European Journal of Molecular & Clinical Medicine (EJMCM)
ISSN: 2515-8260 Volume 07, Issue 11, 2020

Original research article

A prospective cross sectional study to determine the importance of safe drinking water and proper sanitation practices in rural area of Gaya district, Bihar

Dr. Birendra Kumar Rajak[1], Dr. Preeti kumari[2], Dr. Sunil Kumar[3], Dr. Ravi Bhushan Raman[4]

[1]Assistant Professor, Department of Community Medicine, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.

[2]Tutor, Department of Community Medicine, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.

[3]Assistant Professor, Department of Community Medicine, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.

[4]Assistant Professor, Department of Hematology, Indira, Gandhi Institute of Medical sciences, Patna, Bihar, India

Corresponding Author: Dr. Birendra Kumar Rajak

Abstract

Aim and objective: The aim of the present study was to assess of knowledge and practices regarding drinking water and sanitation among rural area of Gaya district bihar . **Material and methods:** This community based cross sectional study was done in the Department of Community Medicine, Anugrah Narayan Magadh Medical college, Gaya, Bihar, India from October 2019 to August 2020. The sample size of the study was finalized to 100 houses Structured questionnaires were prepared, which include the basic sociodemographic profile, knowledge and practice questions regarding drinking water and sanitation of households in the rural communities of the study area. The questionnaire was pre-tested in few selected household. Interview was conducted face to face and study subjects were enrolled till the required sample size was met. Information was collected by interviewing the available adult family member at the time of visit, and also, by physical examination of facilities. **Results:** Out of 100, 24(24%) of them were illiterate, out of whom 56 (56%) of families belonged to middle class and 20(20%) of families belonged to the upper socioeconomic class. Most of households had knowledge about the importance of covered drinking water 94(94%) followed by clean drinking water 85 (85%), cleaning of river/pond water 68(68%), covered garbage dustbin 61(61%), sanitary toilet 83(83%) and hand wash after toilet 93(93%). A total of 100 households were visited for the study purpose. Most of the respondents were adult females 55(55%) and belonged to 20-40 years age group 52 (52%). The most common occupation of head of household was skilled 40(40%) followed by unskilled 28 (28%). We found that the access to water facility was 100% as all the houses derived water from sources. Drinking water was found 91(91%) and majority households 82(82%) collected water for drinking purpose from pipeline followed by remaining others 18(18%). They were travelling for fetching drinking water 108 (52%) outside of premises followed by 48(48%) within premises. It was seen that majority 42(42%) households used boiling method for purification of drinking water followed by 37 (37%) of them treat drinking water by other methods and 21(21%) households did not use any treatment for purification of water. Average 53(53%) households had uncovered garbage dustbin, garbage found openly in premises 57(57%) and households were had a toilet facility within premises 59(59%), households without toilet

facility who used open air defecation 31(31%), households did not use footwear for toilet 23(23%), households washed their hands after toilet with soap 63(63%) and remaining by others like as Ash, Mud, Plain Water 37(37%). Knowledge of clean drinking water was significantly related with practice of covered water 81(81%), distance of source 41(41%). Similarly, knowledge regarding covered drinking water 89(89%) was significantly associated with practice of cleaning and disinfectant for drinking water. Knowledge of covered garbage dustbin was significantly associated with practice of covered garbage dustbin 39(39%) and garbage found openly in premises 33 (33%). Likewise knowledge of sanitary toilet was significantly associated with practice of toilet within premises 56 (56%) and hand wash after defecation 54(54%). Toilet within premises 39 (39%) and sanitary toilet within premises 65 (65%) had shown significant association with soap hand washing practice. **Conclusions:** Knowledge was good enough but unhealthy practices make health education very important for better use of existing facilities and also to prevent the incidences of water and sanitation related diseases.

Key words: Knowledge, Practice, Drinking water, Sanitation

Introduction

WHO/UNICEF Joint Monitoring Programme for water supply and sanitation released in 2013, estimates that 36% of the world's population 2.5 billion people lack improved sanitation facilities and 768 million people still use unsafe drinking water sources. Poor farmers and wage earners are less productive due to illness, health systems are 4 overwhelmed and national economies suffer.[1] Survey by water, sanitation and hygiene (WASH) in India (2008) estimated that with regards to sanitation that most of the India's population (69 %) did not use improved sanitation. In rural parts of India, 79 % of the population used unimproved sanitation facilities. Over 50% of the India's population defecated in the open field. The majority (88%) of the population in India had access to improved source of drinking water. One fourth of the population has water availability in their household premises. The majority (87%) of women used to collect water. Most (67%) of the Indian household do not treat drinking water in any form. Hand washing with soap and water was practiced by 53% after defecation, 38% before eating and 30% before preparing food. Report showed that most (80%) of the child`s stool was not disposed safely. Study stressed the importance of maintaining good sanitation facility and 5 develops hygienic practices.[2]

Water must be safe and wholesome. It should be easily accessible, adequate in quantity, free from contamination, safe and readily available throughout the year.[3] Positive health is not possible without safe water. But unfortunately the problem of water pollution has now become a burning question. Much of ill health that affect humanity is due to lack of safe water supply, particularly in the developing country like ours.[4] The incidence of water borne diseases like typhoid, paratyphoid, diarrhea, dysentery, cholera, parasitic infestations etc. are increasing day by day. These problems can be drastically reduced by raising awareness among people and providing them safe drinking water.[5] Water is the basis of life and blue arteries of the earth. Everyone in the environment depends on fresh water to survive.[6] Villagers are not conscious about the importance of drinking safe water. As a result, they are suffering from various water borne diseases.[6] It is an urgent need to educate them in order to develop the habit of drinking safe water. They should be encouraged to drink water from safe sources and purify water before drinking by various methods of water purification such as boiling, chlorination, filtration etc. when safe sources are not available. Because- "water is the blood in our veins".[7] It is not possible to develop the habit of drinking safe water in 100% people but the percentage can be increased by raising consciousness among them about the

importance of drinking safe water and providing them information about various methods of water purification. Because they must be aware of that- "Water is the oil of 21 century".[8]
The habit of drinking safe water among the people of whole country as it has been carried out in a small community among small number of people. So it does not reflect the actual scenario of the country. But it creates a scope to conduct repeated study in this field. The quality of drinking-water is a powerful environmental determinant of health.[9] Drinking-water quality management has been a key pillar of primary prevention for over one-and-a-half centuries and it continues to be the foundation for the prevention and control of water borne diseases. To ensure availability of safe drinking water supply, reliance has to be placed on regular bacteriological analysis to assess portability and to determine the best course of action for protecting the population against waterborne diseases (Ramteke & Bhattaacherjee, 1992). In 1998, the National Policy for Safe Drinking Water Supply and Sanitation (NPSWSS) was published. The main objective of this policy is to improve public health and produce a safe environment by reducing water borne disease and contamination.[10]

Material and methods

This community based cross sectional study was done in the Department of Community Medicine, Anugrah Narayan Magadh Medical college, Gaya, Bihar, India from October 2019 to August 2020. The sample size of the study was finalized to 100 houses Structured questionnaires were prepared, which include the basic sociodemographic profile, knowledge and practice questions regarding drinking water and sanitation of households in the rural communities of the study area. The questionnaire was pre-tested in few selected household. The pre-test was conducted near the study area which had similar characteristics to the areas where the actual study was carried out. Vague terms, phrases and questions identified during the pre-test were modified and changed and missing responses like no response and others were added, and skipping patterns were also corrected. The questionnaires were then administered to the selected study households at their respective residential places.
A pre-tested restructured questionnaire was used as a tool for the study and study was carried out by house to house visit. Convenient purposive sampling technique was applied because the sampling frame of the population of that area was not available. Interview was conducted face to face and study subjects were enrolled till the required sample size was met. Information was collected by interviewing the available adult family member at the time of visit, and also, by physical examination of facilities. Consent was taken from the household member and those families which were not available at their houses and who didn't give consent were excluded.
Data collected were compiled in MS Excel software and analyzed in institutional SPSS version 16. Variables of knowledge and practice of drinking water and sanitation were analyzed either by chi square or Fischer exact test, data was presented in percentages (%) and proportions form and statistical significance was considered at 0.05 level.

Results

26(26%) of them were illiterate, out of whom 56 (56%) of families belonged to middle class and 26(26%) of families belonged to the upper socioeconomic class according to Convenient form of modified B.G. Prasad revised income categories for all India (IW) 2014 as shown in Table (1).
Most of households had knowledge about the importance of covered drinking water 94(94%) followed by clean drinking water 85 (85%), cleaning of river/pond water
68(68%), covered garbage dustbin 61(61%), sanitary toilet 83(83%) and hand wash after toilet 93(93%) as shown in table (2).

A total of 100 households were visited for the study purpose. Most of the respondents were adult females 55(55%) and belonged to 20-40 years age group 52 (52%). The most common occupation of head of household was skilled 40(40%) followed by unskilled 28 (28%).

Table 1: Distribution of study subjects by sociodemograhic characteristic (n=200).

Sociodemograhic characteristics		**Frequency (n)**	**Percent (%)**
Age	20-40	52	52
	40-60	31	31
	Above 60	27	27
Sex	Male	45	45
	Female	55	55
Education	illiterate	26	26
	High school	60	60
	> High school	14	14
Occupation	unemployed	32	32
	skilled	40	40
	unskilled	28	28
Convenient form of modified B.G. Prasad revised income categories for all India (IW) 2014	Lower class	18	18
	Middle class	56	56
	Upper class	26	26
Total		100	100

Table 2: Distribution of study subjects by Knowledge on drinking water and sanitation

Knowledge	**N=100**	**No. of houses (n)**	**Percentage (%)**
Drinking water should be covered	Yes	94	94
	No	6	6
Clean drinking water should be used	Yes	85	85
	No	15	15
Rivers/Ponds water should be clean	Yes	68	68
	No	32	32
Garbage dustbin should be covered	Yes	61	61
	No	39	39
Sanitary Toilet should be used	Yes	83	83
	No	17	17
Hand wash after toilet	Yes	93	93
	No	7	7
Total		100	100

Table 3: Distribution of study subjects by Hygienic practice on drinking water and sanitation

Hygienic practice	**N=100**	**No. of houses (n)**	**Percentage (%)**
Drinking water was found cover	Yes	91	91
	No	9	9
Source of drinking water	Pipe line water	82	82
	Others*	18	18
Pipe line water = tube well, tape water, hand pump,			

Others* = River/pond/lake			
Distance of source of drinking water	Within premises Outside of premises	48 52	48 52
Water	Boiling	42	42
purification	Others**	37	37
method	None	21	21
Others** = Chlorine tab., Cloth filtration, RO System			
Garbage	Yes	53	53
dustbin was covered in premises	No	47	47
Garbage was	Yes	57	57
found openly in premises	No	43	43
Toilet facility was available	Toilet within premises	59	59
	Open air defecation	31	31
	Community toilet	10	10
Foot wear used for toilet	Yes	77	77
	No	23	23
Hand washing after toilet	Soap water	63	63
	Others***	37	37
Others*** = Ash, Mud, Plain Water			
Total		100	100

We found that the access to water facility was 100% as all the houses derived water from sources. Table (3) was shown covered drinking water was found 91(91%) and majority households 82(82%) collected water for drinking purpose from pipeline followed by remaining others 18(18%). They were travelling for fetching drinking water 108 (52%) outside of premises followed by 48(48%) within premises. It was seen that majority 42(42%) households used boiling method for purification of drinking water followed by 37 (37%) of them treat drinking water by other methods and 21(21%) households did not use any treatment for purification of water. Average 53(53%) households had uncovered garbage dustbin, garbage found openly in premises 57(57%) and households were had a toilet facility within premises 59(59%), households without toilet facility who used open air defecation 31(31%), households did not use footwear for toilet 23(23%), households washed their hands after toilet with soap 63(63%) and remaining by others like as Ash, Mud, Plain Water 37(37%).

Table 4: Association of knowledge and practice of respondents on drinking water and sanitation

Practice		**Knowledge**			**CI = 95%**	
		Yes (%)	No (%)	Total (%)	□2	P value
		Clean drinking water should be used				
Drinking water was found	Yes	81 (81)	10 (10)	91 (91)	30.22	0.00
cover	No	4 (4)	5 (5)	9 (9)		
Distance of source of water	within premises	41 (41)	7(7)	48 (48)	7.42	0.007
	Outside of premises	41 (41)	11(11)	108 (52)		
Water	Boiling	42 (42)	4 (4)	46 (46)	1.87	0.00
purification	Others	37 (37)	2(2)	39 (39)		
method	None	8(8)	13 (13)	21(21)		
Others** = Chlorine tab., Cloth filtration, RO System						
Drinking water should be covered						
Drinking water was	Yes	89 (89)	2 (2)	91 (91)	55.21	0.00
found cover	No	5 (5)	4(4)	9 (9)		
Rivers/Ponds water should be clean						
Water purification method	Boiling	35 (35)	7(7)	42(42)	68.33	0.00
	Others	31(31)	8(8)	76 (37)		
	None	9(9)	12(12)	36(21)		
Garbage dustbin should be covered						
Garbage dustbin was	Yes	39 (39)	8(8)	47(47)	80.33	0.00
covered in premises	No	19(19)	34(34)	53(53)		
Garbage was found openly	Yes	33(33)	24(24)	57(57)	10.36	0.002
in premises	No	29(29)	14(14)	43(43)		
Sanitary Toilet should be used						
Toilet within premises	Yes	56(56)	3(3)	59(59)	72.42	0.00
	No	28(28)	13(13)	41(41)		
Hand wash after defecation	Soap	54(54)	9(9)	130(63)	9.78	0.002
	Others	26(26)	11(11)	70 (37)		
Others*** = Ash, Mud, Plain Water						

Table (4) showed significant association between different variable of knowledge and practice related to drinking water and sanitation. Knowledge of clean drinking water was significantly related with practice of covered water 81(81%), distance of source 41(41%). Similarly, knowledge regarding covered drinking water 89(89%) was significantly associated with practice of cleaning and disinfectant for drinking water. Knowledge of covered garbage dustbin was significantly associated with practice of covered garbage dustbin 39(39%) and garbage found openly in premises 33 (33%). Likewise knowledge of sanitary toilet was significantly associated with practice of toilet within premises 56 (56%) and hand wash after defecation 54(54%). Table (5) was showing hygiene practice significantly related to toilet

facility. Toilet within premises 39 (39%) and sanitary toilet within premises 65 (65%) had shown significant association with soap hand washing practice.

Table 5: Association of respondents on hygienic practice

Hand wash after defecation					**CI = 95%**	
		Soap (%)	Others (%)	Total (%)	□2	P value
Toilet within Premises	Yes	39 (39)	20(20)	59(59)		
	No	21(21)	20(20)	41(41)	6.74	0.015
Sanitary toilet within premises	Yes	65(65)	20(20)	85 (85)		
	No	4 (4)	20 (11)	15 (15)	18.85	0.00
Others*** = Ash, Mud, Plain Water						

Discussion

Provision of drinking water has been of primary concern in rural India.[11,12] In bihar, there are guidelines for provision of potable drinking water in villages and to ensure segregation of sewage and drinking water. This includes setting up village level water and sanitation committee to formulate a master plan for sewage and drainage.[13] These guidelines state that water pipes should not go through sewage or should not be submerged in sewage at any point. However, sewage channels were found to run parallel to water pipes and cross them at various junctions. Since these are open sewage channels, there is the possibility of sewage mixing with the piped water, especially as the water supply is intermittent, causing negative pressure in pipes and after rain, entry of sewage through these taps was a distinct possibility. In order to ensure proper segregation of sewage and faeces from drinking water, alternate designs are needed. Elevating the water pipe at places where water lines cross sewage and covering the sewage channels at junctions are possible methods to minimize contact of sewage with drinking water.[14]

In our study, most of females were homemakers mostly engaged in household activity whereas head of the family was busy in their job. More than half of respondents studied up to matriculation and reported sufficient knowledge about drinking water and sanitation but did not practice it and their economic status was poor as compared to Swaroop N et al.[15] Study reported that most of respondents had knowledge about importance of covered drinking water in prevention of diseases that was nearly similar to 96% in study by Bharti et al.[16] Households had higher knowledge about importance of clean drinking water and hand wash after toilet as compared to (76.92%) in study of Sah et al.[17] They had higher knowledge on clean drinking water were significantly associated with implement of covered drinking water practice for better health and protect from water born disease.

The last two decades have seen major shifts in the proportion of the global population using various types of drinking water sources. The biggest change has been the increase in piped water supplies on premises, the use of piped water on premises grew even faster from previous and over the same period, reliance on surface water was halved, in rural areas.[18] Majority of household significantly practiced covered drinking water in premises as they had knowledge about covered drinking water and 58 (58%) households collected water for drinking purpose from a pipeline which was lower in Swaroop N et al study.[15] Households who collected water within premises was found similar to 43 (43%) pipe water in premises and more outside water source respectively comparatively as Swaroop N et al study and opposite seen in other rural area of Salem district where water source within premises 9% and outside from premises 91% respectively.[19] knowledge on clean drinking water significantly associated to fetching water from outside water source due to there was more chance of water contamination and need to be treated.

It was seen in our study that boiling method more commonly used than straining through cloth for purification of drinking water but Swaroop N et al showed opposite of it.[15] The commonest form of disinfection in rural India is single-point chlorination using bleaching powder whereas this may not be effective because of the possibility of multiple sites of contamination and the amount of chlorine added was inadequate by the WHO standards.[14,20,21] Water is pumped every day but the current TWAD Board guidelines specify that chlorination should be done once a month, thus requiring modification.[13] Alternative point- of-use disinfection methods such as solar water treatment, point-of-use chlorination and storage of water in narrow- mouthed vessels need to be explored.[22-25]

Considering the contamination of all water samples at the household level, end-user disinfection is likely to be more effective in such settings.[26] However, such methods may not be sustainable over longer periods or may not be cost- effective in rural India.[27] The practice of tethering animals close to human dwellings and the consequent proximity to animal faecal matter further enhances the risk of contamination of drinking water.[28,29] The key to providing microbiologically clean drinking water lies in understanding the various mechanisms by which water gets contaminated, and formulating interventions at critical points to decrease and prevent contamination of drinking water.[30] Approximately 21(21%) households did not use any treatment for purification of water due to knowledge about clean drinking water and water source like river, pond significantly impact on water treatment practice whereas in India average 72.7 per cent of the rural population does not use any method of water disinfection [31] Bhattacharya et al. also found 72% of household don‟t follow any treatment and drink it as it.[32] Study reported treating water at home at any point during the year, for the most part seasonally or occasionally rather than year-round. Common triggers for treating water are a change in its appearance or illness in the family mainly increased turbidity during the rainy season may prompt households to treat water, and women often boil water for a sick child or elderly family member and water treatment as a curative, rather than preventive, health measure, to be used in case of sickness.[33]

More than half of households ware significantly had uncovered garbage dustbin and garbage was openly in premises due to lack of knowledge about covered garbage dustbin and health related disease. Knowledge on covered garbage dustbin and sanitary toilet provide protection from breeding places for flies, which transmit cholera, diarrhoea and the dreadful disease of plague, spreads from garbage heaps and it significantly affect households practice.[34] In India, approximately 74% have no sanitary toilets facility whereas our study had high proportion of toilet facility as comparatively to toilet facility 72 (72%) in which sanitary toilet facility 62 (62%) in Swaroop N et al study and knowledge about sanitary toilet significantly impact on toilet facility within premises[15,31] Households without toilet facility commonly used open air defecation and common public latrine nearly similar to use of public latrine 4.6% in whole rural area of Salem district.[35] Open air defecation, a common practice among villagers, may lead to contamination of the water supply system and result in outbreaks of diarrheal disease.[36,37]

Open air defecation more common in our study than other rural area of Salem district.[35] Open air defecation close to human dwellings contributed to the conversion of large areas of land in and around the village into defecation or faecal fields.[14] These faecal fields potentially put the village at risk of flooding with faecal material from surrounding areas during rains. In an adjoining premises, a suspected outbreak of disease was reported after heavy rain because of poorly maintained water supply pipes that ran through a faecal field.[14] Approximately 42(23%) of households were not used footwear for toilet and 9(9%) households didn't used footwear during open air defecation due to almost they were illiterate .

Washing hands after defecation is one of the most effective ways to prevent gastrointestinal parasitic infections.[38,39] A study of Sah R B et al reported (66%) wash their hands with soap

water after defecation and remaining others like as Ash, Mud, Plain Water 37(37%) was same as comparatively to our study in which significant knowledge about sanitary toilet facility affect hand washing practice.[40] In contrast, studies conducted in Colombia and India reported that 82.5% and 86.4% respectively wash their hands after using the toilet.[41,42] .The low frequencies of hand washing with soap significantly attributed to the lack of soap at home and toilet facility in premises. Soap, water, and latrines are essential for proper hygiene practice.[43] Even if knowledge exists, sanitary toilet facility within premises significantly affect hand wash after defecation and lack of appropriate resources may negatively affect proper hand washing practices.[40] A study by Cairncross et al uncovered the effect of a supportive household norm on hand-washing behaviour was seen on education activities, exhibitions, health camps, local theatre, films and health clubs contributed to the success of a hand-washing promotion programme.[30]

Conclusions

Knowledge was good enough but unhealthy practices make health education very important for better use of existing facilities and also to prevent the incidences of water and sanitation related diseases.

Reference

1. Water, sanitation and hygiene[Internet]2011. Available from : www.unicef.org/wash/ Retrieved on 2/10/2013
2. Water, environment and sanitation.Available from : http:// www.unicef.org/india/ wes. html Retrieved on 2/10/2013
3. Moe CL, Rheingans RD. Global challenges in water, sanitation and health. J Water Health. 2006; 4(Suppl 1): 41-57.
4. Progress on drinking water and sanitation 2012 update: JMPreport2012. Available at: http://www.unicef.org/ media/ files/ JMPreport 2012.pdf. Assessed on 8th February 2014.
5. WHO/UNICEF Joint monitoring programme for water supply and sanitation. Meeting the MDG drinking water and sanitation target: a mid-term assessment of progress. World Health Organization, Geneva and United Nations Childrens Fund, New York; 2004. Available at: http://www.who. int/ water_sanitation_ health/monitoring/jmpfinal.pdf. Assessed on 12th February 2014.
6. Howard G, Jahnel J, Frimmel FH, McChesney D, Reed B, Schijven J, et al. Human excreta and sanitation Potential hazards and information Needs. World Health Organization. London UK. IWA Publication:2006.
7. Pandve HT. Environmental sanitation: an ignored issue in India. Indian Journal of Occupational Environmental Medication. 2008;12(1): 40. Available at: http:// www. ijoem. com/ article. asp. Assessed on 15th Febrary 2014.
8. Tamilnadu: Main source of drinking water, 2011. Available at: http://www.census.tn.nic.in / HLO Datasheet Final/ HLO Datasheet Drinking Water Page 1.pdf. Assessed on 18th February 2014.
9. Bilas R, Singh RP. Rural water supply and the problem of health in village India, case of the Varanasi district. Geogr Med. 1981;11: 65-85.
10. Kang G, Ramakrishna BS, Daniel J, Mathan M, Mathan VI. Epidemiological and laboratory investigations of outbreaks of diarrhoea in rural South India: implications for control of disease. Epidemiol Infect. 2001;127:107-12.
11. Bilas R, Singh RP. Rural water supply and the problem of health in village India, case of the Varanasi district. Geogr Med. 1981;11:65-85.

12. Kang G, Ramakrishna BS, Daniel J, Mathan M, Mathan VI. Epidemiological and laboratory investigations of outbreaks of diarrhoea in rural South India: implications for control of disease. Epidemiol Infect. 2001;127:107-12.
13. Tamil Nadu Water Supply and Drainage (TWAD) Board. Guidelines for provision of water supply and hygiene for the village panchayat: book in tamil. Northern Zone, Vellore, Tamil Nadu. Tamil Nadu Water Supply and Drainage Board. Communication and Human Resource Development Division. 2007.
14. Gopal S, Sarkar R, Banda K, Govindarajan J, Harijan BB, Jeyakumar MB. Study of water supply and sanitation practices in India using geographic information systems: some design and other considerations in a village setting. Indian J Med Res. 2009;129:233-41.
15. Swaroop N, Janish A, Fernandez S, Ramakrishna GB, Agrawal T, Ravi S. Access to improved drinking water and sanitation facilities in a rural area of Bangalore urban district; Nat J Res Com Med. 2012;1(2).
16. Bharti, Malik M, Kumar V, Verma R, Chawla S, Sachdeva S. Knowledge attitude and practices regarding water handling and water quality assessment in a rural block of Haryana. Int J Basic Appl Med Sc. 2013;3(2):243-7.
17. Sah RB, Baral DD, Ghimire A, Pokharel PK. Knowledge & practice of water & sanitation application: Health Renaissance. 2013;11(3):241- 245.
18. Progress on drinking water and sanitation 2012 update: JMPreport2012. Available at: http://www.unicef.org/ media/ files/ JMPreport2012.pdf. Assessed on 8th February 2014.
19. Tamilnadu: Main source of drinking water, 2011. Available at: http://www.census.tn.nic.in/ HLO_Datasheet_Final/HLO_Datasheet_Drinking_ Water_Page1.pdf. Assessed on 18th February 2014
20. Propato M, Uber JG. Vulnerability of water distribution systems to pathogen intrusion: how effective is a disinfectant residual? Environ Sci Technol. 2004;38:3713-22.
21. WHO. Guidelines for cholera control. Geneva: World Health Organization; 1993
22. Kang G, Roy S, Balraj V. Appropriate technology for rural India - solar decontamination of water for emergency settings and small communities. Trans R Soc Trop Med Hyg. 2006;100:863-6.
23. Rose A, Roy S, Abraham V, Holmgren G, George K, Balraj V, et al. Solar disinfection of water for diarrhoeal prevention in southern India. Arch Dis Child. 2006;91:139-41.
24. Arnold BF, Colford JM Jr. Treating water with chlorine at point-of-use to improve water quality and reduce child diarrhoea in developing countries: a systematic review and meta-analysis. Am J Trop Med Hyg. 2007;76:354-64.
25. Mintz ED, Reiff FM, Tauxe RV. Safe water treatment and storage in the home. A practical new strategy to prevent waterborne disease. JAMA. 1995;273:948-53.
26. Clasen T, Roberts I, Rabie T, Schmidt W, Cairncross S. Interventions to improve water quality for preventing diarrhoea. Cochrane Database Syst Rev. 2006;3:CD004794.
27. Zwane AP, Kremer M. What works in fighting diarrheal diseases in developing countries? a critical review. Boston: Center for International Development at Harvard University. 2007.
28. Howe AD, Forster S, Morton S, Marshall R, Osbrn KS, Wright P, et al. Cryptosporidium oocysts in a water supply associated with a cryptosporidiosis outbreak. Emerg Infect Dis. 2002;8:619-24.
29. Licence K, Oates KR, Synge BA, Reid TM. An outbreak of E. coli O157 infection with evidence of spread from animals to man through contamination of a private water supply. Epidemiol Infect. 2001;126:135-8.

30. Trevett AF, Carter R, Tyrrel S. Water quality deterioration: a study of household drinking water quality in rural Honduras. Int J Environ Health Res. 2004;14:273-83.
31. International Institute for Population Sciences (IIPS) and Macro International. National Family Health Survey (NFHS-3), 2005-06. Mumbai, India. IIPS;2007.
32. Bhattacharya M. Water handling and sanitation practices in rural community of madhya pradesh: a knowledge, attitude and practice study. Indian J Prev Soc Med. 2011;42(1).
33. Output 1 of WHO contract 1265: Guidance on communication with respect to safe drinking water and household hygiene. WHO cranfield.pdf.
34. Knowledge, attitude and practice: IRC international water and sanitation center. Available at: http://www.ircwash.org/ sites/default/files/822-96- 16013.pdf. Assessed on 24th February, 2014.
35. Tamilnadu: availability and type of latrine facility, 2011. Available at: http://www.census.tn.nic.in/ HLO_Datasheet_Final/HLO_Datasheet_Latrine_Pa ge1.pdf. Assessed on 25th February, 2014.
36. Bora D, Dhariwal AC, Jain DC, Sachdeva V, Vohra JG, Prakash RM, et al. V. cholerae O1 outbreak in remote villages of Shimla district, Himachal Pradesh, 1994. J Commun Dis. 1997;29:121-5.
37. Sarkar R, Prabhakar AT, Manickam S, Selvapandian D, Raghava MV, Kang G, et al. Epidemiological investigation of an outbreak of acute diarrhoeal disease using geographic information systems. Trans R Soc Trop Med Hyg. 2007;101:587-93.
38. Curtis V, Danquah LO, Aunger RV. Planned, motivated and habitual hygiene behaviour: an eleven country review. Health Educ Res. 2009;4:655-73.
39. United Nations Children‟s Fund. Soap, toilets, and taps. A foundation for healthy children, February 2009. Available at www.unicef.org/wash/files/final. Accessed on 27th February 2014.
40. Sah RB, Baral DD, Ghimire A, Pokharel PK. Knowledge & practice of water & sanitation application: Health Renaissance 2013;11(3):241- 245.
41. Lopez-Quintero C, Freeman P, Neumark Y. Hand washing among school children in Bogota, Colombia. Am J Public Health. 2009;99:94-101.
42. Banda K, Sarkar R, Gopal S. Water handling, sanitation and defecation practices in rural southern India: a knowledge, attitudes and practices study Trans R Soc Trop Med Hyg. 2007;101:1124-30.
43. Gorter AC, Sandiford P, Pauw J. Hygiene behavior in rural Nicaragua in relation to diarrhoea. Int J Epidemiol. 1998;27:1090-100

Received :11-09-2020 Revised: 28-09-2020. Accepted:29-10-2020