Pakistan Journal of Nutrition 10 (7): 702-706, 2011
ISSN 1680-5194

Women Perception of Water Quality and its Impacts on Health in Gangapur, Pakistan

Abdullah Yasar, Nuzrat Yar Khan, Ammara Batool, Amtul Bari Tabinda, Rashid Mehmood and Akthar Iqbal
Sustainable Development Study Centre, Government College University, Lahore, Pakistan

Abstract: This study is an attempt to investigate the quality of drinking water used by community and their perception towards water quality. Water samples were collected from hand pump, motor pump and tube well. Total 160 households were surveyed to check their perception against drinking water quality. The results showed the values of bacteriological parameter fecal coliform were above WHO guidelines which made water unfit for drinking purposes. The community was unaware of the quality of water they were drinking. Women with higher education had perception of smell ($F = 3.51$, $p<0.01$), taste ($F = 3.10$, $p<0.05$) and turbidity in water ($F = 5.34$, $p<0.01$). Incidence of water borne diseases especially in infants appeared to be common problem among the sampled households in the study region. Lack of proper water supply system, proper sanitation and drainage facility were the common and contributing to poor health of people.

Key words: Water quality, people perception, health impacts

INTRODUCTION

Clean water availability is a major issue in developing countries. In the Asia and Pacific region, 700 million people are living without proper water supply system and this problem gets grave in rural areas (ADB, 2006). The drinking water source in rural areas of developing world is usually groundwater and people use hand pump or turbine to draw ground water. Private water supply may pose danger to lives of people because groundwater can be contaminated by different microbes such as fecal coliform. Private water supply systems do not treat water before drinking. There are however can be more problems related to poor water quality. Aesthetic problem includes unpleasant taste or odor, precipitation of dissolved minerals and calcification of taps and kitchen utensils. Perception of water quality plays an important role in determining the preventive measures against different water borne diseases. Poor perception of water quality can prevent people from taking any water treatment measure before drinking which later on may have strong health impacts (Cairncross and Valdmanis, 2006) Risk perception and drinking water quality satisfaction are closely related. The perception of risk regarding drinking water is defined as subjective judgment of individual (aesthetically and non aesthetically) (Anadu and Harding, 2000). This suggested that perception of drinking water quality risk results from complicated nexus of education, culture, social and psychological factors.

Few studies had explained the driving factors behind drinking water perception and consumption. The behavior of consumer is determined by his dissatisfaction with source and taste of drinking water (Levallois *et al*., 1999). In addition income and education influence the risk perception. An educated person can perceive taste, smell, color or turbidity in drinking water and can take preventive measures like boiling or filtration. Income of consumer determines the quality of drinking water and decision related to source of drinking water (Larson and Gnedenko, 1999). In case, if consumers are satisfied from apparently cleaner water than they will not use any treatment before drinking the water because consumer usually judge the water quality aesthetically. It seems reasonable that many consumers will establish a link between a potential health risk and an aesthetic problem (Jardine *et al*., 1999). By the same token if drinking water does not have a noticeable taste; odor or visible color may be considered by the consumer to be safe, when it actually contains contaminants with potential health effects (for example, pathogenic micro-organism or inorganic such as nitrate, sulphate) which later may cause severe health problems especially in children. Microbiological quality is most important aspect of drinking water in relation to water borne diseases (Macler and Merkel, 2000) but it is determined apparently by the consumer. Detection of bacterial indicators in drinking water means the presence of pathogenic organisms that are source of water borne diseases. In rural areas of developing countries, usually the drainage facility is very poor and most likely to contaminate the groundwater aquifers with microbes. These factors are responsible to cause stomach problems in children like diarrhea, dysentery and gastro enteritis. These diseases are transmitted through contaminated drinking water (fecal oral path). In

Corresponding Author: Abdullah Yasar, Sustainable Development Study Centre, Government College University, Lahore, Pakistan

other rural areas of Faisalabad, bacteria were present in the water of 68.3% households (MICS, 2007-2008). Such diseases could be fatal (Egoz *et al*., 1999). Gastroenteritis and diarrhea are major causes of morbidity and mortality amongst children of developing regions (Ahmed *et al.*, 1993). Many other diseases and pathogens spread through contaminated drinking water and make children more prone to different other infections. Pakistan is a developing country and rural areas of Pakistan have not adequate facilities of life including availability of clean drinking water. In 2007, almost 11% children get diarrhea and this rate increases in the summer season (PSLM, 2006-2007). According to MICS (2007-2008) 7.2% of children in different rural areas of Faisalabad were having diarrhea. The reason behind could be water sources contaminated by seepage of matter around the site and horizontal flow in groundwater from nearby pit latrines or rubbish dumps (Barrett and Browne, 1996) and in rural areas very few people are aware of this contamination.

In a study of World Bank, the cost of diseases caused by poor sanitation, poor drainage system and contaminated drinking water was between US$3 and 8 billion per year. This is approximately 4% of gross domestic production of Pakistan. Sprawl of diseases in Gangapur was due to poor drinking water quality, poor drainage system and lack of awareness in women. Disease load was immersing the people of Gangapur in acute poverty. In Pakistan, generally microbial quality of water is neglected despite of its fatal implications. A few studies related to water quality have been carried out in different areas of Pakistan (Anwar *et al*., 2010). These studies have not correlated the water quality with the perception of consumers. The purpose of this study was to investigate the water quality of Gangapur and its comparison with public perception toward drinking water quality and with education of respondents. Loss of daily wages due to illness has also been calculated. The trends of personal health of respondent have been compared with water quality of Gangapur.

MATERIALS AND METHODS

The research was undertaken in a village of Gangapur Tehsil Juranwala District Faisalabad. It is a small village with limited facilities of transportation, education, health and employment. It is 12 km away from Nankana Sahab which was sacred place for Sikhs. Gangapur has historical back ground. Its geographical coordinates are 31^{o} 20' 0" North, 73^{o} 54' 0" East. The population of Gangapur is approximately eight thousand. Total of 160 households were randomly selected to fill questionnaires. Questionnaire was used to investigate the perception of the women on taste, odor and turbidity of water along with information of her personal health, spread of diseases in last ten years and stomach problems in children. OPD data was also collected through local dispensary in Gangapur to compare the number of diarrhoeal and patients of other related diseases with perceived and measured water quality.

Unfortunately, there is little information available related to water quality of Gangapur. In this study, water samples were collected at different water depths to check the intensity of contamination. Hand pump was at the lowest depth of below 50 feet, motor pump was above 50 feet but below 100 feet and tube well is more than 100 feet deep.

The analytical test for physical, inorganic parameters and fecal coliform were performed in accordance with approved procedures from Standard Method for Examination of Water and Waste Water (APHA/AWWA/WEF, 1995).

Statistical analysis: The collected data was entered and analyzed using SPSS version for windows version 17. Correlations between different variables and ANOVA had been applied. In Post hoc, Tukey's test has been applied to check discriminent group of variables

RESULTS AND DISCUSSION

In depth water analysis revealed that drinking water was contaminated with fecal coliform (Table 1). The fecal coliform was high in tube well (installed in the fields) samples as compare to samples of hand pump and turbine because in rural areas of Pakistan cow dung and municipal waste water is applied as fertilizer in crops which may contaminate the ground water tables with fecal matter. Samples of hand pump and turbine had also higher concentration of fecal contamination as compared to WHO guide lines (WHO, 1996) which may cause the stomach problems like diarrhea especially in infants. The source of contamination may be the poor drainage and disposal of municipal waste water.

Table 2 shows the average number of patients from year 2004 to year 2009. The number of patients was increasing every year. According to the basic health unit sources diseases were high from June to August as compare to winter season. The disease spread had been drastically increased from 2004 to 2009 which revealed the declining health status of Gangapur. The most probable cause could be the contaminated ground water (Table 3). In last ten years, there had been no change in water availability and improvement in water quality. People trusted the groundwater for drinking purposes without any prior treatment. The disease spread increased in the summer season due to high consumption of drinking water and favorable environment for bacterial growth (Jones *et al.*, 2006). Stomach problem was common in majority of houses, the most self reported disease during survey.

Majority of respondents rated the water quality good and had perceived no smell, taste, turbidity or color in water. The perception of people of Gangapur about water quality was in line to the laboratory results of physical

Table 1: Results of water samples from different locations

Parameters	Hand pump	Motor pump	Tube well
pH	6.78 (7.22, 8.07)	6.7 (7.15, 7.75)	7.77 (7.2, 8.10)
Temperature	12.15 (12.1, 15.9)	10.61 (11.6, 12.3)	23.98 (21.1, 31.9)
Turbidity	4.15 (0.75, 15.24)	1.64 (1.31, 2.47)	5.36 (1.33, 11.2)
EC	27.48 (24.6, 31.1)	27.80 (24.6, 31.3)	22.82 (19.7, 34.6)
Hardness	18 (0, 38)	13.5 (0, 28)	58.198 (30, 122)
SO_4^{-2}	36.1 (0, 303)	20 (0, 58)	40.8 (0.48, 110)
PO_4^{-2}	0 (0, 0)	0.006 (0, 0.015)	0.72 (0, 1.5)
NO_2^{-1}	2.08 (0, 2.5)	7.83 (0, 22)	11.44 (0, 23.5)
Na	149 (42, 207)	191.5 (64, 265)	250.89 (21.6, 407)
K	8.19 (1.7, 13.4)	20.79 (6, 49.5)	6.92 (4, 9.8)
Cl^-	29.1 (14.2, 39.05)	47.5 (31.9, 88.7)	47.7 (19, 53)
Ar	0 (0, 0)	0 (0, 0)	0 (0, 0)
F. coli	162.4 (0, 1600)	358.7 (0, 1600)	265 (0, 1600)

Table 2: Data of OPD of Basic Health Unit in the village of Gangapur

Month	2004	2005	2006	2007	2008	2009
January	525	729	1450	3206	2938	3250
February	417	518	1393	3566	2899	3383
March	671	570	2125	3729	3766	3802
April	745	640	1912	3098	3531	4108
May	769	575	2502	3261	3487	4092
June	695	496	2469	3145	3487	3904
July	571	545	2777	3623	4509	5038
August	1035	503	3492	4005	4549	4681
September	1013	661	3179	3757	3791	4198
October	1042	723	3356	3008	3399	3719
November	530	735	2595	3602	3289	4435
December	671	1518	3150	3122	2544	3161

Source: Basic health unit of Gangapur

Table 3: Correlations of fecal contamination in water with different variables of health

Variable	S.D.	P.H.W.	S.P.C.	W.Q.	D.F.
Fecal contamination in hand pump	0.185*	…….	……	…….	0.169*
Fecal contamination in motor pump	……	…….	…….	0.169*	…….
Fecal contamination in tube well	……	…….	……	0.168*	0.162*
Drainage facility in last ten years	…….	…….	0.235**	0.425**	…….

S.D. = Spread of disease in last ten years; P.H.W. = Personal health of women in last ten years, S.P.C. = Stomach problems in children; W.Q. = Water quality in last ten years; D.F. = Drainage facility in last ten years

parameters (Table 1) because majority of samples have no taste, turbidity or smell. Women with high education were more concerned about their drinking water quality. Table 4 shows that perception about drinking water quality improved with increase in educational level of women in Gangapur. Women with education level of middle, matriculation and above had ability to perceive smell ($F = 3.51$, $p<0.01$), taste ($F = 3.10$, $p<0.05$) and turbidity in water ($F = 5.34$, $p<0.01$). Those women were inclined to treat water before drinking especially when their children were sick. Poor water quality was affecting the personal health of women. The results showed that majority of people were unaware of contaminated drinking water and route of contamination. Lack of awareness about drinking water quality barred majority of women to take any preventive measure (Anderson *et al*., 2007).

Table 5 shows correlation between different ions in the water. Results revealed that different salts of sodium were present in the water which may have health affects. There was strong correlation of sodium and nitrate with chloride ions. These salts may be present due to fertilizers and other anthropogenic inputs (Li *et al*., 2009). High level of sodium chloride could cause high blood pressure. The data of last ten years (Table 3) shows that poor drainage system in Gangapur was strongly affecting the personal health of women. Stomach problem was the prevalent disease in children and infants. Majority of children were suffering from diarrhea in Gangapur and situation was worse as compare to other rural areas of Faisalabad (MICS, 2007-2008). The reason behind was the poor drainage system, which contaminated the ground water aquifers with fecal coliform at different depths. Ground water of Gangapur was contaminated as in other rural areas of District Faisalabad (MICS, 2007-2008). Water of hand pump and motor pump was unfit for drinking due to fecal contamination and it may cause diarrhea, dysentery and

Table 4: Analysis of variance showing effects of women's education with perception about drinking water quality

Variable	SS	df	MS	F-ratio
Perception of smell in water	0.70	4	0.17	3.51**
Perception of taste in water	0.63	4	0.15	3.10**
Perception of turbidity in water	1.24	4	0.31	5.34**

*p<0.05, **p<0.01, ***p<0.001

Table 5: Correlations between different ions

	Cl in H.P.	Cl in M.P.	Cl in T.W.
Nitrate in hand pump	1.000**		
Nitrate in tube well			0.998**
Sodium in hand pump	1.000**		
Sodium in motor pump		1.000**	
Sodium in tube well			0.998**

H.P. = Hand Pump; M.P. = Motor Pump; T.W. = Tube Well

Table 6: Percentage of sick respondents with different daily wages

	Delays			
Daily wages (Rupees)	15 days	30 days	60 days	120 days
350	64%	18%	10%	3%
500	31%	1%	0%	1%
1500	12%	4%	1%	0%
3000	2%	0%	1%	0%

typhoid. Ground water is usually prone to contamination because of unsafe disposal of municipal waste water (Nath, 2003). According to women there was no change in the drainage system of Gangapur in last ten years. It was worse in past as in present. Therefore, with poor drainage system water quality of Gangapur became poor and had caused contamination in drinking water. According to Pakistan Council of research in water resources, bacterial contamination in drinking water was frequent country wide. Perception of taste, turbidity and smell are not indicator of bacteriological contamination because bacteria are not visible by human eye (Anisha *et al*., 2010; Pradhan *et al.*, 1995). Therefore, majority were at risk of having stomach related problem. Cost analysis revealed that people with lower daily wage were experiencing sickness more frequently as compare to people with better daily wage as shown in the Table 6. The sickness of bread winner will not only affect himself but his whole family (Acemoglu and Pischke, 2001). Inflation rate is getting higher in rural Punjab and all these factors are increasing this rate. Morbidity and mortality of bread winner in a house of rural area is lowering the level of education and increasing the poverty rate at national level (Perez *et al.*, 2004).

Conclusion: Fecal contamination has no apparent indication in drinking water except that it causes stomach problems. Fecal contamination in the samples of hand pump, turbine and tube well exceeded WHO limit. Stomach problems were common, more prevalent among infants but women were unaware of main cause of water contamination and they were not taking any preventive measures to clean their drinking water. Personal health of women in last ten years was affected by poor water quality. Other than fecal contamination, different ions of salts were also present which may cause sickness. Disease occurrence has been rapidly increased during last ten years. Morbidity and sickness was causing loss of daily wages and was immersing poor people more in the vicious cycle of poverty. It is required to shift from an individual household to a community water supply system to avoid the wide spread contamination. Sewage drains should be lined and covered use of untreated waste water for irrigation should be stopped. There is a dare need of a Public awareness campaign to educate the people for adaptation of safety measures for household storage and possible treatment before using the drinking water.

ACKNOWLEDGEMENT

Authors are thankful to Higher Education Commission for providing the funds under the project "Ecosystem Health of the Indus Watershed: Socioeconomic Impacts and Behavioral Responses of Communities to Environmental Degradation in Ravi-Chenab Watershed"

REFERENCES

Acemoglu, D. and J.S. Pischke, 2001. Changes in Wage structure, family income and children's education. Eur. Eco. Rev., 45: 890-904.

Ahmed, N.U., M.F. Zeithin, A.S. Beiser, C.M. Super and S.M. Gershoff, 1993. A longitudinal study of the impact of behavioural change intervention on cleanliness, diarrhoeal morbidity and growth of children in rural Bangladesh. Soc. Sci. Med., 37: 159.

Anadu, E.C. and A.K. Harding, 2000. Risk perception and bottled water use. J. AM. Water Works Assoc. November, 82-92.

Anderson, B.A., J.H. Romani, H. Philips, M. Wentzal and K. Tlabela, 2007. Exploring environmental perception, behaviors and awareness: Water and water pollution in South Africa. Pop. Environ., 28: 133-161.

Anisha, I.L., K. Bogart, A. Uyeda, Rabin and M. Schuster, 2010. Perception about availability and adequacy of Drinking water in a large California School District, Preventing Chronic Diseases. Public Health Res. Practice Policy, 7: 1-10.

Anwar, S.M.S., G. Lateef and M. Siddiqi, 2010. Bacteriological quality of drinking water in Lahore. Biomedia, 26: 66-69.

APHA/AWWA/WEF (American Public Health Association, American Water Works Association, Water Environment Federation), 1995. Standards for the examination of water and waste water, 19th Edn., United Book Press, Baltimore, MD.

Asian Development Bank, 2006. Serving the rural poor: A review of civil society-led initiatives in rural water supply and sanitation. Discussion Paper. Manila.

Barrett, H. and A. Browne, 1996. Health, hygiene and maternal education: Evidence from Gambia. Elsevier Science Ltd. Soc. Sci. Med., 43: 1579-1590.

Cairncross, S. and V. Valdmanis, 2006. Water supply, sanitation and hygiene promotion, in Disease Control Priorities in Developing Countries, 2nd Edn., Editors D.T. Jamison, J.G. Breman, A.R. Measham, G. Alleyne, M. Claeson, D.B. Evans, P. Jha, A. Mills, P. Musgrove. Oxford University Press and The World Bank.

Egoz, N., Shmilovitz, M. Kretzer, B. Lucian, V.M. Porat and R. Raz, 1999. An outbreak of Shigella sonnei infection due to contamination of municipal water supply in northern Israel. J. Infect., 22: 87-93.

Jardine, C.G., N. Gibson and S.E. Hrudey, 1999. Detection of odor and health risk perception of drinking water. Water Sci. Technol., 40: 91-98.

Jones, A.Q., C.E. Dewey, K. Dore, S.E. Majowicz, S.C. Mcewen, T.W. David, M. Eric, D.J. Carr and S.J. Henson, 2006. Public perception of drinking water: Postal survey of residents with private water supplies. BMC Public Health, 6: 94.

Larson, B.A. and E.D. Gnedenko, 1999, Avoiding health risks from drinking water in Moscow: An empirical analysis. Environ. Dev. Econ., 4: 565-581.

Levallois, P., J. Grondin and S. Gingras, 1999. Evaluation of consumer attitudes on taste and tap water alternatives in Quebec. Water Sci. Technol., 40: 135-139.

Li, S., Q. Liue, Y. Lang, Z. Zhao and Z. Zhou, 2009. Tracing sources of nitrate in Karstic groundwater in Zunyi, Southwest China: A combined nitrogen isotope and water chemistry approach. Environ. Earth Sci., 60: 1415-1423.

Macler, A.B. and C.J. Merkel, 2000. Current knowledge on groundwater microbial pathogens and their control. Hydrogeol. J., 8: 29-40.

MICS (Multiple indicator cluster survey), 2007-2008. District Faisalabad. Planning and Development Department. Bureau of Statistic. Government of Punjab.

Nath, K.J., 2003. Home Hygiene and environmental sanitation. Int. J. Environ. Health Res., 13: 19-28.

Perez, M.A., S. Smits, A. Benavides and S. Vargas, 2004. Multiple uses of water, Livelihood and poverty in Colombia: A case study from Ambichinte microcatchment. In: Butterworth, J., van Koopen, B. (Eds), Beyond Domestic: Case Studies on Poverty and Productive Uses of Water at the Household Level IRC Technical Paper Series, 41: 74-93.

Pradhan, B.J., M.P. Sherchand, Shrestha and S. Pradhanang, 1995. Water quality and people's knowledge about water related diseases: The case of Kirtipur locality, Kathmandu. Nepal. J. Inst. Med., 17: 26-31.

PSLM (Pakistan Social and Living Standards Measurement Survey), 2006-07.

WHO (World Health Organization), 1996. Guidelines for drinking water quality, 2nd Edn., Health criteria and other supporting Information, vol. 2. WHO, Geneva, Switzerland.