



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

International Journal of Current Research
Vol. 10, Issue, 10, pp.74392-74396, October, 2018

DOI: <https://doi.org/10.24941/ijcr.32599.10.2018>

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

RESEARCH ARTICLE

ASSESSMENT OF KNOWLEDGE AND PRACTICE OF HOUSEHOLD WATER PURIFICATION AND STORAGE TECHNIQUES AMONG RESIDENTS OF SOKOTO NORTH LOCAL GOVERNMENT AREA, SOKOTO STATE, NIGERIA

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ARTICLE INFO

Article History:

Received 09th July, 2018

Received in revised form

26th August, 2018

Accepted 15th September, 2018

Published online 30th October, 2018

Key Words:

Household purification techniques,
Residents, Sokoto north LGA.

ABSTRACT

Background: Potable drinking water is an absolute necessity, as its quality is as important as its availability. Consumption of unsafe drinking water contributes to about 4 million annual cases of diarrheal and water related diseases world-wide. Purification removes particulate matter and disease agents from water obtained from potentially contaminated sources, thus making it potable.

Objectives: To assess the knowledge and practice of household water purification and storage techniques among residents of sokoto north local government area, sokoto state, Nigeria. **Materials and methods:** A cross-sectional study was conducted among 330 residents selected by multistage sampling technique from August, 2017 to March 2018. Data were collected using semi-structured, pre-tested, interviewer administered questionnaire and analyzed using IBM SPSS version 20. **Results:** Majority of respondents 188 (57.0%) had good knowledge of water purification and storage techniques. The most commonly used water purification techniques were boiling 125(55.5%), filtration 94 (30.1%), and use of alum 63(12.7%). There was a statistically significant association ($p = 0.001$) between practice of household water purification and storage techniques and formal education.

Conclusion and recommendations: Although, the respondents showed high level of knowledge and practice of water purification and storage techniques, it can still be improved through periodic mass public health enlightenment campaigns. In addition, the Sokoto State Water Board should ensure provision of adequate quantity of potable water to the residents of the state.

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Citation: Yunusa, E.U., Oche, M.O., Yahaya, et al. 2018. "Assessment of knowledge and practice of household water purification and storage techniques among residents of sokoto north local government area, Sokoto State, Nigeria", *International Journal of Current Research*, 10, (10), 74372-74396.

INTRODUCTION

Yet this basic right remains unrealized for a vast majority of people in developing countries, especially within rural communities (WHO, 2000). Safe drinking water is "water that does not present significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages" (Himesh, 2007). In the year 2000, the United Nations (UN) set eight Millennium Development Goals (MDGs), one of which is to halve the proportion of the world's population that does not have access to improved water sources (Park, 2009 and WHO, 2017).

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In the eleventh year since that goal was set, considerable progress has been made, particularly in China and India, which together contain approximately a third of the world's population though unrealized in most sub-Saharan Africa countries (United Nations, 2000). The purification of water reduces the concentration of particulate matter including suspended particles, parasites, bacterial, algae, viruses, fungi and a range of dissolved and particulate material derived from the surface that water may have made contact with after falling as rain. This will reduce the prevalence of water related diseases that are associated with consumption of unsafe water (Jain, 2009). Treatment of water at the household level has been shown to be one of the most effective and cost-effective methods of preventing waterborne diseases. Hence vulnerable populations take ownership of their water security by treatment and safe storage of household water (UNICEF, 2008). About

2.2 million cases of death result from diarrheal disease occurring annually mostly among children in developing countries is attributed to the consumption of unsafe water (Van Hale, 2007). Contaminated drinking water is one of the biggest health challenges facing children and families in the developing world (Sobsey, 2002). Impure water is one of the main factors in the deaths each year of 1.8 to 2.5 million children under the age of five from diarrheal disease (WHO, 2015). Increase in the prevalence of water borne diseases such as Typhoid, Dysentery, Cholera, infective hepatitis, Schistosomiasis, Guinea worm, Trachoma and Onchocerciasis can be prevented if proper water purification techniques are put in place (Prüss, 2007). Some people especially those in rural areas are not literate and are unaware of the importance of water purification, the diseases associated with contaminated water and various water purification techniques available at household level (Prüss, 2008 and Lantagne, 2006). In Nigeria, the inadequacy of safe water and improved sanitation services is manifested in the prevalence of water and sanitation related diseases. Diarrhea, which results from poor sanitary hygiene habits and consumption of water of poor quality, is the second main cause of infant mortality after malaria, and the third main cause of under-five mortality. The prevalence of diarrhea is higher in the rural than in the urban areas and in the northern zones than in the south (Olusegun, 2010). The distribution of infectious diseases reported in the primary health centres in Sokoto North Local government area of Sokoto state in 2017, showed that waterborne infections constituted 10.3% of the reported 8,353 diagnosed infections. Diarrhoea was the most reported case of waterborne infection, accounting for 62.17%, followed by dysentery with 24.58% (Kimbi, 2013). This outbreaks were attributed to the consumption of improperly treated water due to inadequate awareness and poor knowledge of water purification and storage techniques (Raji, 2011). The study was therefore aimed at assessing the knowledge and practice of household water purification and storage techniques among residents of sokoto north local government area, sokoto state, Nigeria.

MATERIALS AND METHODS

Study design: It was a cross-sectional study carried out among 330 adult household occupants in Sokoto North Local government area, Sokoto State from August, 2017 to March 2018. All household occupants that practice water purification technique were considered eligible and enrolled into the study. Households that do not practice water purification technique were excluded.

Sample Size Estimation and Sampling Technique: The sample size was estimated at 330 using the formula for calculating the sample size for descriptive studies (Araoye, 2004). A multistage sampling technique was used to select the study subjects. Simple random sampling was done to select 5 wards out of eleven wards in LGA, proportionate allocation for the last stage, in each household, simple random sampling by balloting was done to select one adult member of the household as a respondent.

Data Collection: A pre-tested semi-structured standardized interview-administered questionnaire was used to obtain information on socio-demographic characteristics, knowledge of household purification techniques, and source of water, household water purification techniques and water storage practices. The questionnaire was adapted from previous studies

(Miner, 2015). Little modifications were done after pretesting in order to increase the validity of the instrument. Three medical students of Usmanu Danfodiyo University, Sokoto, Nigeria, assisted in questionnaire administration after pre-training on conduct of survey research, the objectives, and questionnaire administration.

Data Analysis

Data was analyzed using the IBM Statistical Package for the Social Sciences (SPSS) Version 20 statistical computer software package. Respondents' knowledge of Household Water Purification and storage Techniques was scored and graded. One point was awarded for a correct response, while a wrong response or a non-response received no points. Respondents that scored $\geq 50\%$ were considered as having 'good' knowledge, while those that scored $< 50\%$ were considered as having 'poor' knowledge. Frequency runs were done for further editing and cleansing of the e-data. Frequency distribution tables were constructed; and cross tabulations were done to examine relationship between categorical variables. Chi-square and Fisher's exact tests of independent association was used to test for relationship between categorical variables. All levels of significance were set at $p < 0.05$.

Ethical consideration

Approval for the study was obtained from the Ethical committees of the Sokoto State Ministry of Health and Usmanu Danfodiyo University Teaching Hospital, Sokoto. The consent form was adapted based on the World Medical Association declaration of Helsinki ethical principles for use of humans in medical research. Permission for the study was also granted by the Chairman of Sokoto North Local Government.

RESULTS

All the questionnaires were completely filled and retrieved, giving a response rate of 100%. Majority 120 (36.4%) of the study subjects were within the age range of 20-29 years. The mean age of the respondents was 34.5 ± 11.8 . More than half 220 (66.7%) of the respondents were males while females constituted 110 (33.3%). Majority 275 (83.3%) of the respondent were Muslims while 55 (15.8%) were Christians. More than half 193 (58.5%) of the respondents were married and most 193 (58.5%) were Hausa. Less than half 137 (41.5%) of the respondents were degree/HND/ and NCE holders, 107 (32.4%) were secondary school certificate holders. More than a third 128 (38.8%) of the respondents were business Men/Women, 14 (4.2%) were farmers, 74 (22.4%), 73 (22.2%) and 41 (12.4%) were civil servants, unemployed and full time house wives respectively. More than half 167 (57.0%) household have an average member of 1-9 while 3 (1.0%) lived alone. More than half 120 (56.1%) of the respondents earn less than N50, 000 per month while 3 (1.4%) of respondents earn about N500, 000 and above monthly. More than half 188 (57.0%) of the respondents had good knowledge while 142 (43.0%) had poor knowledge on household water purification techniques. Most 304 (92.1%) of the respondents had good knowledge on boiling techniques while 218 (65.9%) and 249 (75.2%) had good knowledge of filtration and use of alum respectively. Majority 95 (26.1%) of the respondents had knowledge of house hold water purification from their families and friends while 97 (28.2%), 97 (28.2%) and 30 (10.5%) got the information from media (Radio and Television), Health

Table 1. Socio-Demographic Characteristics of the Study Subjects

Variables	Frequency (n = 330)	Percentage (% = 100)
Age range (years)		
<20	14	4.2
20-29	120	36.4
30-39	98	29.7
40-49	58	17.6
50-59	34	10.3
60-69	4	1.2
>70	2	0.6
Tribes		
Hausa	193	58.5
Fulani	36	10.9
Yoruba	54	16.3
Igbo	24	7.3
Others	23	7.0
Sex		
Male	220	66.7
Female	110	33.3
Marital Status		
Single	115	34.8
Married	193	58.5
Divorced	9	2.7
Separated	3	0.9
Widow	10	3.0
Number of Household		
1-9	167	57
10-19	103	34.9
20-29	15	5.0
30-39	7	2.3
40-49	1	0.3
50-59	0	0.0
≥ 60	1	0.3
Religion		
Muslims	275	83.3
Christians	52	15.8
Others	3	9.0
Level of Education		
None	13	3.9
Qur'anic school only	34	10.3
Adult Education	17	5.2
Primary school	22	6.7
Secondary school	107	32.4
Tertiary institution	137	41.5
Occupation of Respondents		
Civil servants	74	22.4
Business	128	38.8
Farming	14	4.2
Full time house wife	41	12.4
Unemployed	73	22.1
Average household monthly income		
<50,000	120	56.1
50,000-990,000	60	29.5
100,000-149,000	10	4.7
150,000-199,000	10	4.7
200,000-249,000	3	1.4
250,000-299,000	6	2.8
300,000-349,000	0	0.0
350,000-399,000	1	0.5
400,000-449,000	0	0.0
≥500,000	3	1.4
Not responding	114	34.5

Table 2. Knowledge of the respondents on Household Water Purification Techniques

Variables	Frequency (n = 330)	Percentage (% = 100)
Good knowledge	188	57
Poor knowledge	142	43
Knowledge of the respondents on specific purification techniques		
Boiling method		
Having the knowledge	304	92.1
Not having the knowledge	26	7.9
Filtration method		
Having the knowledge	218	65.9
Not having the knowledge	112	34.1
Use of Alum		
Having the knowledge	249	75.2
Not having the knowledge	81	24.8
Chemical method		
Having the knowledge	72	21.8
Not having the knowledge	258	78.2
Other methods		
Having the knowledge	9	2.7
Not having the knowledge	321	97.3
Sources of knowledge of the Respondents		
Health personnel	97	28.2
Families and friends	95	26.1
Media	97	28.2
News paper	30	10.5
Others	11	7.0

Table 3. Practices of the respondents towards water Purification techniques

Variables	Frequency (n=330)	Percentage (%)
Good practice	172	52.1
Poor practice	158	47.9
One method	159	48.2
Two methods	131	39.7
Three methods	33	10.0
Others	7	2.1
Water purification techniques practiced by the respondents		
Techniques	Frequency	Percentage
Boiling	178	48.9
Filtration	65	29.8
Use of Alum	54	11.4
Use of other chemical	31	9.3
Others	2	0.6
The frequency of water purification after collection among the respondents		
Every collection	104	33.0
Once in two collections	26	7.5
Once in three collection	2	0.6
Occasionally	198	58.9

Table 4. The Storage Practices among the Respondents

Variables	Frequency (n=330)	Percentage (%)
Respondents that store water	266	80.6
Respondents that do not store water	64	19.4
Various Containers used for Storage		
Buckets	20	11.8
Jerry can	157	43.9
Clay pot	109	30.9
*Galvanized tank	25	7.6
Others	19	5.8
Places where containers are kept in the Houses of the Respondents		
Kitchen	66	20.9
Bedroom	46	14.6
Backyard	48	15.2
Corridor	135	42.7
Others	21	6.6
Frequency of washing container for storing water		
Once in a week	90	27.3
Once in two weeks	26	7.9
Once in three weeks	3	0.9
Occasionally	174	52.7
Others	37	11.2

Personnel and Newspaper respectively. More than half 198 (58.9%) of the respondents occasionally purified their water before consumption while 104 (31.5%) purify their water upon each collection. More than half 172 (52.1%) had good practice while less than half 158 (47.9%) had poor practice. Majority 178 (48.9%) of the respondents practiced boiling techniques followed by filtration 65 (29.8%), use of alum 54 (11.4%) then few 31 (9.3%) respondents use other chemicals for purification of their household water. Majority 266 (80.6%) of the respondents store water while 64 (19.1%) do not store water.

Table 5. Relationship between knowledge of household water purification techniques and socio-demographic characteristics

Variables	Frequency (n = 330)	Percentage (% = 100)	Test statistics
Age (years) <20			
Good knowledge	6	42.9	
Poor knowledge	8	57.1	
20-29			
Good knowledge	58	48.3	
Poor knowledge	62	51.7	
30-39			
Good knowledge	69	68.4	$\chi^2=20.647$ $df= 6$ $p=0.002$
Poor knowledge	31	31.6	
40-49			
Good knowledge	39	67.2	
Poor knowledge	19	32.8	
50-59			
Good knowledge	18	52.9	
Poor knowledge	16	47.1	
60-70			
Good knowledge	0	0.0	
Poor knowledge	4	100	
≥ 70			
Good knowledge	0	0.10	
Poor knowledge	2	100	
SEX			
Male			
Good knowledge	103	46.8	$\chi^2=27.745$ $df= 1$ $p=0.001$
Poor knowledge	117	53.2	
Female			
Good knowledge	85	77.3	
Poor knowledge	25	22.7	
Marital Status			
Single			
Good knowledge	49	42.6	$\chi^2=17.291$ $df=4$ $p=0.002$
Poor knowledge	66	57.4	
Married			
Good knowledge	122	63.2	
Poor knowledge	71	36.8	
Divorce			
Good knowledge	7	77.8	
Poor knowledge	2	22.2	
Separated			
Good knowledge	3	100	$\chi^2=3.263$ $df=4$ $p= 0.883$
Poor knowledge	0	0.0	
Widowed			
Good knowledge	7	70.0	
Poor knowledge	3	30.0	
Educational Status			
Non			
Good knowledge	8	61.5	$\chi^2=10.320$ $df=5$ $p=0.058$
Poor knowledge	5	38.5	
Quran School Only			
Good knowledge	24	70.6	
Poor knowledge	10	29.4	
Adult Education			
Good knowledge	13	76.5	$\chi^2=21.275$ $df= 5$ $p=0.001$
Poor knowledge	4	29.4	
Primary School			
Good knowledge	16	72.7	
Poor knowledge	6	27.3	
Secondary School			
Good knowledge	58	54.2	
Poor knowledge	49	45.5	
Tertiary Institution			
Good knowledge	69	50.4	
Poor knowledge	68	49.6	

Less than a quarter 157 (43.9%) of the respondents use jerrycan for water storage while 109 (30.9%), 25 (7.6%) and 20 (11.8%) use clay pots, galvanized tank and buckets respectively. About a quarter 135 (42.7%) of the respondents that store water kept their storage containers in their corridors while 66 (20.9%), 48 (15.2%) and 46 (14.6%) kept their storage containers at kitchen, backyard and bedroom respectively.

Table 6. Relationship between Practices of Household Purification Techniques and Socio-Demographic Characteristics

Variable	Frequency (n=330)	Percentage (%)	Test statistics
Age (years)			
<20			
Good knowledge	7	50.0	
Poor knowledge	7	50.0	
20-29			
Good knowledge	66	55.0	
Poor knowledge	54	45.0	
30-39			
Good knowledge	52	53.1	$\chi^2 = 2.371$ $df= 6$ $p=0.883$
Poor knowledge	46	46.9	
40-49			
Good knowledge	27	46.6	
Poor knowledge	31	53.4	
50-59			
Good knowledge	18	52.9	
Poor knowledge	16	47.1	
60-69			
Good knowledge	1	25.0	
Poor knowledge	3	75.0	
≥ 70			
Good knowledge	1	80.0	
Poor knowledge	1	50.0	
SEX			
Male			
Good knowledge	117	53.2	$\chi^2=0.298$ $df=1$ $p =0.585$
Poor knowledge	103	46.8	
Female			
Good knowledge	55	55.0	
Poor knowledge	55	50.0	
MARITAL STATUS			
Single			
Good knowledge	66	57.4	
Poor knowledge	49	42.6	
Married			
Good knowledge	96	49.7	
Poor knowledge	97	50.3	
Divorce			
Good knowledge	3	33.3	
Poor knowledge	6	66.7	
Separated			
Good knowledge	2	66.7	$\chi^2=3.263$ $df=4$ $p= 0.883$
Poor knowledge	1	38.3	
Widowed			
Good knowledge	5	50.0	
Poor knowledge	5	50.0	
LEVEL OF EDUCATION			
Non			
Good knowledge	7	53.8	
Poor knowledge	6	46.2	
Quran School Only			
Good knowledge	22	64.7	$\chi^2=21.275$ $df= 5$ $p=0.001$
Poor knowledge	12	35.3	
Adult Education			
Good knowledge	15	88.2	
Poor knowledge	2	11.8	
Primary School			
Good knowledge	8	36.4	
Poor knowledge	14	63.6	
Secondary School			
Good knowledge	63	58.9	
Poor knowledge	44	41.1	
Tertiary Institution			
Good knowledge	57	41.6	
Poor knowledge	80	58.4	

More than half 174 (52.7%) of the respondents washed their containers occasionally while 90(27.3%) washed their storage once weekly. There is a statistically significant association between the knowledge of household water purification techniques and age of respondents ($p=0,001$), knowledge and

sex ($p=0.001$), knowledge and Marital status (0.002). There is a statistically significant association between practice of household water purification techniques and levels of education ($p=0.001$).

DISCUSSION

The community in this study shows heterogeneity in the ethnic makeup though it is still predominantly occupied by the native inhabitants. The level of education is also high as most respondent had completed secondary school and tertiary levels of education. Most of the respondents were aged 20-29 years with the mean age 34.5 ± 11.8 . This was similar to a study conducted in Plateau on household drinking water; knowledge, and practice of purification in a community of Lamingo, Plateau state, Nigeria where majority of the respondents were between 20-29 years of age 136 (41.8%) (18). Majority of the respondents were males 220 (66.7%) in contrast to a study conducted in Plateau 158 (53.3%) (18) were females and had good knowledge of water purification practice 210 (63.2%). Relationship between marital status and knowledge of household water purification techniques was found to be statistically significant ($p<0.002$). Less than half 137 (41.5%) of the respondents attended tertiary institution and had good knowledge on water purification techniques. Albeit the relationship was statistically found to be not significant ($p<0.067$). Majority of the respondents had good knowledge about the water purification and storage techniques especially the degree, HND and NCE holders 69 (50.4%) which is contrast to study which carried out in Gwafan community in Jos north L.G.A of plateau state, knowledge of water purification practice was good in only 26.1% of the respondents and 54% practice at least one method purification in their household. Majority of the respondents had good knowledge on various purification techniques and greater percentage of them practiced boiling as their preferred method 228 (68.9%) which is contrast to study that was carried out in Jos north L.G.A where addition alum (43.3%) was the predominant practice. More than half (57.0%) of our respondents had good knowledge and good practice (51.1%), which was found among rural women in Katsina-Ala local government area, Benue state where only 32.6% of the rural women had good knowledge and practice of water management and water sanitation (Kimbi, 2013). None of our respondents used plant extracts such as *Moringaoleifera*, *Jatropha curcas* and *Guar gum* in water purification which is contrast to study done in Ethiopia on purification of drinking water by low cost method, where majority (72.8%) of the study subject enjoyed practicing such method (Sobsey, 2002). None of our respondents used ultraviolet disinfection methods in household water purification which is in contrast to the study done in Texas, Mexico on Ultraviolet disinfection in evaluating home water purification methods for community in Texas (Van Halem, 2007).

Conclusion and Recommendation

This study found good knowledge as well as adequate practice of household water purification and storage technique among the respondents. Almost half of the respondents practiced only one method of purification technique. There was statistically significant association between practice of household purification technique and level of education of the respondents. It is therefore recommended that the populace should be more enlightened on various methods of water

purification and storage techniques and will also benefit from more frequent supply of portable water from the government.

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