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Assessment of sanitation and water handling practices in rural communities of Ogun State, Southwestern Nigeria

Olufunke Bolatito Shittu[1, *], Iyang Akpan[1], Chiedu Felix Mafiana[2], Elijah Oluwole Ogunshola[3], Oyin Sodipe[4]

[1]Department of Microbiology, Federal University of Agriculture, Abeokuta, Nigeria
[2]Department of Biological Sciences, Federal University of Agriculture, Abeokuta, Nigeria
[3]Department of Primary Health Care and Disease Control, Ogun State Ministry of Health, Nigeria
[4]World Health Organization, Abeokuta, Nigeria

Email address

olufunke_b@yahoo.com (O. B. Shittu), iyakpan@yahoo.com (I. Akpan), chiedu.mafina@gmail.com (C. F. Mafiana), drwoleelijah@yahoo.com (E. O. Ogunsola)

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Abstract

Background: Water and sanitation are important determinant of public health and there is a need to evaluate knowledge and practices related to these in diarrhoeal and cholera endemic areas. *Method:* A descriptive qualitative assessment of sanitation and water handling practices in some rural areas of Ogun State Nigeria was conducted with a combination of structured and open-ended questionnaire in 250 rural households that were selected by multistage and cluster sampling techniques. *Results*: The results obtained showed that about 30% do not have toilet facility while 55.6% had pit latrine. Only 20.8% had a closed dustbin, open dustbin (37.2%) while 42.0% had none. Refuse-dumps (42.0%), nearby gullies (3.6%), backyard (9.2%), streams (2.0%) and nearby bush (47.2%) were used for disposal. Domestic animals kept in the household included dog (49.2%), poultry (24.8%), goat (15.2%), cat (15.2%) pig (2.0%) and cattle (4.4%) Households' vector of infectious diseases indicated rats (69.6%) and cockroaches (78.8%). Water sources showed that borehole (20%), hand dug well (36%); pipe-borne water (12%), river (9.2%) and streams (14.4%) were used by the household. Point-of-use water treatment is actually practiced in 67.0% of the 194 respondent that could mention any water treatment method. Water storage into open containers (28.8%), closed container (71.2%), wide mouthed (93.6%), and narrow necked (6.4%) were also observed. Water storage period varied from < 2 days (64%) to > one month (1.6%). *Conclusion:* Sanitation level in rural household is still very far from attaining the millennium development goals (MDGs) and the knowledge of point-of-use water treatment is actually different from practice.

Keywords

Sanitation, Waste Disposal, Household Vector, Water Handling, Household Treatment, Perception on Water

1. Introduction

Water and sanitation are among the most important determinants of public health [1] and an adequate supply of clean water is one of the most basic human needs and one that must be met [2-3]. Sanitation refers to all conditions that affect health especially concerning dirt and infections and specifically to the drainage and disposal of sewage and refuse from houses. The problems of collection and disposal are particularly far from being solved in developing nations. Improvements in faecal disposal are essential in order to raise levels of public health. Deficient sanitation poses a serious threat to human and animal health involving complex relationships between environments, animals, refuses, food, pathogens, parasite and man [4]. Sanitation practices have a major effect on community and household water issues. In most rural communities, the use of on-site sanitation is a common tradition, which is not hygienic for the health. As a result of this, there is a growing concern that the wide spread use of on-site sanitation systems will cause sub-surface migration of contaminants, ultimately resulting in disease transmission and environmental degradation. Surface waters such as rivers and ponds undergo such degradation as they are subject to biological and chemical contamination [5].

A scenario of vicious cycle between lack of adequate sanitation and contamination of water sources was described [2]. Where people defecate in open spaces or dispose off their waste in nearby gullies and streams, such de facto latrines become breeding grounds for bacteria, ripe to contaminate the children who play in these open spaces and the families who wash and fetch drinking water from streams near them. These sites also encourage the growth of virulent strains of typhoid, typhus and dysentery and infestation by disease-ridden carriers such as insect. A major battle is considered won against a wide range of diseases when people have access to safe drinking water and adequate sanitation [6].

More than 2.6 billion people, over forty percent of the world population do not have access to basic sanitation [3]. Around 2.2 million children die of basic hygiene related diseases like diarrhoea every year, the great majority of which are in the developing countries [6, 7]. In September, 2000, 189 countries adopted the Millennium Development Goals one of which was to reduce the proportion of people without access to safe water and basic hygiene by 2015. A midterm assessment of progress on the Millennium Development Goals (MDGs) on drinking water and sanitation target between the MDGs baseline year of 1990 and halfway mark of 2002 makes significant prediction on reaching 2015 goals on sanitation [3]. The global sanitation target will be missed by half a billion people most of them in rural area Africa and Asia allowing waste and diseases to spread, killing millions of children and leaving millions more on the brink of survival.

A large fraction of the World's population around 1.1 billion people do not have access to improved sources of water for drinking and essential purposes [8-9], while for many others, contamination during transport and in the household presents a significant health risk [9]. Through the adoption of resolution A(RES/47/193) of 22nd February 1993, United Nations declared the 22nd of March of each year as World Water Day, to be observed starting from 1993. The aim is to create public awareness on the benefit of clean water, and the problems of water supplies. Water sources and improper water handling practices constitute the socio risk factors of waterborne infectious diseases. In addition to water sources, water collection, water storage in appropriate vessel and point-of-use treatment have been shown to greatly reduce diarrhoea generally and cholera specifically [10-15].

Ogun State, where over 60 percent of the population are living and working in rural areas with the remaining 40 percent in urban area [16] has recorded cases of diarrhoea and cholera mostly in the rural area. The objective of this work is to evaluate the status of sanitation and water handling in the rural population of mostly affected by this diarrhoea and cholera illness.

2. Materials and Methods

2.1. Study Area

Ogun State is located in the Southwestern part of Nigeria. It lies within latitude 6oN and longitude 21/2oE and 5oE. The State comprises twenty Local Governments areas [17] and they are divided into four zones [18]. According to Federal Office of Statistics, the State covers about 16,762 sq Km, approximately 1.82% of Nigeria Land Mass. The state (Fig. 1) is situated in the most tropical rainforest and experiences two seasons, the rainy season between March and November and the dry season between November and March with annual rainfall between 1, 250 mm and 1,500 mm [19].

2.2. Pretesting of Questionnaire

The questionnaire was pre-tested at Alabata community. Ten households were selected for pre-testing of the questionnaire before large-scale study. Results of the pretest were used in the revision of the initial survey tool.

2.3. Data Collection

Rural communities were selected using the multistage sampling technique. An optimum sample size of 380 was calculated using Epi-info version 6 from which a minimum of two hundred and ten (210) was determined using the formula for single proportion: $n= Z^2 (P) (1-P)/ E^2$ based on estimated awareness level of 85%, at 95% confidence level (Z score value, 1.96) and 5% precision giving room for 7% non response. Households were selected using the cluster sampling technique [20]. A household was defined as individuals living together in the same house and sharing meal together at least once in a day. World Health Organization (WHO) trained Monitoring and Evaluation Officers of each Local Government Area assisted with the administration of questionnaire to households. Descriptive cross-sectional survey was employed using a combination of open ended and structured questionnaire to obtain epidemiological data and information.

2.4. Statistical analysis

Epidemiologic data were analyzed by use of EpiInfo 6.0 (CDC, Atlanta, GA) to obtain the frequency distribution of numeric and string variables. Missing values were excluded in the analysis, don't know was treated as a category.

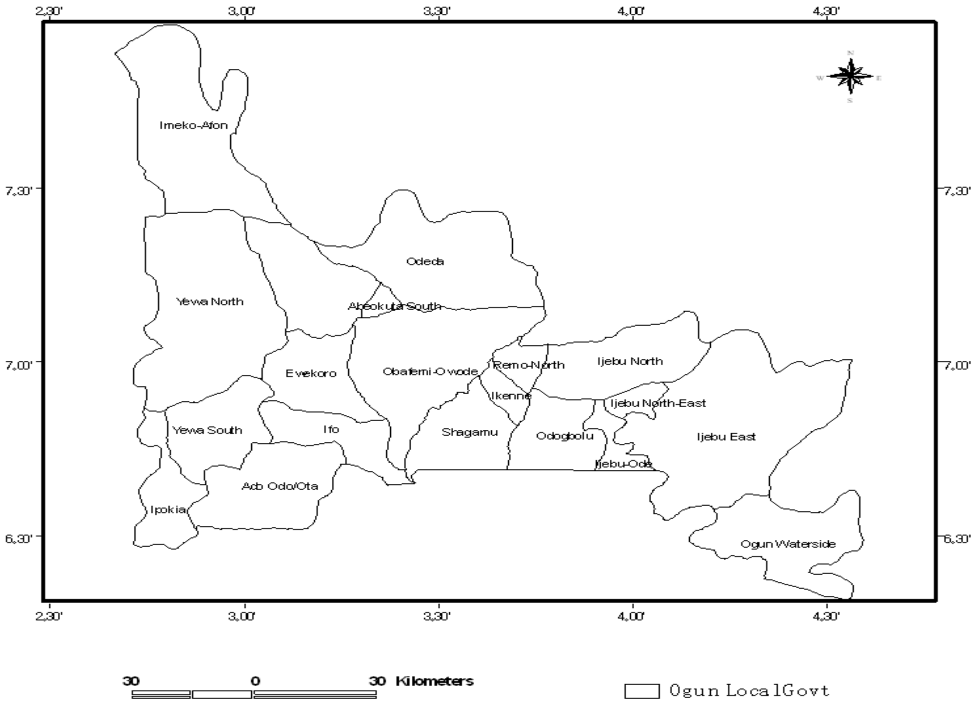

Fig. 1. *Map of Ogun State*

3. Results and Discussion

3.1. General Method of Sewage Disposal

Table 1. *General method of sewage disposal in the households*

Variables	Frequency	%
1. Type of toilet facility (N=250)		
Pit latrine	139	55.6
Water carriage system	36	14.4
None	75	30.0
2. Use of toilet facility by every member of the household (N=175)		
Yes	116	66.3
No	59	33.7
3. Regular use of toilet facility (N=175)		
Always	126	72.0
Sometimes	49	28.0
4. Alternative sewage disposal available for use (N=250)		
Open space		
Yes	15	6.0
No	235	94.0
Nearby gullies		
Yes	3	1.2
No	247	98.8
Backyard		
Yes	20	8.0
No	230	92.0
Streams		
Yes	3	1.2
No	247	98.8
Nearby bush		
Yes	114	45.6
No	136	54.4

Table 1 shows the general method of sewage disposal. About 30% of the rural dwellers do not have toilet facility. For households with toilet facility, not every member of the household utilizes it. Some members of the 250 households still resort to alternatives. It has been observed that in households with no standard sewage disposal system, the children defecated in and around the premises and even homes with pit latrine, the facilities were not adapted for children use and this contributed to indiscriminate defecation and thus increased the risk of handling excreta by parents, and caregivers and by children themselves [21]. Months of heavy rains have been reported to trigger cholera epidemics in West Africa that was associated with flooding latrine and contaminated wells. Children's faeces are as hazardous as adult even though household may consider them innocuous.

3.2. Reason for Choice of Use of Alternative Sewage Disposal

Table 2 shows the reasons given by the households for alternative use of open space. Stinking state of the available toilet, non-availability of toilet, lack of water were some of the reasons stated. These observations reflect the general practice and habit of the rural dwellers. It also reflects a misconception. If making use of nearby bush seems easier or defecating in the stream allows easy disposal of sewage, then this is without cognizance of the pollution effect on water bodies. The danger in stream defecation is that as some are making use of it at onsite upstream, some other dwellers are either bathing, washing or fetching for domestic purposes at midstream and downstream. But the people's misconception in the saying 'dirt in water does not kill' indirectly mislead them in their behaviours. This response on open defecation near water bodies agrees with the work of [22] who observed faecal deposit around water bodies in their investigation on the role of surface water usage and its potential role in transmission of parasitic diseases. Generally, this method of sewage disposal constitutes a significant risk factor for diarrhoea diseases as there will be continuous contamination of soil and water with human enteric pathogen. This will result in propagation and dissemination of diarrheagenic pathogens in human population that are in regular contact with such water bodies. The stinking state of available pit latrine will definitely convert it to breeding grounds for flies. Flies could transmit organisms from latrines to food which has been found to contribute to the increased risk of persistent diarrhoea in children [23].

3.3. General Method of Waste Disposal

The general method of waste disposal (Table 3) showed that only 20.8% which had a closed dustbin had the correct sanitation practice. Open dustbin is a festering place for flies. One of the most overlooked vectors that presents a significant disease transmission risk are the nuisance flies, particularly the house fly, *Musca domestica* [24]. The ability of these insects to transmit enteric pathogens from faeces is well documented [25, 26].

Many pathogens that cause diarrhoea in humans, including *V. cholerae, Shigella* spp. *Campylobacter*, *E. coli*, poliovirus, *Entamoeba histolytical* can be recovered from flies and can survive on their integument for a period of 10 days. Pathogen can also be carried in the food by flies and deposited on food when they regurgitate or deposit faeces. Thus, flies are a potent source of contamination in foods and water [23].

Disposal of refuse into refuse dumps was practiced by 42.0% of the households while others made use of nearby gullies, backyard, streams, and nearby bushes. Refuse dumps could be prevented from being a point-source of pollution especially if the dump is located far from surface source of water and also with constant incineration. However all of these practices could give credence to breeding and thriving of flies. Proper and frequent incineration of refuse dumps and backyard refuse will promote cleanliness and good health. The knowledge of the households on benefit of refuse disposal was excellent in 84.8% of the respondents. However, the excellent sanitary knowledge is not actualized in the practice of waste disposal, because a total of 61% disposed their refuse into nearby stream, gullies, bush and backyard. This difference in knowledge and practice was similar to that of [27] who observed that some of the food safety knowledge of the vendors could not be translated to practice.

Table 2. *Reason for choice of use of alternative sewage disposal*

Variables	Frequency	%
1. Open space (N=15)		
The available toilet is stinking	6	40.0
There is no latrine	4	26.7
When not at home	1	6.7
Bush is available everywhere	1	6.7
Easier to use	2	13.3
Lack of water	1	6.7
2. Nearby gullies (N=3)		
No toilet facility	3	100
3. Backyard (N=20)		
Privacy	7	35.0
Easy to use	9	45.0
No toilet facility	4	20.0
4. Stream (N=3)		
For easy disposal	3	100
5. Nearby bush (N=114)		
Inadequate toilet facility	23	20.1
Easier to use	74	64.9
Lack of water	4	3.5
Emergency use	5	4.4
Dirty toilet	5	4.4
Suck-away is full	2	1.8
Serve as manure	1	0.9

Table 3. *General method of waste disposal in the 250 households*

Variables	Frequency	%
1. Available dustbin		
Closed dustbin	52	20.8
Open dustbin	93	37.2
None	105	42.0
2. Disposal of refuse		
Refuse dump		
Yes	105	42.0
No	145	58.0
Nearby gullies		
Yes	9	3.6
No	241	96.4
Backyard		
Yes	23	9.2
No	227	90.8
Streams		
Yes	5	2.0
No	245	98.0
Nearby bush		
Yes	118	47.2
No	132	52.8
3. Known benefit of refuse disposing in the 250 households		
Prevention of infectious diseases	80	32.0
Clean environment and Hygiene	148	59.2
Don’t know	22	8.8

3.4. Domestic Animals Kept in the Household

Table 4 shows that domestic animals such as dog (49.2%), poultry (24.8%), goat (15.2%), and cat (15.2%) pig (2.0%) and cattle (4.4%) were kept in the households but a very low percentage housed their animals. This observation agrees with [28] who observed that domestic animals were roaming about in two out of three households visited for HACCP studies on Kunnu-Zaki. Domestic animals are known to be reservoirs of some zoonotic pathogens [29, 30; 31]. These imply that keeping domestic animals in the open could increase environmental contamination through faecal shedding and indiscriminate deposition in open spaces.

Table 4. *Domestic animals kept in the households*

Variables	Frequency	%
1. Livestock, pets and poultry		
Dog		
Yes	68	27.2
No	182	72.8
Poultry		
Yes	123	49.2
No	127	50.8
Goat		
Yes	62	24.8
No	188	75.2
Cat		
Yes	38	15.2
No	212	84.8
Cattle		
Yes	11	4.4
No	239	95.6
Others (pig)		
Yes	5	2.0
No	245	98.0
2. Domestic animal kept in cages/pen		
Dog	N=68	
Yes	4	5.9
No	64	94.1
Poultry	N=123	
Yes	20	16.3
No	103	83.7
Goat	N=62	
Yes	6	4.8
No	56	90.3
Cat	N=38	
Yes	0	0
No	38	100
Cattle	N=11	
Yes	2	18.2
No	9	81.8
Others (Pigs)	N=5	
Yes	5	100
No	0	0

3.5. General Sanitary Level with Regard to Presence of Vectors of Infectious Disease

The general sanitary level with regard to presence of non-livestock vectors of enteric disease (Table 5) showed presence of rats (69.6%) and cockroaches (78.8%). Various studies [32, 33, 34, 35, 36] have shown that cockroaches are carriers of pathogenic organisms. Several enteric pathogens including *V. cholerae* was isolated from the body and intestinal tract of household cockroaches in Nigeria by [35] and are therefore considered to be pathogen reservoirs. At the household level, a relationship had been established between cockroach infestation and standards of hygiene [37]. From this present study, only 35% took measures against cockroach while 58.9% simply did nothing to eradicate them. In areas where there is continuous access of this vector into the households, such as suck-away or a pit latrine with an opening, the battle becomes a determined and a difficult one.

Table 5. *Vectors of infectious diseases in the household*

Variables	Frequency	%
1. Rats in the household		
Yes	174	69.6
No	76	30.4
2. Cockroach in the household		
Yes	197	78.8
No	53	21.2
3. Measures taken to eradicate rats	(N=174)	
Rodenticides	73	42.0
Drugs (Indocid applied to food)	23	13.2
Cleanliness	5	2.9
Local traps	32	18.4
Cats	15	8.6
Manual killing	3	1.7
Rat guard	2	1.1
None	21	12.1
4. Measures taken to eradicate Cockroach	(N=197)	
Insecticides	66	33.5
Kerosene	3	1.5
Cleanliness	5	2.5
Manual killing	7	3.6
None	116	58.9

Rodents are also generally recognized as vectors of enteric pathogens [38,39,40] with various reported associated disease outbreak. Rodents have been recognized as a source of enteric pathogens in the farm environment. They have been implicated in the transmission of salmonellosis in dairy and beef herds and in poultry flocks [41]. At household level, rodents are frequently overlooked as a source of enteric pathogens aside constituting a nuisance. Different measures taken to eradicate rats such as rodenticides (42.0%), indomethacin (13.2%), could not said to be 100% effective as there are several fake or substandard brands in the market and getting an original sorely depends on luck. Manual killing either, will not be effective in households that have become a breeding place for them. Cockroaches and rats could contaminate raw food stuff such as *Gaari* (which can be consumed without further cooking) and leftover cooked foods with pathogens carried in their bodies and their faecal shedding during their nocturnal activities. Contaminated foods play a major role in the occurrence of diarrhoea diseases [42], cockroach and rats should be seen as significant vectors of food contamination and microbial proliferation in the household and thus as risk factors of diarrhoea diseases.

3.6. Major Sources of Water Supply for the Household

The major source of water supply for the 250 households investigated (Table 6) showed that 36% were dependent on hand-dug well while borehole which is regarded as a safe source of water supply [6] was only used by 20% of the population. Hand-dug well was used by only 36% and pipeborne water (12%) of the households. Generally, underground water is believed to be the purest known water [43] because of the purification properties of the soil; however, it can also be contaminated. Groundwaters were found to be contaminated due to improper construction, shallowness, animal wastes, proximity to toilet facilities, sewage, refuse dump sites, and various human activities around the well [44]. Surface water such as river and stream were also used by some of the households. It is known that these surface water sources are subjected to contamination from various point and non- point sources.

Table 6. *Sources of water supply for the 250 households*

Variables	Major source		Minor source	
	Frequency	%	Frequency	%
Hand dug well	90	36	17	13.6
Borehole	49	19.6	13	10.3
Pipeborne	30	12	11	8.7
River	23	9.2	10	7.9
Stream	36	14.4	18	14.2
Pond	3	1.2	7	5.6
Rainwater	19	7.6	49	38.9
Spring	0	0	1	0.8

3.7. Seasonal Variation of water Sources

The seasonal variation in water sources (Table 7) showed little variation in water sources with the exception of river water (12.8% and 0.8%) which had a remarkable reduction in number of users in the rainy season. During this season, water was available from hand-dug wells and rainwater collection. Households did not entirely depend on a single water source, and thus there are major and minor sources of water.

3.8. Water Storage Practices

The water storage practices (Table 8) showed that out of the 250 households, wrong practice with significant health risk was observed in some households using open and wide mouthed containers. The characteristics of storage vessel contribute significantly to the quality of stored water [45]. The observation of water contamination during home storage has been repeatedly confirmed by several workers such as [46-49]. Contamination of drinking water is man-made and usually due to improper handling, storage and handling which leads to serious waterborne diseases [45].

Table 7. *Seasonal variation of water source of the 250 households*

Variables	Dry season		Rainy season	
	Frequency	%	Frequency	%
Hand dug well				
Yes	83	33.2	82	32.8
No	167	66.8	168	67.2
Borehole				
Yes	60	24.0	50	20.0
No	190	76.0	200	80.0
Pipeborne				
Yes	34	13.6	32	12.8
No	216	86.4	218	87.2
River				
Yes	32	12.8	2	0.8
No	218	87.2	248	99.2
Stream				
Yes	50	20.0	38	15.2
No	200	80.0	212	84.8
Pond				
Yes	3	1.2	7	2.8
No	247	98.8	243	97.2
Rain				
Yes	28	11.2	68	27.2
No	222	88.2	182	72.8
Spring				
Yes	0	0	1	0.4
No	250	100	249	99.6

Vibrio cholerae O1 was identified in stored drinking water in Bahrain in 1981 which probably resulted from post collection contaminations, since tap water samples in the same homes and other tested water sources were negative for *V. cholerae* [50].

Storage of water in narrow mouthed vessel prevents contamination of stored water compared to the use of plain bucket into which hands could be inserted. After contamination occurs, characteristics of the storage vessels may affect survival in stored water [11]. In inoculation experiments with African domestic water storage vessels *V. cholerae* O1 survived for 7 days in clay pots, 22 days in plastic container and 27 days in metal drums [51]. Improving water handling practices by promoting water hygienic behaviour improves water quality [52].

Varied storage period was also observed in the households.

Storage period is among other factors that contribute to greater risks of microbial contamination of stored water [6]. Water quality especially bacteriological quality declines with prolonged storage as confirmed in an assessment of potable water [53]. Degradation in water quality during storage was also stated by the households, however, protected opening and dispenser on storage vessel was not practiced by all of them .

Table 8. *Water storage practices of the 250 households*

Variables	Frequency	%
1. Storage vessel		
Open container		
Yes	72	28.8
No	178	71.2
Closed container		
Yes	178	71.2
No	72	28.8
Wide mouthed		
Yes	234	93.6
No	16	6.4
Narrow necked		
Yes	16	6.4
No	234	93.6
Earthen pots		
Yes	45	18.0
No	205	82.0
Drums		
Yes	65	26.0
No	185	74.0
2. Storage times		
1-2days	160	64.0
One week	81	32.4
One month	5	2
> one month	4	1.6
3. Effect of storage on water quality		
Taste		
Yes	50	20.0
No	200	80.0
Sliming		
Yes	20	8.0
No	230	92.0
Germs		
Yes	18	10.4
No	224	89.6

It should be noted that in Nigeria as a whole, there is no standard storage vessel as each household purchases whatever capacity or type that will meet their specific need. A wide mouthed bucket with cover and also with opening and spigot for dispensing is used by some families while some used 25 L vegetable oil keg. Commendable is the cleanability of the storage vessel in 78.4% of the households.

3.9. Point of Use Water Treatment

Point of use water treatment (Table 9) was actually practiced in 67.0% of the 194 respondents that could mention any water treatment method. All in all, the awareness (77.6%) and excellent knowledge (>80%) of water treatment was different from actual practice (52.0%) of point of use treatment with varying perception by not non-practicing.

Table 9. *Point of use water treatment of the 250 households*

Variable	Frequency	%
1. Heard about water treatment		
Yes	194	77.6
No	56	22.4
Method of household water treatment known (N=194)		
Alum	86	44.3
Alum and boiling	6	3.1
Boiling	85	43.8
Filtration	3	1.6
Boiling and filtration	2	1.0
Treatment with waterguard	9	4.6
Salt	3	1.6
2. Actually practicing water treatment (N=194)		
Yes	130	67.0
No	64	23.0
3. Method of treatment actually used in the household (N=130)		
Boiling		
Yes	84	64.6
No	46	35.4
Filtration		
Yes	3	2.3
No	127	97.7
Plain sedimentation		
Yes	51	39.2
No	59	60.8
Coagulation with Alum		
Yes	60	46.1
No	70	53.8
Chlorination (waterguard)		
Yes	14	10.8
No	116	89.2
Exposure to sunlight		
Yes	11	8.5
No	119	91.5
Perceived efficiency of water treatment (n=130)		
High	76	58.5
Fair	44	33.8
Low	10	7.7

n = Number of respondents

Water treatments that may be applicable in some settings include flocculation and acidification with aluminum potassium sulfate (alum potable), filtration through sand or cloth, and the use of copper sulfate. However, none of these treatments has demonstrated the safety and efficiency of chlorination. Boiling drinking water at home has been shown to have lower risk of cholera specifically and diarrhoea in general but the affordability [46] and convenience is a serious problem. Addition of alum potash to drinking water was shown to reduce infection with *V. cholerae* during epidemic in Bangladesh [54]. The effectiveness of potash alum in decontaminating households' water in Myanmar [55] and particularly *V. cholerae* [56] had been demonstrated. It was also demonstrated that the spread of cholera within households could be reduced by the use of chlorine tablets in traditional storage vessel and in families using narrow necked pitchers with spouts for home water storage [57]. Survived times of *V. cholerae* rarely exceeded 1 day in water with chlorine levels of 0.2 mg or greater [58]. Sodium and calcium hypochlorite are relatively safe, easy to distribute and use, inexpensive and effective against most bacterial and viral pathogens [13].

The various reasons for not practicing water treatment reflect the perception of the households (Table 10). Most borehole and pipeborne users perceived the water to be pure. The question then, is how pure is our borehole and tap water? Other perceptions, such as people's belief in drinking from a source without any harm (20%), clean water does not need treatment (20.0%) are misconceptions. Contributing to the poor quality of the borehole is the improper construction and shallowness. Pipeborne water is equally contaminated due to clandestine connections, leakages, and inadequate or low residual chlorine at distribution points.

Table 10. *Reasons for not practicing water treatment (n=120)*

Variables	Frequency	%
1. Perceived water source is pure	40	33.3
2. Used to drinking from the source without any harm	24	20.0
3. As long as the water is clean, no need for treatment	24	20.0
4 Boiling is stressful and not practicable	8	6.7
5. Not to change the taste of water	4	3.3
6. River plants had already filter the water	4	3.3
7. Drinking water only should be treated	2	1.7
8. It is a problem to get used to treated water	2	1.7
9. Don't believe in it	12	10.0

n = Number of respondents

4. Conclusions

This work has shown that sanitation level in rural household is still very far from attaining the millennium development goals. This study has also shown that the practice of water treatment is actually different from its knowledge. Considering the very small percentage of household with the awareness of 'waterguard', this study has revealed the importance and need for aggressive publicity of this cost effective, cheap, readily available and safe chlorination treatment method.

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