

Domestic Water and Family Health : A Review on Water Management Behavior

Suchandra Samanta Mandal^{1,2}, Deb Prasad Sikdar¹

¹ Department of Education, University of Kalyani, West Bengal, India

² Krishnanagar B.Ed. College, P.O. Krishnanagar, Nadia, West Bengal, India

ABSTRACT

Domestic water supply is one of the basic needs of human life to sustain. Besides drinking household water is used for various purposes like cooking, bathing, washing clothes, hygienic practices, car washing, lawn watering, small scale horticulture and other similar activities. Minimum volume of water consumption per capita is found to depend on the availability of water in that area. Household water is collected from various sources of surface water and ground water. In India tap, well, hand pump, tube-well and miscellaneous other sources are used as sources of water in rural and urban households. Access to water from a house becomes difficult in dry and arid zones. Often the women folks of the family have to carry the water from several kilometers away. The water may be contaminated with pathogenic microorganisms causing enteric diseases, toxic natural chemicals like fluoride, arsenic and nitrates. Often children are the main victims of the contaminated water. This review delves into the factors behind the health problems arose out of water. Awareness among family members regarding hygienic use of water, government initiatives to provide clean and safe water for human consumption, various purification methods adopted in household and the storage methods are discussed as the remedies to the problems of unsafe water. Finally women are the guardians of water in every household. Their roles in the domestic water management are discussed.

Keywords: Domestic Water, Family Health, Water Management Behavior

I. INTRODUCTION

Time and again civilizations were setup near the sources of water because domestic water supply is one of the fundamental requirements for human life. Without water life cannot sustain beyond a few days and the lack of access to safe water supplies leads to the spread of diseases. Children bear the greatest health burden associated with poor water and sanitation. The suffering of women members of the family comes next. Diarrhoeal diseases accounts for 1.73 millions deaths each year and 3.7% of the global burden of disease (Hung, et. al. 2012). Other diseases are related to poor water quality, sanitation and hygiene, such as Trachoma, Schistosomiasis, Ascariasis, Trichuriasis, hookworm disease, malaria

and Japanese encephalitis and contribute to an additional burden of diseases. The quality of domestic water depends on the source from which it is collected. It may be contaminated with pathogenic microorganisms or toxic chemicals like fluorine, arsenic and nitrate. The technologies to make the water safe for domestic use may prove costly to the poor households and the access to those technologies by the rural mass is difficult.

Irrespective of the quality of the domestic water, the most difficult part of it is the collection of it. As of 2000 it was estimated that one-sixth of humanity (1.1 billion people) lacked access to safe water supply within 1 kilometer of their home (WHO and UNICEF, 2000). Lack of access to safe and adequate

water supplies contributes to ongoing poverty both through the economic costs of poor health and in the high proportion of household expenditure on water supplies in many poor communities, arising from the need to purchase water and/or time and energy expended in its collection. The cost of collection of safe water in terms of collection time and money becomes prohibitive especially for poor families. Hence, “access to water services” forms a key component in the UNDP Human Poverty Index for developing countries (UNDP, 1999).

II. OBJECTIVES

This article is an attempt to trace:

- (i) Basic uses and quantity of water required in domestic condition.
- (ii) Sources and access of water for household consumption.
- (iii) Domestic consequences of health problems related to water.
- (iv) Possible causes behind health problems.
- (v) Methods of overcoming the health problems.
- (vi) Role of women in domestic water management in family health maintenance.

Uses of Water for Domestic Purposes

Water is the main component of our body. For survival we drink water. Once thirst is satiated people use water for other purposes at home. World Health Organization (WHO) defines domestic water as being 'water used for all usual domestic purposes including consumption, bathing and food preparation' (WHO, 1993). As civilization developed, the use of water also ramified. These uses of household water may be classified into four broad categories as per the suggestion of White et.al. (1972) and Thompson et. al. (2001). These are:

- Consumption – it includes drinking and cooking,
- Hygiene – it includes basic needs for personal and domestic cleanliness like bathing, washing clothes, floors, etc.

- Amenity use – for instance car washing, lawn watering, etc.
- Productive use – brewing, animal watering, construction and small-scale horticulture.

Quantity of Water Required for Household Consumption

Water consumption is directly related to the availability of water. If water scarcity is present in an area the water consumption markedly comes down and in water affluent zones, water consumption and wastage are found to be high. As per the Bureau of Indian Standards, IS:1172-1993, minimum water supply of 200 litres per capita per day (lpcd) should be provided for domestic consumption in cities with full flushing systems. IS:1172-1993 also mentions that the amount of water supply may be reduced to 135 lpcd for the Lower Income Group and the economically weaker sections of the society and in small towns (Modi,1998).

Sources of Household Water

According to Census 2011 India the sources of drinking water in India were selected as tap water, well, hand pump, tube well or borehole, spring, river or canal, tank, pond, lake, etc. Figures in MS Excel format collected from 'House listing and Housing Census Data Highlights – 2011' (Office of the Registrar General and Census Commissioner, India., 2011) are categorized and the percentage of each source is calculated against the total households in India. The data is plotted as bar chart and shown in Figure 1.

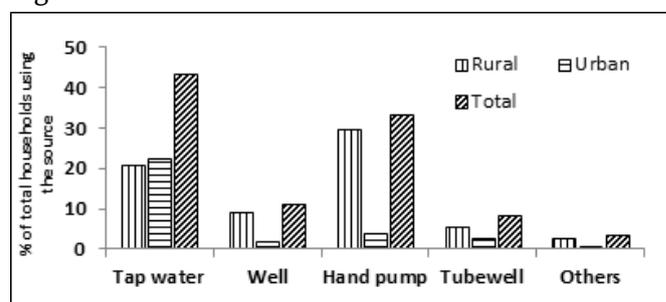


Figure 1. Sources of drinking water in India (Census 2011)

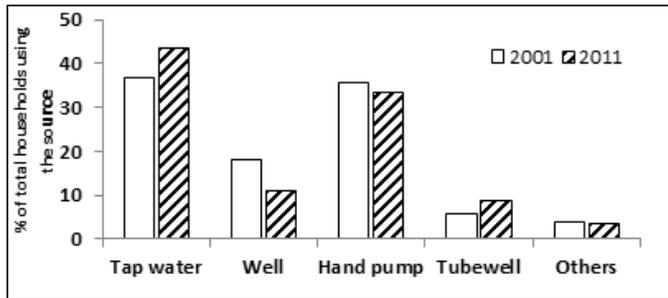


Figure 2. Comparison of sources of drinking water in India from census of 2001 and 2011

It is evident from the census data that the main sources of drinking water are tap water, well, hand pump and tube-well. Rest of the sources is accumulated under 'Others'. Comparison of two subsequent census data of 2001 and 2011, (Figure 2) a rise in tap-water usage (18.6%) and tube well usage was found in expense of well, hand pump and others. This may be due to the fact of growth of urbanization in the last decade.

Access to Water

Although the census data shows the contribution of drinking water sources adopted by Indian households, the accessibility to safe drinking water varies with area and season. In areas like Gujrat, Rajasthan, Delhi, Hyderabad, etc. areas in dry zones during summer season water has to be shipped by water trucks by private vendors. In the summer of 2016 Latur district of Gujrat, water had to be supplied in trains (Chitnis, 2016). In dry areas the women members and children of the poor families have to carry water from far-off places with water pitchers on their heads and buckets in their hands. Ground water table gets depleted in dry areas. Ganges basin has already been contaminated with toxic heavy metal Arsenic. In order to get drinking water free from Arsenic, few deep tube wells are fitted with arsenic filters. People have to collect the arsenic free drinking water from those far-off tube wells.

Health Problems Related to Water

Surface water is often contaminated with pathogenic bacteria like cholera, shigella, typhoid; viruses like hepatitis, and parasites like worms; and protozoa like amoeba, giardia, etc. Drinking, handling, cooking, and

bathing in such water exposes people to a wide range of health risks, including Diarrhea, Hepatitis, Worm infestation, Amoebiasis, Fungal infections, etc. Moreover, the lack of sufficient water of any kind does not allow people to bathe, wash clothes, wash foodstuffs, utensils and floors adequately and thus contributes to the spread of diseases. Bradley in 1977 suggested four different categories of water related health problems although they are not mutually exclusive.

1. **Water-borne** – They are caused through ingestion of pathogens in drinking water, for instance Diarrhoeal diseases, Enteric fevers, such as, Typhoid, Hepatitis A, etc.
2. **Water-washed** – This is caused through incidental ingestion of pathogens in the course of other activities. It may result from having insufficient water for bathing and hygiene. Examples are diarrheal diseases, trachoma, scabies and eye infections.
3. **Water-based** – Here an intermediate invertebrate aquatic host is required to propagate the disease. It often results from repeated physical contact with contaminated water, for instance, guinea worm, schistosomiasis, etc.
4. **Water-related Vector** – These diseases are spread through insect vectors that breeds in or near water. Examples are mosquito carried malaria and dengue fever.

A study conducted in India used nutritional status as a health measure. It suggested that water quality was the principal determinant for health in children under the age of 3, whereas water quantity was most important for children above 3 (Herbert, 1985).

The majority of the health problems is suffered by children in developing countries (Prüss, et al., 2002 and Prüss-Ustün, et al., 2014). However, outbreaks of cryptosporidiosis in Milwaukee (MacKenzie, et. al., 1995) and E. coli and Campylobacter jejuni infection in Ontario (Clark, et al., 2003) illustrate

that the developed world is also exposed to the risk of water-based infection.

Household division of work normally exposes women members to water and water borne diseases. Washing clothes and utensils, cleaning children, working in flooded paddy fields – all increases the risk of the rural women to disease caused by water sources, like skin diseases. Rural women prefer washing the clothes in canal water because it is soft and produces more lather. Thus they are at a risk of getting exposed to schistosomiasis. Their urban counterparts are at lesser risk when their clothes are washed with tap water and/or in washing machine.

Fluorosis and arsenic contamination, the other two menaces, are crippling the Indian subcontinent. In India 17 states are affected by fluorosis out of which the most affected states are Rajasthan, Gujrat and Andhra Pradesh. An estimated 62 million people in India are affected with dental and bone fluorosis. The contamination level in the ground water is found to vary from 1.0 to 48.0 mg/L in those areas (Susheela, 1999).

Arsenic is a heavy metal that body cannot metabolize and excrete through urine easily. It gets accumulated in the body, usually in the keratins present in hair, nail and skin. After prolonged exposure to arsenic in drinking water various clinical symptoms like hyperpigmentation of skin and keratosis occurs. Skin lesions are found first on the palms and the soles of the victims. It enhances the risk of skin, internal organs and lung cancers. Cardiovascular diseases, neuropathy, memory loss are other symptoms are found to be associated with arsenic consumption (Kapaj, et.al., 2006). WHO recommended the permissible limit of arsenic in ground water as 50 microgram per liter. Nine districts of West Bengal and 42 districts of Bangladesh are found to possess the arsenic level well above this limit (Chowdhury, et al., 2000). This water is used by the villagers for drinking, cooking and other household purposes.

Nitrate is another concern, where the scale of health effects due to it is yet to be accounted. However, in few countries it is manifested as methemaglobinaemia (Saywell, 1999) as the notifiable disease. Raised nitrate (Melian, et. al., 1999) is, however, identified as a potential public health problems in countries where concentrations in groundwater reach extremely high values.

Factors Behind the Health Problems

1) Inadequate Supply

In large villages and suburban communities although supply of piped water is present but they are of interrupted type. At certain intervals the water is supplied in a day. In those cases the water is stored in buckets or jars by family members for household purposes. In drought areas water is supplied by water trucks by government or in cans by private vendors. Recently water is shipped from Krishna river by train to the worst hit areas of Maharastra (Rashid and More, 2016).

2) Contamination

Drinking water may be contaminated from various activities of people. Rivers, lakes, streams, tanks may be contaminated from bathing cattle, washing clothes of patients with contagious diseases, washing of pesticides from agricultural fields, etc. Leakage of municipal sewage pipes and/or drinking water supply pipes cause the contamination of drinking water with coliform bacteria and other pathogenic microorganisms. The data from Municipal Corporation of Greater Mumbai (MCGM) shows that 8-10% of the samples taken from consumer taps in 1997 and 1998 were contaminated with coliform bacteria and were unfit for consumption (Shaban, 2008). Faecal coliforms appear to be the main contaminants in the southern states like Madhya Pradesh and Uttar Pradesh (mainly surface water and hand pumps) due to open defecation by the some rural population (Guatam and Biswas, 2009).

3) Unhygienic Domestic Water Management

Hands are often involved in pouring out water from a container, washing utensils or food materials. Thus hands can directly contaminate the stored drinking water, or indirectly through the transfer of fecal material from contaminated nails.

4) Natural Contamination

Fluoride, arsenic and nitrate in ground water when go above the permitted values cause health problems related to the contaminant. Depending on the geological characteristics the ground water of some specific places contains these chemicals in more than permitted limit.

III. THE REMEDIES

5) Awareness of Water Users

The farmers should be made aware that how the ground and river water contamination takes place with over use of pesticides and fertilizers. Both men and women members of families should be educated with water knowledge, sources of contamination and the management of drinking water, improper disposal of sewage and solid wastes, hygienic habits and proper sanitation culture. Recently Government of India has funded a campaign of building toilet in every household in India and aggressively pushing it.

Hands are a common vector for the transmission of fecal-oral diseases (Curtis, et. al., 2000). Hand-washing with soap after defecation, after cleaning children, and before and after food handling can interrupt this diarrheal disease transmission path.

6) Government Initiatives

Government of India has formed Ministry of Drinking Water and Sanitation (MDWS) in 2011 and has given due emphasis on providing safe drinking water and improved sanitation for all in rural India.

Under this Ministry several initiatives are taken. Potable water is being supplied through pipes to rural areas, drinking water and toilet facilities are constructed in all government schools and anganwadis. Removal of fluoride, arsenic and nitrate from water require huge investment which is only possible by government initiatives only. Some half-hearted efforts are seen regarding removal of fluorides and arsenic by government agencies but lack of maintenance of those facilities jeopardizes the supply of safe water. The government agencies should make water-testing facilities easily accessible and low cost so that the populace can get the information of the quality of water they are using and whether the water facilities require maintenance like changing of filter media or adsorbents.

7) Household Water Treatment and Purification

Methods

If the quality of water obtained from a source is not sufficient for drinking then treating it at the point-of-use is the best strategy to execute. Various treatment methods, which are cost effective and technically feasible to maintain in a house, are (i) allowed to stand for sedimentation, (ii) allowed to flocculate in presence of alum, (iii) straining through cloth, (iv) passing through ceramic filter, (v) polymeric filter, (vi) ultra violet disinfection, (vii) reverse osmosis (RO), (viii) boiling and (ix) chemical treatment with combination of flocculating agents (e.g. ferric sulphate, aluminium sulfate) and disinfectants (e.g. sodiumhypochlorite, calcium hypochlorite, sodium dichloroisocyanurate (Jain, 2010).

A study by Karn, et. al. in 2003, some selected slums in Mumbai, Delhi and Kolkata surveyed the water treatment methods adopted by the households. The data may be summarized in Table 1.

Table 1. Water treatment methods followed by the households in the slums of Mumbai, Delhi and Kolkata expressed in % of total households.

Water treatment methods followed	Mumbai	Delhi	Kolkata
Boil water before consumption	12	9	Not reported
Filter through cloth	80	6	Not reported
Do not use any purification method	8	85	78

Filtering through cloth is not a method for removing microorganism. It can only remove larger particles, dirt, etc. In Delhi and Kolkata slums the nearly 80% slum households are not using any purification methods, this may be due to the fact that they are getting better quality municipal water supply through taps.

Chemical treatments are frequently used during flood situations and by militaries in emergency situations. The solid forms of chlorine type disinfectants, for example in the form of tablets, granules or powder, are most popular. To treat turbid water into clear water some flocculating agents are required. Water soluble aluminium salts and ferric salts are usually employed for this purpose. Although chemical treatments are not routinely used.

WHO recommends several household water treatment technologies. ("Household water treatment and safe storage," n.d.) The physical methods, include boiling, heating (with fuel and solar disinfection), settling, filtering, exposing to the UV radiation in sunlight, and UV disinfection with lamps. The chemical methods include coagulation-flocculation and precipitation, adsorption, ion exchange and chemical disinfection with germicidal agents (primarily with chlorine salts). However the uses of all those prescribed methods are not common in developing countries including India. Generally, practices like straining water through a cloth or

letting it stand and settle are not considered appropriate methods for disinfecting water for drinking. In urban market some popular household treatment products are available. They are Ceramic Candle filters, UV-light disinfection methods (Aqua Guard), Reverse Osmosis (Kent RO system), PUREIT (Hindustan Unilever) Water Treatment Systems, etc. Their cost and lack of awareness about these products or their technologies prohibited the wide use among rural mass. Cost of maintenance of these proprietary products is also a stumbling block in low income groups.

8) Household Water Storage

Recontamination of water during collection, storage and use at home is a problem that should be addressed by changing the habit of the members of the family. When drinking water is stored in narrow mouthed containers the risk of contamination is reduced several folds. It avoids any utensil to be dipped into the storage container.

Women as Domestic Water Manager

Women have significant household water management roles. Especially, in areas where safe water and drainage are not available in the house, Women play a major role in collecting, storing, and using water and for disposing of waste water (El-Katsha and Watts, 1992). They decide the source to collect water for various purposes and in various seasons, how much water to collect and how to use it.

Often they choose the water sources by dint of their own reasoning based on the criteria of access, time, effort, water quantity, quality, and reliability. Their informal learning about water and sanitation takes place through interpersonal contacts between themselves. At present, their opinions and needs regarding water management are getting importance. They are actively participating in communal efforts, user agreement and arranging women's group for the maintenance of shared facilities, and decision making of the creation of hygienic water source sites in the village.

Women play a key role in the management of domestic water use and household hygiene. They train hygienic habits to the growing children like hand washing and proper use of toilet. Women spent most of their income on basic family needs, such as fooding, clothing, and payments for domestic water supply and household hygiene.

IV. CONCLUSION

Changes in rainfall patterns accompanied by global climate changes are expected to cause the decline of fresh water resources. With ever growing population, pressure on water is increasing gradually. The problem is going out-of-proportion especially in under-developed and developing countries. Therefore, to ensure future supplies of clean and safe water we need to use it more carefully and judiciously. Initiatives like rain water harvesting, recharging of ground water aquifers should be taken in the government level to ensure adequate supply of clean water. The UN (United Nations General Assembly, 2000) set a Millennium Development Goal to "halve the proportion of people who are unable to reach or to afford safe drinking water by 2015".

Finally community at large can take an active role in protecting the community's drinking water sources by understanding where our drinking water comes from and finding out about its quality, by conserving the amount of water that we use, and learning ways

to prevent our water supply from becoming contaminated. Government may put the water management in school curriculum to sensitize the children and make them responsible water managers.

V. REFERENCES

- [1]. Bradley, D. (1977). Health aspects of water supplies in tropical countries. In R. Feachem, M. McGarry, and D. Mara (Eds.), *Water, wastes and health in hot climates* (pp. 3-17). Chichester, UK: John Wiley and Sons.
- [2]. Chitnis, P. (2016, March 22). Latur water crisis worsens: city suffers more than rural areas. *Business Standard*.
- [3]. Chowdhury, U. K., Biswas, B. K., Chowdhury, T. R., Samanta, G., Mandal, B. K., Basu, G. C., others. (2000). Groundwater arsenic contamination in Bangladesh and West Bengal, India. *Environmental Health Perspectives*, 108(5), 393.
- [4]. Clark, C. G., et.al. (2003). Characterization of waterborne outbreak-associated *Campylobacter jejuni*, Walkerton, Ontario. *Emerging Infectious Diseases*, 9(10), 1232-1241.
- [5]. Curtis, V., Cairncross, S., and Yonli, R. (2000). Review: Domestic hygiene and diarrhoea-pinning the problem. *Tropical Medicine & International Health*, 5(1), 22-32.
- [6]. El-Katsha, S., and Watts, S. (1992). A Multifaceted Approach to Health Education: A Case Study from Rural Egypt. *International Quarterly of Community Health Education*, 13(2), 139-149.
- [7]. Guatam, A., and Biswas, A. (2009). *Community-based Water Quality management in India: Issues and Challenges*. New Delhi: WaterAid India.
- [8]. Hebert, J. R. (1985). Effects of components of sanitation on nutritional status: findings from South Indian settlements. *International Journal of Epidemiology*, 14(1), 143-152.
- [9]. Household water treatment and safe storage. (n.d.). World Health Organization. Retrieved from http://www.who.int/household_water

- /research /technologies_intro /en/ accessed on 07/05/2016
- [10]. Hung, Yung-Tse, Lawrence K. Wang, and Nazih K. Shammass. 2012. Handbook of Environment and Waste Management: Air and Water Pollution Control. World Scientific.
- [11]. Jain, M. (2010). Status of Household Water Treatment and Safe Storage in 45 Countries and a Case Study in Northern India. Massachusetts Institute of Technology, Cambridge, Massachusetts, United States.
- [12]. Kapaj, S., Peterson, H., Liber, K., and Bhattacharya, P. (2006). Human Health Effects From Chronic Arsenic Poisoning-A Review. *Journal of Environmental Science and Health, Part A*, 41(10), 2399-2428.
- [13]. Karn, S., Harada, H., and Shikura, S. (2003, August 23). Living Environment and Health of Urban Poor: A Study in Mumbai. *Economic and Political Weekly*, 3575-3586.
- [14]. MacKenzie, W. R., Kazmierczak, J. J., and Davis, J. P. (1995). An outbreak of cryptosporidiosis associated with a resort swimming pool. *Epidemiology and Infection*, 115(03), 545-553.
- [15]. Melian, R., Myrlian, N., Gouriev, A., Moraru, C., and Radstake, F. (1999). Groundwater quality and rural drinking-water supplies in the Republic of Moldova. *Hydrogeology Journal*, 7(2), 188-196.
- [16]. Modi, P. N. (1998). *Water supply engineering*. Standard Book House, Delhi.
- [17]. Office of the Registrar General and Census Commissioner, India. (2011). *Houselisting and Housing Census Data Highlights - 2011*. Retrieved from http://censusindia.gov.in/2011census/hlo/hlo_highlights.html
- [18]. Prüss-Ustün, A., Bartram, J., Clasen, T., Colford, J. M., Cumming, O., Curtis, V., Cairncross, S. (2014). Burden of disease from inadequate water, sanitation and hygiene in low- and middle-income settings: a retrospective analysis of data from 145 countries. *Tropical Medicine and International Health*, 19(8), 894-905.
- [19]. Rashid, A., and More, M. (2016, April 17). How India's longest water train is coming to Latur. *The Indian Express*. Retrieved from <http://indianexpress.com/article/india/india-news-india/how-indias-longest-water-train-is-coming-to-latur-2756820/>
- [20]. Saywell, D. (1999). Pollution from on-site sanitation-the risks? What risks? *Waterlines*, 17(4), 22-23.
- [21]. Shaban, A. (2008). *Water Poverty in Urban India: A Study of Major Cities*. Jamia Millia Islamia, New Delhi. Retrieved from http://jmi.ac.in/upload/publication/Water_Pove_rty_in_urban_India.pdf
- [22]. Susheela, A. K. (1999). Fluorosis management programme in India. *Current Science Bangalore*, 77, 1250-1256.
- [23]. Thompson, J., Porras, I., Tumwine, J., Mujwahuzi, M., Katui-Katua, M., Johnstone, N., and Wood, L. (2001). *Drawers of Water II: 30 years of change in domestic water use and environmental health in east Africa*. Summary (Vol. 3). London, UK: IIED.
- [24]. UNDP. (1999). *Human Development Report 1999*. New York, USA: Oxford University Press.
- [25]. United Nations General Assembly. (2000). *Resolution 55/2: Millennium Declaration*. New York: United Nations.
- [26]. White, G. F., Bradley, D. J., White, A. U., and Ahmed, T. (1972). *Drawers of water*. University of Chicago Press Chicago.
- [27]. WHO 1993, *Guidelines for drinking-water quality: Volume 1 Recommendations*. (1993) (2nd ed.). Geneva, Switzerland: WHO.
- [28]. WHO, and UNICEF. (2000). *Global water supply and sanitation assessment 2000 report*. Geneva: World Health Organization.