Preservation and Handling Practices of Household Drinking Water in Ahmedabad city with special reference to Bacterial Contamination and Diarrheal Episode in Children: A Cross Sectional Study

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ABSTRACT

Background: Safe drinking water is essential for healthy human life. Presence of coliform organism, E. coli in particular, has been found to be the most specific bacteriological indicator of faecal contamination. Studying their preservation and handling practices of household drinking water, its contamination and diarrheal episodes in children is very necessary for hygiene promotion intervention. **Methods:** This cross-sectional study was conducted at urban field practice area of community medicine department B.J.M.C, Ahmedabad in year 2020-2021. Total 168 Drinking water samples were collected from each household and tested at microbiology department. Information regarding household characteristics, preservation and handling practices of drinking water were gathered from mother using pre-tested and pre-designed proforma. Data were entered in Microsoft excel and analysed using Epi-info Software. **Result:** Out of 168 households studied, 165(98.2%) households used matka / earthen pot and 161(95.8%) used narrow necked covered container to preserve drinking water. Only in 10 (5.8%) households' water was filtered with folded cotton cloth at the time of collection. 101 (60%) water containers did have tap while 67 (39.8%) didn't have it. 4/168 (2.3%) samples were bacteriologically not acceptable for drinking purpose. **Conclusion:** Narrow necked coveredmatka (earthen pot) was the most commonly used container to preserve drinking water. Though prevalence of bacterial contamination and ADD episodes in under five child were low due to pre-treated piped water supply, diarrhoeal morbidity is more in household where broad necked, non tapped containers used. Education of mother has positive impact on preservation and handling practices of drinking water.

Keywords: Preservation, Handling, Drinking water, Coliform, Diarrheal episode, Under 5 children

INTRODUCTION

Safe drinking water is essential for healthy human life. It is defined by World Health Organization (W.H.O.) as that water having acceptable quality in terms of its physical, chemical and bacteriological parameters.[1]

Bacterial contamination of drinking water due to human and animal faecal material remains a persistent serious problem in developing countries including India. Faecal coliform in drinking water is an indicator of such contamination. Its presence, E. coli in particular, has been found to be the most specific bacteriological indicator of faecal contamination.[2]In urban areas and metro cities, large scale drinking water purification is done by municipality. Water is then distributed to households by a well-established network of pipelines followed by routine surveillance and monitoring conducted at various levels as per the guideline.[3]

All efforts to make drinking water safe are futile if the water is improperly preserved or handled at household level. For example, narrow necked storage containers prevent contamination but are difficult to

clean. Wide necked containers, on other hand, are easily contaminated but easily cleaned. Even filtering / sieving water with clean cotton cloth while collecting from tap is also an important step to enhance the contact of disinfecting agent with water for treatment.[4]

Globally, 5,25,000 children in under five age die due to diarrhea per year, a second leading cause of death in this group which can be prevented through safe drinking water, adequate sanitation and hygiene.[5]In low income countries, children below three years' experience at least three episodes of diarrhea yearly.[6]Even though deaths in under five age group has declined in India, diarrhoea is responsible for 13% deaths each year with higher burden of diarrheal morbidity and its relation to malnutrition..[7]Among the factors related to higher prevalence of diarrhoea in children are poor water and sanitation, poor hand hygiene, faulty preservation practices and lack of education of mother.[8,9]

In most community, drinking water is collected, preserved and handled by females, mother of child in particular. The objectives of this study were: 1) to examine preservation and handling practices of household drinking water, 2) to assess bacteriological contamination of drinking water at point of use and 3) to calculate one year prevalence of acute diarrhoeal disease in under five children.

MATERIALS AND METHODS

This cross-sectional study was conducted at urban field practice area (Asarwa urban health centre) of community medicine department B.J. Medical college, Ahmedabad in year 2020-2021. The approval of the institutional ethical committee and local health authority was obtained prior to study. There were approximately 15,000 households with 73,000 population in Asarwa Urban Health Centre (UHC). Households in this UHC are distributed among 16 Accredited Social Health Worker (ASHA workers) to cater the health need of people, approximately 1000 household for each ASHA. Households with under five children were listed from each ASHA worker's area. Based on this information 168 household,10–11 from each ASHA worker area, were randomly selected for study purpose. The respondents were mother of the children in selected household. After taking informed consent and explaining the purpose of study, drinking water sample (200 ml) was collected from storage container (earthen pot etc) at each household in sterilized container using standard water collection techniques. Samples were then sent to microbiological laboratory of attached medical college within two hours. Multiple tube test was performed on each sample to detect coliform organisms by Most Probable Number (MPN) method.[10–12]Water samples with coliform more than 1cfu /100 ml were considered non acceptable for drinking purpose.[10]Local health authority was informed about non acceptability of water sample for necessary action.

The household characteristics and preservation practices of drinking water were gathered from mother of child in household using pre-tested and pre-designed proforma. Mothers were asked recall about episodes of Acute Diarrhoeal Disease (ADD) in last one year. They were educated about safety of drinking water and diarrhoeal disease in children. Acute diarrheal disease in children was defined as passage of three or more loose watery motions, as reported by mother.[5]Data thus collected were entered in Microsoft excel and analysed using Epi-info Software. Frequency and percentage were calculated for continuous data. Chai square test was used as test of significant for categorical data. P value < 0.05 was considered significant.

- **Inclusion criteria**
  Children under the age of 5 years residing in the selected study area (Field practice area of B.J Medical college, Ahmedabad.)
- **Exclusion criteria**
  Non-consenting caregivers were excluded from the study.

RESULTS

Table-1shows that out of 168 households, 139 (82.73%) were located in slums and 29(17.26%) were in non-slum area. There were 133 (79.16%) kutcha or kutcha pakka houses and 35 (20.83%) pakka houses. 4 (2.38%) houses didn't have separate latrine facility while 3 (1.78%) houses didn't have separate drinking water source.

Table 1: Characteristics of households in present study

	Household characteristics	**Frequency (N=168)**	**Percentage (%)**
1	Location of household		
	Slums	139	82.73
	Non slums	29	17.26
2	Type of Household		
	Kutcha/ SemiPucca	133	79.16
	Pucca	35	20.83
3	Separate latrine facility		
	Yes	164	97.61
	No	4	2.38
4	Separate drinking water facility		
	Yes	165	98.21
	No	3	1.78

Table 2: Preservation and handling practices of drinking water, its acceptability and episode of acute diarrheal disease (ADD) in under five children at study households *

	Preservation and handling practices of drinking water	**Households (N = 168)**	**Water samples not acceptable (N=4)**	**Episode of ADD in U5 children (N=7)**
1	Location of household			
	Slum	139 (82.73)	4 (2.87)	7 (5.03)
	Non Slum	29 (17.26)	0 (0.00)	0 (0.00)
2	Type of drinking water storage container			
	Matka (earthen pot)	165 (98.2)	4 (2.42)	7 (4.24)
	Other than matka	3 (1.6)	0 (0.00)	0 (0.00)
3	Is drinking water container narrow necked and covered ?			
	Yes	161 (95.8)	3 (1.86)	6 (3.72)
	No	7 (4.1)	1 (14.3)	1(14.28)
4	Frequency of washing cum filling of water storage container			
	Every morning	164 (97.6)	4 (2.44)	7 (4.26)
	As per need	4 (2.2)	0 (0.00)	0 (0.00)
5	Precaution while filling drinking water			
	Filtration with folded cotton	10 (5.8)	0 (0.00)	0 (0.00)
	Filtration with plastic sieve	158 (94)	4 (2.53)	7 (4.43)
6	Does drinking water storage container has “tap”?			
	Yes	101 (60.1)	2 (1.98)	1 (0.99)
	No	67 (39.8)	2 (2.98)	6 (8.95)
7	If no “tap”, method of taking water from container? (n=67)			
	Doya	21 (13.09)	1 (4.76)	1(4.76)
	Glass / Lota / Others	46 (86.91)	3 (6.52)	6 (13.04)
8	Have a habit of washing hand with soap while taking drinking water from container			
	No	132 (78.57)	1 (0.75)	6 (4.54)
	Yes	36 (21.42)	3 (8.3)	1(2.77)
9	Literacy of Mother			
	Illiterate / Primary	62 (36.90)	4 (6.45)	7 (11.29)
	Secondary / Higher	106 (63.09)	0 (0.00)	0 (0.00)

*Figure in the parenthesis indicates percentage.

Table - 2 shows that matka (earthen pot) was used to preserve drinking water in 165 (98.2%) households. In 161 (95.8%) households narrow necked covered container was used to preserve water. Only in 10

(5.8%) households water was filtered with folded cotton cloth at the time of collection. 101 (60%) water containers did have tap while 67 (39.8%) didn't have it. Doya / ladle was used at only 21 (13.09%) households among 67 households where tap was not available in water container. 36 (21.42%) mothers reported hand washing with soap and water whiling taking drinking water from container.

Out of 168 drinking water samples collected, only 4 (2.38%) were not-acceptable bacterioloically. The positivity was 1.8% (3/161) in narrow necked covered container as compared to 14.3%(1/7) in broad necked container. Contamination was not reported in 10 households were water filtered with folded cotton. Positivity was 1.98% (2/101) when water was preserved with a container having tap while it was 2.98% (2/67) in non-tap containers. Out of 67 containers without tap, positivity was 4.7% (1/21) in households using doya for taking water from container as compared to 6.5% (3/46) where it didn't.
There were 7 episodes of Acute Diarrhoeal Diseases (ADD) reported in last one year among 217 under five children from 168 households with a prevalence of 3.2%. All 7 episodes reported in slum households where mothers were illiterate or educated up to primary school. ADD episodes were more reported at households using broad necked (14.28% vs 3.72) and without tap (8.95 % vs 0.99 %) containers. Among households that didn't have taped container, more ADD episodes were reported when doya (ladle) was not used to take water from container (13.04% vs 4.76%) than otherwise.

Table-3: Preservation and handling practices of drinking water and education of mother in study households.

	Preservation and handling of drinking water at household	**Illiterate / Primary (n = 62)**	**Secondary / above (n = 106)**
1	Does drinking water storage container has "tap"? *		
	Yes	22 (35.48%)	66(62.26%)
	No	40 (64.51%)	40(37.73%)
2	Method of taking water from container *		
	Doya	2(3.22%)	17 (16.03%)
	Glass / Lota / Others	60(96.77%)	89 (83.96%)
3	Habit of hand washing while taking drinking water from container		
	No hand wash	12(19.35%)	15 (14.15%)
	With soap and water	50(80.64%)	91 (85.84%)

* p value < 0.05

Table – 3 shows that households where mother educated secondary / above were using more tapped containers (62.26% vs 35. 48%) and doya (16.03% vs 3.22%) than those who were illiterate / primary educated. These differences were statistically significant. Though more secondary / above educated mother (85.84%) were using soap and water to wash their hand while taking drinking water from container as compared to illiterate / primary educated mother (80.64 %), the difference was not significant statistically.

DISCUSSION

Proper preservation and handling of drinking water is a proven intervention to improve drinking-water quality and reduce diarrhoeal disease. This study was conducted at Asarwa urban field practice area of community medicine department, B.J. Medical College, Ahmedabad with the objective to examine preservation and handling practices of drinking water, its association with bacterial contamination and under five diarrhoeal morbidity.
According to NFHS-5, in India, 96% households used improved water facility and 69% used improved sanitation facility which is not shared with other households.[13]Availability of safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection.[14]In present study,98.2% and 97.61% urban households did have facility for separate piped drinking water and separate latrine respectively.
In our study 98.2% households used matka (earthen pot) to preserve drinking water. 95.8% households used narrow necked covered container to preserve drinking water. Yohanis A.A. [15] et al reported 89 % plastic container, Kuberan et al reported 75% wide mouth closed container.[16] and Robert E.Q. et al reported 48 % households used narrow necked containers in for preservation of drinking water.[17]Narrow

necked covered container reduces the chances of contamination of drinking water at source. The difference in these studies may be due to location and socio-economic condition of particular community.
Filtration of drinking water with folded cotton cloth at the time of collection helps to remove dirt, insect larvae and other suspended solids. It also improves effect of available chlorine as disinfectant. This practice was seen only in 10 (5.8%) households in our study. This could be due to their knowledge that treated piped water supply from municipality is safe.[8]
In present study only 60% water containers had tap while doya / ladle was used at only 13.09% households from among 67 households where tap was not available in water container. Use of tap in drinking water container makes it safe as it reduces or eliminates chances of contact of water and unsafe hands while taking water from container. A study by N. Luvhimbi et al reported 91% households using cups to take water from container.[18]The risk of contamination increases when doya is not used or cups without handles are used. In such a situation there is higher chance that the water collector would touch the water in the container with his/her fingers. The Centers for Disease Control and Prevention (CDC) recommends that containers for drinking water should be fitted with a small opening (tap) with a cover or a spigot, through which water can be collected while the container remains closed, without dipping any potentially contaminated object into the container.[19]
In present study only 2.38% samples were positive for coliform organisms and were not acceptable bacterioloically. As it is a pre-treated piped water, the use of chlorine as disinfectant could probably have killed pathogens and made water safe for use as reported by Hasmi I et al also.[20]Though it was not an objective to identify source of contamination in this study, detection of coliform bacteria suggests that the water is contaminated at source, in the distribution networks or at the point of use.[21,22,23]
The positivity or contamination were more found in broad than narrow necked containers (14.3% vs 1.8%) and non-taped than taped containers (2.98% vs 1.98%).Positivity was 4.7% in households using doya to take water from container as compared to 6.5% where it didn't.This finding is consistent with earlier studies suggesting that pre-treated piped water supply, appropriate water vessel design and water handling can protect the microbiologic quality of stored water.[17,24]
In present study the annual prevalence of Acute Diarrhoeal Diseases (ADD) was 3.2% in under five children. NFHS-5 reported it as 7.3% in India and 5.7% urban Gujarat[13] The low incident may be due to pre- treated water supply. Incidentally all ADD episodes reported in slum households where mothers were illiterate / primarily educated highlighting the role of housing criteria and literacy of mother in ADD. The episodes of ADD were more reported at households using broad necked (14.28% vs 3.72), without tap (8.95 % vs 0.99 %) containers and those households where doya (ladle) was not used to take water from container (13.04% vs 4.76%). This has been discussed earlier.
This study shows that mother educated up to secondary schooling or above as compared to those who were illiterate or educated up to primary schooling used more taped drinking water containers (62.26% vs 35. 48%) and have habit of using doya / ladle to collect water from container (16.03% vs 3.22%). It clearly highlights the role of education of mother in changing and sustaining behaviour related to storage and handling of drinking water. It is also to note that mothers may not have sufficient decision-making power within their households. It is reported by Nath K J that higher the education in community, more it likely to respond to promotion of water treatment and safe storage.[25]
Limitations: As this study was done as part of development of post graduate research laboratory in community medicine department, source of contamination, seasonal variations in level of contamination and episodes of ADD in under five children were not targeted.

CONCLUSION

Narrow necked covered matka (earthen pot) was the most commonly used container to preserve drinking water. Only 60% containers did have tap. From remaining 40% containers otherwise only, 13% households used doya. Only 4.7% households used folded cotton cloth to collect water at domestic level. Three forth households didn't use soap to wash hand while taking drinking water from container. Though prevalence of bacterial contamination and ADD episodes in under five child were low due to pre-treated piped water supply, diarrhoeal morbidity is more in household where broad necked, non tapped containers used. Education of mother has positive impact on preservation and handling practices of drinking water. There is a need to have hygiene promotion intervention regarding preservation and handling of drinking water.

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