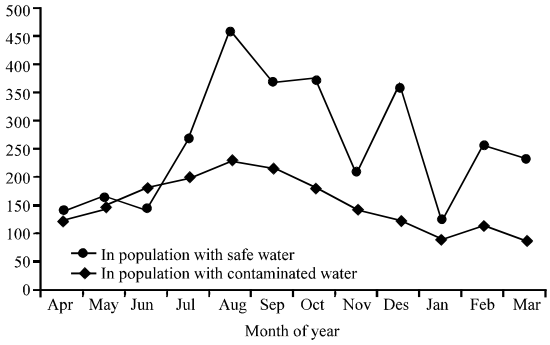

Fig. 2: Numbers of diarrhea diseases in communities with safe and contaminated water

contamination is in Jun to Aug, that have warmest day in this year. In Fig. 2 rates of incidence of diarrhea is compared in communities with safe water and contaminated water.

DISCUSSION

Risk assessment and intervention trials have been used to estimate drinking water health risks. Risk assessment is

Table 2: Results from water examination and Cases of diarrhea incidence

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Des	Jan	Feb	Mar
Total water sample	43.0	39.0	39.0	40.0	94.0	53.0	49.0	37.0	48.0	23.0	19.0	23.00
Contaminated samples %	34.4	43.5	58.9	70.0	50.0	43.4	38.7	37.0	66.7	47.8	36.8	39.10
Estimated cases of diarrhea	260.0	308.0	325.0	466.0	686.0	581.0	549.0	358.0	482.0	215.0	364.0	320.00
Estimated cases of diarrhea in locations with safe water	120.0	145.0	180.0	198.0	230.0	223.0	180.0	148.0	122.0	89.0	110.0	89.00
Estimated cases of diarrhea in locations with contaminated water	140.0	163.0	145.0	268.0	456.0	368	369.0	210.0	360.0	126.0	254.0	2.31
Fraction from total cases of diarrhea	5.3	6.3	6.6	9.5	10.4	11.8	11.1	7.3	9.8	4.3	7.4	6.50

Table 3: Analyses of occurrence of diarrhea in one year in the selected domain

	Initially reported	Sick identified by questionnaire	Estimated No. of sick	No. at risk (person)
Giardiasis	34*	**	1885	58605
Typhoid	2	**	---	
Dysentery	29	19	190	
Cholera	57	**	---	
Unknown agent	1230	486	4860	

*This number has obtained from examination of 1283 peoples

**No identified from usage the questionnaire

important under conditions of low risk when estimates are difficult to attain from trails [11]. Diarrhea diseases are one of the important agents of mortality, especially in the developing countries P [12]. World health organization has estimated that diarrhea annually 2.2 million people will kill worldwide [5]. Also WHO have reported contaminated water is an important cause of diarrhea. In the world-wide around 1.1 billion people lack access to improved water sources and 2.2 billion have not basic sanitation [13]. Also Lang *et al*. [4] have estimated that 35% of the total reported gastroenteritis among tap- water drinker was water-related.

In this study, estimating are shown that 69.2 cases of diarrhea in each 1000 people have been take placed in each year. This rate is 8.94 times fewer than rate that WHO has estimated. Also result has shown that with increasing temperature in the environment, rate of contaminated water will increased. According to estimations that World Health Organization has done, diarrhea causes 4% of mortalities [5] but in this survey cases of death do not find.

Effect of temperature on rate of contaminated water samples is shown in Fig. 1 maximum percentage of contaminated samples had take placed in warm months. Investigating on Fig. 2 will give two results. The first, rates of incidence of diarrhea in communities with polluted water is higher than communities with safe water. And the second, with warming of weather, rates of incidence of diarrhea have been increased in each two communities.

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