Online Journal of Health and Allied Sciences
Peer Reviewed, Open Access, Free Online Journal
Published Quarterly : Mangalore, South India : ISSN 0972-5997
Volume 10, Issue 2; April-June 2011

Original Article:

Drinking Water Quality Deterioration in Households of Students with High Illness Absenteeism

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Citation: Tambekar DH, Shirsat SD, Bhadange DG. Drinking Water Quality Deterioration in Households of Students with High Illness Absenteeism. *Online J Health Allied Scs.* 2011;10(2):4
URL: http://www.ojhas.org/issue38/2011-2-4.htm
Open Access Archives: http://cogprints.org/view/subjects/OJHAS.html and http://openmed.nic.in/view/subjects/ojhas.html

Submitted: Jun 24, 2011; Accepted: Jul 16, 2011; Published: Jul 30, 2011

Abstract: Objective: School and household lacked safe drinking water and thus school absenteeism rates were high among students with poor water quality. So we assessed fecal contamination of drinking water in households of students with high illness absenteeism and evaluate the factors for non-potability. **Method:** Drinking water samples (100) were collected from household water container of 50 students for fecal contamination. **Results:** A total of 40 (80%) family's water was potable before use, out of which 40% became non-potable after use. Factors responsible for reduction in potability were water withdrawal without handwashing up to (56%), poor domestic hygiene (56%), dipping hands in water (55%), placing water dipper on lid (52%) and no washing of container (0%). Socio-economic condition also had impact on water potability. **Conclusion:** Water quality deterioration occurs by multiple factors like improper storage, unhygienic habits of water handling and circumstances. Results focused on the need for further protocols for safe and hygienic storage of water.

Key Words: Household water quality; fecal contamination; Storage-handling; Hygiene; Illness absenteeism

Introduction:

The burden of diarrhoeal diseases remains high in the developing world due to poor sanitation, inadequate personal, and domestic, household and community hygiene which are responsible for most waterborne infections.(1) Most, diarrhoeal infections are transmitted through the faeco-oral route, and over 70% of all diarrhoeal cases can be attributed to contaminated food and water.(2) That results in 2.5 million childhood deaths yearly.(3) Usually pollution in drinking water is man made and due to improper handling, storage and serving practices which leads to the serious water borne diseases.(4) The number of different types of pathogens that can be present in water as a result of pollution with human or animal faeces is very large and it is not possible to test water samples for each specific pathogen. The coliform group has been extensively used as an indicator of water pollution and public protection concept.(5) Even, a better water source does not lead to full health benefits in the absence of improved water storage and sanitation. (6) Clearly, point-of-use water quality is a critical public health indicator.(7) School-aged children (5-13 years) often remain absent because of the common infectious diseases. Absenteeism as a result of illness from transmissible infections is a major problem in educational institutions which may interfere with class absenteeism and affect academic performance.(8) Undoubtedly, adequate personal and domestic hygiene practices are essential in reducing the risks of water quality deterioration and thus illness rate in school children. An improved hygiene-education programme appears to need to change deep-rooted inherent behaviors such as hand washing prior to water handling, as well as proper protection of container-stored water from personal, domestic and environmental contamination. In this project we determine the extent of and risk factors for fecal contamination in drinking water, by examined drinking water quality during the cascade from storage to consumption in households of students with high illness absenteeism.

Materials and Methods:

Criteria for inclusion: The study was conducted during the session of 2010-2011 among houses of students from three primary schools of different places talukas viz Chandur Rly, Dhamangaon Rly and Bhatkuli of Amravati district, Maharashtra.

Selection of schools: For the study, primary schools (below 12 years) were selected based on baseline survey of student's previous year data with high rate of illness absenteeism among all elementary schools in the particular talukas with prior permission of District education officer.

Selection of students: From these schools, 50 students were selected based upon the absenteeism mainly due to gastrointestinal illness based on detailed discussion with their teacher and parents about health, illness episodes and behavioral habits of students.

Collection and processing of water samples: On the selection of targeted students, a total of 100 drinking water samples before use (unused water) and after use (residual/remnant water in container) were collected from households of 50 students (two samples from each family) from water storage container/vessel of the house for presence of fecal contamination or thermo-tolerant Coliforms (TTC) by Eijkman test and processed within 6 hours. Both before use and after use samples were inoculated in selective Brilliant Green Bile Lactose Broth (BGLB) as presumptive medium and tryptone broth and were incubated at 37^0C and 45.5^oC for 24-48 hours. If growth (cloudiness) and gas occurred in BGLB with production of Indol (detected by

Kovacs reagent) confirmed the presence of thermo-tolerant coliforms in drinking water.

Family Background of students: The detailed information of the family background of the students, hygienic conditions, and method of collection, storage and practices were recorded by questioning the parents and household members. The socio-economical condition, education of the parents, number of children etc were also been recorded and correlate these information in water hygiene practices and behaviors of the household members.

Statistical methods: To find out the probable cause of the non-potability or contamination in drinking water, a 125 questionnaire were filled, along with information on the respondent's personal and domestic hygiene practices, water handling, storage container characteristics, usage, socio-economical status and related data from respective house. The collected data was statistically analyzed by using SPSS software (SPSS version 15.0 for window) in relation to potability of drinking water of households of students.

Results and Discussion:

A total of 50 primary school students (with high absenteeism rate) were selected from three different places/schools viz 15 from school of Bhatkuli, 17 from Chandur Rly and 18 from Dhamangaon Rly of Amravati district. Two drinking water samples (Before use and after use) from each households of student i.e. a total of 100 water samples were collected and analyzed for potability.

To find out the probable cause of the non-potability in drinking water, this survey was conducted and quality of household drinking water (before and after use) were analysed for TTC contamination. Out of 50 water samples collected before use 40 (80%) were potable and 10 (20%) non-potable. Total of 10 families had non-potable water before use and these families water were not further discussed. Out of 40 households water, 16 (40%) became non-potable after use due to improper storage and handling practices were studied further for water quality between source and point-of-use. Furthermore, the deterioration in water quality between source and point-of-use has been shown to be proportionately greater than source water.(9) The quality of residual drinking water (potability after use) was correlated with family background, personal and domestic hygiene and water hygiene behavior of family members.

Domestic hygiene of houses affects the drinking water quality, and showed that good domestic hygiene kept water 62% potable, moderate up to 60% and poor hygiene reduces the potability up to 56%. The results confirms the findings that maintaining overall good domestic hygiene leads to high potability of water whereas low hygienic conditions in the houses leads to poor quality of water.(10,11)

Our data strongly suggested that the major sources of contamination were resulted from poor water storage and unhygienic practices in the home. Hygiene of water container was the important aspect; the good hygiene of container maintains (62%) water samples potable, the moderate (63%) and the poor (50%) (Fig.1).

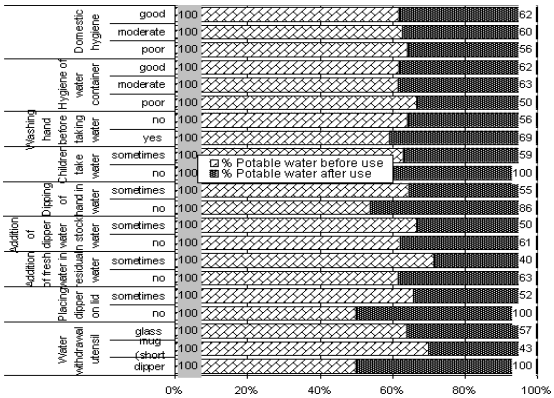

Fig. 1: Effect of domestic hygiene, container hygiene, hand washing, hand dipping, adding unused water from dipper, adding fresh water to residual water, placing dipper on lid and type of water withdrawal utensil on quality of drinking water.

The unhygienic habits of most of the people lead to the various infections through contaminated hands and fingernails. (12) Those family members washed their hands before water withdrawal maintained water potability 69% whereas those didn't washed hands reduced it to 56% (Fig.1). Hence it proves that hand washing before drinking of water is the most effective and least expensive major to prevent transmission of infection.(13)

Dirty hands of children caused contamination in drinking water when they put their hands or utensils into the household water container. Those students/ children are not allowed to take water by themselves leads 100% potability even after use whereas children take water by their own hands reduces the portability to 59% after use (Fig.1). These findings are consistence with those obtained by Jensen *et al*., 2004 who stated that children take water themselves after playing without handwashing or with dirty hands, enhance the chances of water contaminations. (14)

Those students/ children withdrawn drinking water by dipping their hands contaminates the water and reduces its potability to 55% whereas those collecting water without dipping hands retains 100% potability (Fig.1) which proves that dirty hands and household utensils appeared to contribute to point-of-use contamination, highlighting the need for improved personal and domestic hygiene practices.(15) The dirty hands carry the bacterial pathogens and cause most of the serious intestinal infections.(12)

Tambekar *et al*., 2008 showed that practicing additions of fresh water in residual water or unused water from dipper to storage container enhance the chances of contamination (10) which was consistence with our finding resulted in reduction in water potability (40%) whereas when families didn't add fresh water in remnant water in container maintained potability of water to 63%. When water was added from water dipper (Jar water) to container, potability of water reduced to 50% after use. Keeping the water dipper (jar) on lid of water storage container lead to 52% water potability whereas the families, who never placed water dipper on lid had 100% water potability after use (Fig.1).

Use of long handle dipper for withdrawal of water prevents chances of contamination during storage and kept the water 100% potable whereas it reduced when glass (57%) or mug (43%) were used for water withdrawal (Fig.1). These findings are consistence with the results of other authors.(10,16) Hence people should use dipper with long handle and avoid the use of glass or mug for withdrawal of water to prevent the transmission of contamination in the stored water.

Nearby accumulation of residual of spilled water enhances the chances of contamination in drinking water. Container kept in-

side the house on stand or on height reduces the potability to 72% whereas it was up to 57%, 50%, 40%, 0% when containers were placed inside the house without stand, outside without stand, outside on stand and on kitchen (owta) platform respectively (Fig. 2). Frequent or daily washing of storage container increased the potability whereas no washing or occasional washing reduced the potability. (10) The types of storage water container affect the keeping quality of household drinking water (17) and it was found that plastic container reduces the potability to 0% whereas it was 61% and 62% in earthenware or steel container respectively (Fig. 2).

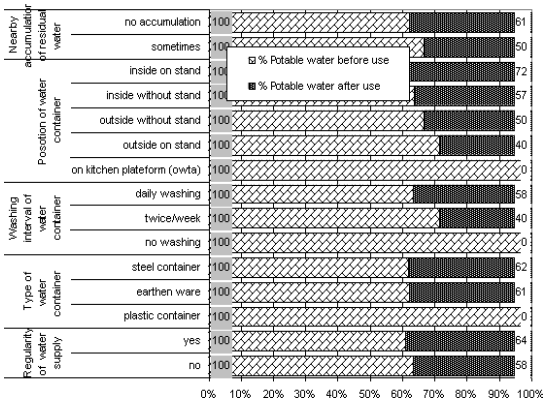

Fig. 2: Effect of nearby residual water accumulation, position of container, washing interval of container, type of container and regularity of water supply on quality of drinking water.

Longer storage time leads to less potability as compare to regular (64 % potability) or intermitted (58%) water supply, thus indicating longer storage time implies more chances for contamination.(15)

Socioeconomic condition has prominent effect on overall hygienic condition of family and quality of food and drinking water.(18,19) In our study, socioeconomic condition of family's kept or maintains good quality water whereas it reduced to 67-33% low to very low economic group indicating socio-economical status of families of students were inversely proportional to quality of drinking water as well as over al hygiene of family (Fig. 3).

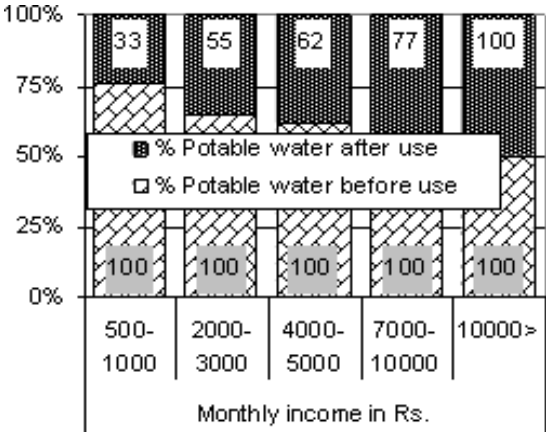

Fig. 3: Effect of socio-economical status of students family on drinking water quality.

Conclusion:

The study concluded that small families, keeping the water container at height, use of dipper with long handle for water withdrawal, no addition of fresh/used water in residual water, hand washing before taking water, avoiding dipping of hands in water, daily washing of storage container, proper domestic hygiene and personal hygiene maintains potability of drinking water. Hence using these practices improves the drinking water quality as well as the health of the user or family members and decreases the absenteeism in the school which indirectly enhances social and health status of the students and the family members.

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