Original Research Article

A cross-sectional epidemiological survey on drinking water, sanitation and hygiene amongst residents of Bamboutos Division, West Region Cameroon: a Knowledge, Attitude and Practice (KAP) study.

ABSTRACT

Background: Although Cameroon is the second country in Africa after the Democratic Republic of Congo in terms of water availability, access to good drinking water constitutes an every day's struggle. A household survey was conducted to assess knowledge, attitudes and hygiene practices among households during collection, storage and preservation of potable water and evaluate some general hygiene/sanitation practices employed at the household level on daily basis in Bamboutos Division.

Methods: A community-based descriptive cross-sectional survey was conducted in April 2019 in two Sub-Divisions of the Bamboutos Division. Parents (household head or his spouse) and children of 18 years and above who consented to participate in the study, were interviewed using a structured questionnaire.

Results: Out of the 460 households interviewed, 85.09% (n=371) could cite only one waterborne diseases with typhoid taking the lead (n=331; 89.22%); followed by cholera (n=191; 51.48%) and dysenteries (n=154; 41.51%). Most residents (n=361; 79%) had poor knowledge and practices on waterborne diseases when classified in to good/poor. Several water sources were declared by residents for drinking purposes with the springs (50%), wells (35%) and boreholes (30%) as their main sources while others (35%) mentioned rain water during the rainy season. Knowledge and practices in the prevention of WBD were found to be associated to education level while water source was found to predispose people to suffer from WBD. Most participants (n=452; 98.26%) said they washed their hands before and after eating (98.26%) and after visiting the toilets (n=358; 77.82%) with water and soap (n=403; 87.60%).

Conclusion: The study indicated poor knowledge on WBD and poor practices in their prevention in Bamboutos Division. The use of a variety of water sources for drinking purposes implies that access to good quality water is a nightmare for the population of

Bamboutos. Hence measures have to be put in place for the assessment of water quality and ensure the availability of potable water to everyone.

Key words: Waterborne disease, knowledge, attitude, practice, Bamboutos Division, Cameroon.

I. INTRODUCTION

Lack of access to safe water and sanitation facilities together with poor hygiene extinguishes and threatens the lives millions of children day by day leading to poverty and reduced opportunities for many others. Unimproved water quality has been reported to be the cause of 5 million deaths every year where it threatens the health of about 37.7million people affected annually with 1.5 million children dying from diarrhea and related diseases each year [1]. The Sustainable Development Goals (SDGs) succeeded the Millennium Development Goals (MDGs) for the 2016-2030 periods with an important point on access to water and sanitation (SDG 6). Even though some progress was made to increase access to potable water and sanitation, billions of people especially in the rural areas are still in lack of these basic necessities. Most of these countries experiencing high water scarcity are in Africa and part of Asia. In 2017, 785 million people still did not have basic drinking water and only 3 out of five people had elementary hand washing facilities with water and soap, meaning that over 3 billion people are still not capable to practice good hand hygeine. To remedy the situation the United Nations (UN) emphasized on the reuse of wastewater, desalinated water and direct use of agricultural drainage water [2].

Drink worthy water should be of approved quality complying with both national and international standards applied for drinking water purposes [3] Hence, good quality water or otherwise potable water should be odorless, colorless, practically tasteless and free from any physical, chemical and biological contaminants and safe for consumption [4] but still access to good drinking water constitutes an every day's struggle in the World as a whole and developing countries in particular [5]. Often times, the problem is accelerated by the fact that individuals store water intended for drinking purposes for long periods of time due to water scarcity and the long distances they go just to get water of which the quality is even doubtful.

However, the Global Water Partnership (GWP) states that 45.3% of Cameroonians (58 urban and 23% rural) have access to drinking water [6]**.** It is therefore clear that the majority of the Cameroonian population relies on unimproved drinking water sources especially those in the rural areas despite the available water sources in the country. Nevertheless, she joined the millennium development goals since 2001 and has made some advancement in the

availability of potable water but much is still left to be done especially in rural areas. Hence, access to safe drinkable water can bring a great contribution to human health as improving access to potable water, good sanitation and proper hygiene are great components in the prevention of waterborne and water-related diseases. Meanwhile education has been proven by some studies to be a strong determinant in the improvement of drinking water quality at the household level [7,8] most families have insufficient knowledge or still, are ignorant on the duration of the storage and the type of recipient to be used in the collection and preservation of drinkable water.

With the main aim to forestall the occurrences of water-borne diseases in the Bamboutos Division, this study was designed to describe Knowledge, attitudes and hygiene practices among households during collection, storage and preservation of potable water and evaluate some general hygiene/sanitation practices employed at the household level on daily basis.

II. Materials and methods

II.1. Study site

The study was carried out in the Mbouda and Babadjou Sub-Divisions of the Bamboutos Division. Bamboutos is a Division of the West Region in Cameroon which covers an area of 1,173 km² and as of 2001, had a total population of 318,848. The Division is divided administratively into 4 communes (Babadjou, Batcham, Galim and Mbouda) and in turn into villages. The climate is equatorial with high elevations and moderate to high humidity [9]**.** Rainfall is moderated by the mountains with 1,000-2,000 mm per year. It experiences two major seasons, the year begins in a long, dry period of little or no rain, which runs until April, and then the rains begin in May or June and last until October or November [10]**((Neba, 1999).**The main activities carried out in these communities are agriculture and livestock rearing. This study was conducted in two of these communes; Mbouda and Babadjou (Figure 1).

The capital of Bamboutos is Mbouda with Geographical co-ordinates of 5°38’ North, 10°15’ East with a surface area of 437km^2 and a population of 46071 inhabitants. The town of Mbouda is bordered in the South by the villages Baleng and Bamougoum, in the North by Wabane, in the West by Batcham and the East by Babadjou and Galim [9]**.** Data was collected from five different quarters in the Mbouda Sub-Division (Lepi, Nylon, Bamessingue, Bameboro ville and Montchio).

Babadjou on the other hand is situated along the Bafoussam-Bamenda (National n°6) transect with a surface area of 250km^2 and a population of 50.000 inhabitants. Its geographical position or coordinates are 5° 40' North, 10° 12' East. It is bordered in the North by the Bamevuh and Bammock villages of the South West Region, in the East by the Pinying village of the North West region, in the West by the Balatchi village and in the South by the Bamessingue village both of the Western Region [11]**.** In Babadjou, data was collected from four quarters (Kingplace, Njinso, Ngangong and Kombou).

II.2. Study Design

A descriptive cross sectional study design was put in place where data was collected through questionnaire administration with open and closed ended questions on 460 households of the Mbouda and Babadjou Sub-Divisions. The target population for this study were permanent residents of the said area regardless of their religion, sex, occupation and socio-economic status. Before the beginning of the survey, the questionnaire was pilot tested within a few households in the Dschang neighborhood. Within a period of 2 weeks from April 11th to the 25th 2019, five trained interviewers administered questionnaires to the members of households, moving from one end of the different quarters to the other. The questionnaire was reviewed with all the interviewers and some interview techniques discussed before going down to the field. The household questionnaire consisted of 29 questions divided into three main sections: the first section was structured such that information on some demographic variables such as age, level of education, sex, number of people living in the house and profession of the house head were gotten. The type of the house was equally recorded. The second part aimed at assessing the level of knowledge, attitude and practical measures put in place by respondents to forestall the occurrences of waterborne diseases (i.e, the different types of waterborne diseases they know, the type or source of water they drink during different seasons, possession of a separate household storage container, method of water collection, washing frequency of storage tank, water treatment, hand washing practices and health seeking behaviors of household members during sickness). Lastly, a third section was designed to seek correspondent's perception on general hygiene practices and the importance of owning a toilet at home. The questionnaire was administered in the French and English languages and whenever possibility arose, it was translated in the local language for those who could not understand any of the languages. The target interviewees were the house heads (fathers) and mothers but in case none of them was present at home at the time of data

collection, a child was chosen to answer provided he/she was at least 18 years old. The quarters were systematically selected such that the different points of the two communities were covered by the survey while households were randomly selected.

II.3. Inclusion criteria

Only permanent residents (head of households, their spouses or children aged at least 18 years) of the study area who signed the Informed Consent Form were included in the study.

II.4. Sample Size Determination

The sample size was computed as in **Fonyuy** [12] using the Lorentz formula:

$$N = \frac{Z^2 pq}{\alpha^2}$$

where, N is the minimum required sample size, Z is the standard normal deviate at 5% level of significance (1.96), p is the estimated population of households, q = (1-p) and α is the precision of the estimate (0.05). We assumed the population of households to be 15 % (p) as in a study carried out in the North West Region of Cameroon on the Knowledge of Hygiene and Sanitation Practices in the Collection, Treatment and Preservation of Potable Water by **Fonyuy** [12]**.** From this, our sample size was calculated as follows:

$N = (1.96)^2 \times 0.15(1-.0.15)/ (0.05)^2 = 197.$

Therefore, 197 was the minimum number of households to be included in this study, but to have a more representative sample size of the households or still, to provide an appreciable level of confidence, we collected data from 250 and 210 houses from Mbouda and Babadjou respectively, making a total of 460 households.

II.5. Statistical Analysis

Data from questionnaires was initially registered in Excel Microsoft spread sheet where the process of cleaning and editing was done after checking for typing errors and missing values. It was further exported to SPSS (Statistical Package for Social Science, v 20) predictive analytic software for analyses. The chi square test was used to compare percentages meanwhile for categorical variables; data was presented as frequencies and percentages. For continuous variables (age and number of people per house) data was presented as mean ± standard deviation (SD) and compared between Sub-Divisions using the student T test. Confidence intervals (CI) of 95% were calculated and P-values ≤0.05 considered statistically significant**.** The Excel Microsoft ware was used to draft graphs while the level of knowledge

on WBD was assessed by considering inhabitants who listed at least 3 WBD as good knowledge and others as poor (less than 3). Good practice on the prevention of WBD was also assessed by taking in to account regular washing of drinking water vials, usage of soap, water treatment and covering of water containers. People with at least three correct responses were considered 'good practice" while others were 'poor practice'. To assess the risk level of suffering from WBD in the area, odd ratios and their confidence intervals were calculated using Medcalc statistical software.

II.6. Ethical Considerations/ Administrative Authorizations

For the sake of interviewer's safety, this study was approved by the Regional Delegate of Public health and Senior Divisional Officer of Bamboutos Division by providing authorization letters with reference numbers 0051/L/MINSANTE/SG/DRSPO/CBF and 004/AR/F.31/SAAJP respectively. For the better enrolment of the survey, an Ethical Clearance with reference number 2019/10/46/CE/CNERSH/SP was equally provided by the National Ethical Committee of Research for Human Health. An Information Notice was used to explain the purpose of the study to respondents and an Informed Consent formulated to seek participant's consent. All participation was voluntary and withdrawal from the study was possible at any point in time. No financial incentives were provided in this study and data collected was treated as strictly confidential.

III. RESULTS

III.1. Socio demographic and households' characteristics

The response rate for this study was 90.22% meaning that before making a total of 460 households, only 45 house heads rejected or refused to participate in the study. A total of 250 households were included in Mbouda Sub-Division and 210 in Babadjou. The age of participants ranged from 18 to 75 years with an average of 38.26±14.65 years. The majority of the correspondents were females (73.04%) with spouses representing a high proportion (64.56%). In general, majority (83.26%) of the questionees/interviewees were adults giving more credibility to the responses we received. Most of the interviewees had completed secondary education (n=268; 58.26%), followed by primary education (n=171; 37.17%) meanwhile illiterates were the least represented (n=5; 1.08%). Generally, most of the participants were engaged in small scale business (51.30%), followed by farming (26.52) while a fine minority were civil servants (11.52%). Socio demographic background of the study population is illustrated in Table 1.

Most houses of the study site were constructed with mud blocks (n=233; 50.65%) and cement (n=224; 48.7%) with all the houses having iron sheet roofs. Others were mud with chatted roofs. The number of people per household ranged from 1 to 25 individuals with an average of 6.38±2.9. Sixty five percent of households harboured children less than five years old (Table 1).

III.1.1. Socio-Demographic and Households characteristics according to Sub-Division

Some household characteristics were Sub-Division dependent. It was observed that the number of people did not vary significantly in both sites with an average of 6.25±2.8 and 6.53±2.9 people per house in Mbouda and Babadjou respectively (t=1.05; P=0.29). The quality of the houses varied significantly between the two Sub-Divisions (χ^2= 40.81; P=0.0001) with Babadjou having more blocks houses (66.7%) compared to Mbouda with 61.6% of cemented houses with iron sheet roofs.

The mean age of respondents equally varied with Sub-Division (t=2.63; P=0.009). It was 39.98±15.25 in Babadjou compared to 35.94±13.50 in Mbouda. Also, educational level significantly varied with Sub-Division (χ^2=18.7; P<0.001); illiterates and primary school levels were more represented in Babadjou while secondary and tertiary levels were higher in Mbouda. Farming was the main activities in Babadjou while small scale business was predominant in Mbouda.

III.2. Type of water they drink during the rainy and dry seasons

Figure 1 highlights the different types of water residents used for drinking purposes. Most respondents mentioned the springs (50%), wells (35%) and boreholes (30%) as their main sources of drinking water except that some people drink rain water during the rainy season and as such, the proportion of those drinking other types of water is reduced but without any statistical significance (Fig 1). Drinking water type does not vary from dry to rainy seasons (P>0.05). Few people declared using mineral or sachet water as drinking. This observation was important in houses harboring adolescents and children less than five years w hose parents did not drink the same water with them

III.2.1. Type of drinking water according to Sub-Division

It was equally observed that the type of drinking water varied with Sub-Division (χ^2=50.38; P<0.0001). In Mbouda, a majority declared drinking water from springs, boreholes

while in Babadjou Sub-Division, water from wells and springs were the main sources of drinking water in addition to rain water during the rainy season. (Fig 2).

III.3. Knowledge on waterborne diseases and treatment seeking behavior during sickness

Participant's knowledge on waterborne and treatment seeking behavior during sickness is highlighted in Table 2. The majority of interviewees (n=371; 85.09%) knew at least one waterborne diseases with typhoid taking the lead (n=331; 89.22%); followed by cholera (n=191; 51.48%) and dysenteries (n=154; 41.51%). Others included worm and diarrhea. The level of knowledge was evaluated based on the number of waterborne diseases cited by participants. In general, most residents (n=361; 79%) had poor knowledge on waterborne diseases. Some respondents even went as far as citing malaria and diabetes as waterborne diseases. Only 21% of the respondents had a good knowledge on waterborne diseases. Two hundred and seventy two (61.26%) respondents declared that they had suffered or a member of the household had suffered from a waterborne disease two weeks before the interview and most of them declared that they visited the hospital for consultation (n=233; 55.74%) while 38.08% visited traditional healers (n=155; 38.08%). Very few people mentioned auto medication as the action undertaken when sick and that they bought their drugs from the market and the road side.

III.3.1. Knowledge on Waterborne diseases according to study area

The proportion of respondents who knew about or cited some WBD varied significantly between Sub-Divisions (χ^2=8.75: P=0.003) with 89.9% in Mbouda and 79.81% in Babadjou.

III.4. Behaviour during collection, storage and preservation of potable water

Almost all households used specific vials in storing drinking water (n=450; 97.83%). These containers were mostly narrowed mouthed plastic jugs with most of them being cleaned with soap and water. Most respondents revealed that their storage containers were only cleaned when water got finished (n=309; 67.91%). They also declared that these containers were closed (97%) after collecting water with a mug but this declaration was not true in all households as Investigators observed some open containers at the time of data collection (personal observation). A majority of respondents trekked far distances (0.5km to 2km away) from their homes to get water while very few collected water around or at home. A few house

heads (n=113; 24.56%) declared treating water before drinking with chlorination (40.02%) and filtration (28.32%) as the main treatment techniques (Table 3).

III.4.1. Behaviour of participants during collection, storage and preservation of water according to Sub-Division

No significant difference was observed in residents of both study sites concerning water storage, method of collection and measures taken to prevent drinking water contamination. Collecting water at home or around houses was more represented in Mbouda, n=46; 18.4% vs. n=14; 6.7% (χ^2=9.99; P=0.001) where people owned boreholes and taps at homes while in Babadjou, residents fetched water from far away distances.

III.5. Relationship between good practices, good knowledge and level of education,

The study also depicted the association between good knowledge, good practice of waterborne diseases and educational level. Knowledge on waterborne diseases was associated with educational level. Respondents with high education (secondary and university) listed more diseases compared to those with primary education. This is presented on table 4. From the analysis, it appeared that participants with the University or Secondary levels of education had better knowledge on WBD compared to those with the Primary level (OR=3.75; P=0.015). Again, respondents with the University or Secondary levels presented good practices at home to prevent waterborne diseases compared to those with the primary level (OR=3.2; P=0.036).

III.6. Determinants of the occurrences of WBD in households

Comparisons were also conducted to assess any association between those that suffered from any waterborne diseases two weeks before the study with some categorical variables such as knowledge and practice of WBD, house type, Sub-Division and educational level. This knowledge was also associated with the respondent's health history; those who declared having suffered from any waterborne diseases for the past two weeks before the study listed more diseases compared to others. From the analysis, it appeared that the risk of suffering from WBD was not associated with educational level, Sub-Division, house type, practice and knowledge about WBD (P≥0.05). It was found that only the type of drinking water is a risk factor (determinant) for waterborne diseases, meaning that those that declared drinking water from wells have high risk of suffering from waterborne diseases than others (Table 5).

III.7. Household general hygiene practices

Residents of Bamboutos were equally interviewed on their general hygiene practices at home on daily basis and their responses are summarized in the Table 6. Most people declared that they defecated in the toilet while a minority mentioned bushes and pigsties. Most respondents revealed that they only visit the toilet for intimacy reasons (n=200; 43.48%) and for fear of spreading diseases (n=193; 41.96%) while some (n=116; 25.22%) said it was just for hygiene purposes that they used the toilets. A vast majority (n=452; 98.26%) said they washed their hands before and after eating (98.26%) and after visiting the toilet (n=358; 77.82%) with water and soap (n=403; 87.60%). In addition, few households declared they did laundry at the same springs (n=54; 11.74%) and rivers (n=144; 31.30%) where they fetch their drinking water.

III.7.1. Household general hygiene practices according to Sub-Division

The household general hygiene varies with the study site ($p < 0.05$). In both sites, most participants used the toilets for defecation but few declared going to bushes or using the pigsty as toilets. In Babadjou, most residents declared washing their clothes at home (n=191, 90.95%) compared to Mbouda (n=217; 86.8%) but without any significant difference ($\chi^2=0.07$; P=0.78). In Mbouda, the same springs where residents collected drinking water were used for doing laundry (Table 6).

Discussion

This study was conducted with the main aim to assess the level of awareness and practical measures put in place by the residents of Bamboutos Division to prevent the occurrences of waterborne diseases. In general, it was observed that residents of the Bamboutos Sub-Division drink water from unimproved sources. Majority had little or no knowledge on waterborne diseases and did not use good practices that could prevent waterborne diseases. It was observed that the type of drinking water did not vary between the two seasons but interestingly, some inhabitants turn out drinking rain water during the rainy season. Such behaviour might be due to the fact that they go long distances to get drinking water. Majority of the respondents got drinking water from springs and wells. This finding is in accordance with the results of obtained by Fonyuy [12] in Santa, North West Region of Cameroon and can be attributed to the fact that only a few households possess pipe borne water which do not even flow frequently. This result confirms the Water, Sanitation and

Hygiene (WaSH) report showing low and middle income countries with limited access to drinking water [13] where a basic drinking water service includes drinking water from an improved source. In some houses with children of less than five years of age, it was observed that they used sachet water which is not a good practice as it was reported by Blé *et al*. [14] in Ivory Coast; Managa *et al*. [15] in Douala, Cameroon and Olewo *et al*. [16] in Nigeria that sachet water is very polluted and unsafe for drinking. It was equally observed that those drinking rain and well water were more represented in Babadjou than in Mbouda. This can be attributed to the fact that Mbouda is more urbanised as compared to Babadjou, where residents still rely on alternative water sources. However the GWP, reported only 23% of Cameroonians in rural areas have access to potable water [6].

Most respondents (85.09%) could cite only one waterborne diseases implying a low level of knowledge as a whole. This is because the level of knowledge was evaluated based on the number of diseases cited and most participants fell under the poor level of knowledge as they could cite only one WBD. This can be supported by the fact that some household members went as far as citing malaria and Diabetes as examples of WBD. Typhoid was the most cited waterborne diseases. This remark is in accordance with the findings of Bodzewan, [17] who equally recorded typhoid as the most known type of waterborne disease in the Bamendakwe municipality, North West Region Cameroon. Typhoid is the most common WBD in the country regardless of the locality in addition to cholera mostly found in northern part of the country. Also, the severity of this disease or better still, the morbidity it causes to human health can create awareness at the household level and make people always remember its name. However, it was proven in this study that those who had suffered from a WBD two weeks before the study could name many diseases as compared to others. Interviewees with higher level of education mentioned many waterborne diseases as compared to illiterates or those who stopped at the primary level of education. This is not surprising as education will always go a long way in creating awareness not only on waterborne diseases but on other disciplines in general. A similar finding was also reported by Talipouo *et al*. [18]. The severity of these diseases on human health could be supported by the fact that 61.26% of the respondents or a member of the household had suffer from a waterborne diseases two weeks before the interview, showing how regular these diseases occur. However most of the respondents visited the hospitals whenever they felt sick of any of the diseases while some visited traditional healers or practiced auto medication. Such behaviours can be attributed to lack of knowledge or even poverty as they may find it cheaper buying drugs at the market

rather than going to the hospitals. Again, Talipouo *et al*. [18] also reported 36.2% of respondents buying drugs at the roadside for malaria treatment.

The present study equally evaluated the water storage attitude and practices among households where the absence of piped borne water into households encourages the storage of drinking water for long periods as most members declared washing their jugs only when water got finish. Over 97.83% of respondents revealed that they stored water in plastic narrow mouthed jugs. This is a good practice as the use of wide mouthed containers for storage of drinking water has been found to be associated with increased microbial contamination [19]. Most respondents (67.91%) revealed that due to shortages in potable water, they washed their containers only when water got finished from the vessels; meaning they do not change their water regularly. A similar result was obtained by CDC [20] in Linden, Guyana where respondent stored water for long periods in storage tanks [20]. This indicates that they knew the importance of washing storage containers before collection but ignored that leaving drinking water for long periods might increase not only the growth of already present microorganisms but equally increase the chances of getting further contamination [21]. This urges the need for the evaluation of water quality at the household level to verify the effects of long term storage after collection. A majority of respondent trekked far distances (0.5km to 2km away) from their homes to get water while very few collected water around or at home. This can be attributed to lack of good water around homes. However 85.02% said they used water and soap to wash their containers, which is ideal for storage containers. Ninety six percent revealed that they kept water recipients closed and used mugs in collecting water. Even though adapting a tap on storage jugs exposes less the water to contamination, keeping the jug closed as well is a good practice as children could play around or contaminate water when they want to drink water themselves. Majority of the participants said that they drink water as such, i.e. without any treatment process. A similar observation was also reported by Fonyuy [12] in Santa and Verma *et al*. [22] where 83.5% of respondents drank water without any further purification. Amongst those that treated their water, chlorination (40.02%) took the lead followed by filtration with 28.32%. Fonyuy [12] equally revealed these treatment techniques with the exception that boiling was the most used method followed by chlorination in North West Region. The use of these methods can be attributed to the fact that they are cheap and easily affordable by the populations.

This study equally evaluated the association between good knowledge, good practice of waterborne diseases and education level. Participants with the University or Secondary levels of education had better knowledge on WBD (OR=3.75; P=0.015) with good practices

(OR=3.2; P=0.036) at home to prevent waterborne diseases. This is not surprising as education will always go a long way in creating awareness.

Some categorical variables such as water source, house type, education level etc were equally associated to those that suffered any WBD two weeks before the study and was depicted that well water predisposes residents to contamination with WBD. This observation is similar to those of Olowe *et al*. [16] in Ado-Ekiti in Nigeria and Yassin *et al.* [23]. This implies that well water may be a more contaminated water source in the locality as Nchang [24] reported 17 out of eighteen wells to be highly contaminated, with bacteria in Bambui and Bambili residential areas, North-West Region, Cameroon.

General hygiene practices were equally evaluated as summarized on table 4. Over 98.91% declared they owned a toilet at home and used it for defecation while surprisingly, a few respondents (1.08%) declared using the pigsties for defecation purposes. This is a call for concern as it poses at stake the health of both humans around the vicinity and the animal itself. This finding is contradictory to the results obtained by Kalyan *et al*. [25] where only 31.8% of households interviewed had functional toilets. About half of the study population perceived that the use of a toilet at home could prevent the spread of diseases and was good for intimacy reasons. Laundry was mostly done at home (88.70%) while some declared washing dresses at rivers and springs where they fetched water used for drinking purposes. Such practices are not good because washing dresses around springs could contaminate the water. Regarding hand washing practices, 98.26% of the respondents washed their hands before and after meals, with most (87.60%) of them using soap and water. Seventy seven percent equally declared washing their hands after using the toilet. These findings are in line with the results registered in India by Sudhir *et al*. [26] where 96.7% of the respondents washed their hands with soap and water before eating food and 97.3% after defecation. This can be attributed to the fact that populations are gradually gaining awareness on the importance of personal hygiene at the household level.

Conclusion

The study showed that knowledge, attitude and practice on WBD is inconsistent in the study area, with some aspects known to a majority while certain other aspects are left out. The variation of drinking water sources in the locality is a clear indicator that residents lack good drinking and turn out getting water from alternative sources. Lack of knowledge and trekking far away distances has led to inappropriate water storage conditions. The study hence recommends creating awareness to reduce WBD and stresses the need for implementing

additional educational approaches, such as community educators who can disseminate information on good water storage practices and more effective low-cost technologies of water treatment through radios in local languages and social media (Facebook, WhatsApp, and YouTube). Furthermore the results from this study urges the need for further studies on the assessment of water quality from the collection sites to the point-of-use (household level). It is also important to explore clinical data in the study area as information collected could be used as baseline data for the fight against WBD.

Consent for publication

Not applicable

Availability of data and material

Not applicable

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Table 1: Socio-demographic and Households' characteristics in Bamboutos Division.

Items	Characteristics	N	Frequency (%)

Gender	Male	124	26.96
	Female	336	73.04
Interviewee	Child	77	16.74
	Father	86	18.70
	Mother	297	64.56
Highest level of education completed	None (illiterate)	5	1.08
	Primary level	171	37.17
	Secondary level	268	58.26
	University level	16	3.48
Occupation	Public servant	53	11.52
	Small scale business	236	51.30
	Farmer	122	26.52
	unemployed/Students	49	10.65
Type of constructions	Cements	224	48.70
	Bricks/block	233	50.65
	Others	3	0.7
Households with children less than 5 yrs	Yes	303	65.87
Age of respondents	<20	40	10.9
	20-29	80	21.9
	30-39	86	23.5
	40-49	65	17.5
	≥50	95	26.0
Number of People in houses	<5	130	28.3
	5-9	274	59.6
	≥10	56	12.2

Table 2: Population knowledge on waterborne diseases and treatment seeking behavior

Variables	Answers	N	Frequency (%)
Knowledge of waterborne disease	Yes	371	85.09

	No	65	14.91
Type of waterborne disease	Dysenteries	154	41.51
	Cholera	191	51.48
	Typhoid	331	89.22
	Diarrhea	70	18.87
	stomach ache	25	6.74
	Worm	7	1.89
	others	25	6.74
Suffered from water borne disease recently	Yes	272	61.26
	no	172	38.74
Action undertaken when people have WBD	Hospital	233	55.74
	Auto medication	30	7.16
	Traditional healer	155	38.08
Source of drug in case of auto medication	On road side	13	43.33
	Hospital	2	6.67
	Pharmacy	9	30.00
	Market	17	56.67

Note: Percentages do not add up to 100 because these results are from multiple response questions

Table 3: Attitudinal and practical measures during collection, storage and preservation of water

Variables	Answers	N	Frequency (%)	P value
Use of specific vial to store drinking water	Yes	445	96.74	<0.0001
	No	15	3.26	
Storage condition of drinking water	Plastic jug	450	97.83	
	Metal	18	3.91	<0.0001
	Calabash	2	0.43	
Washing frequency of storage container	Daily	77	16.92	
	Weekly	30	6.59	<0.0001
	Monthly	12	2.64	
	when water got finish	309	67.91	
	rarely	27	5.93	
Practical measure after collection from storage container	Close	442	96.72	<0.0001
	Open	15	3.28	
Method of collection from recipient	Mug	443	96.30	<0.0001
	Tap	24	5.22	
Washing of storage container	Water	36	7.93	
	Water and soap	386	85.02	<0.0001
	Water and sand	29	6.38	
	Others	3	0.66	
Distance from house to point of collection	At home	56	12.17	
	<50m	56	12.17	
	[50 -100m[	61	13.26	
	[100 – 500m[	87	18.91	<0.0001
	>500m	131	28.48	
	1km	59	12.83	
	2km	59	12.83	
Treatment method	Ebullition	17	15.04	
	Sedimentation	7	6.19	
	Filtration	32	28.32	<0.0001
	Solar	0	0	
	Chlorination	52	40.02	
	Salt	5	4.42	

Note: Percentages do not add up to 100 because these results are from multiple response questions

Table 4: Association between level of education and knowledge of WBD/ good practices

Variables	Education level	N respondents	% with good knowledge/good practice	OR(95% CI)	P value
Knowledge of WBD	Primary	169	17.2	[a]1	
	Secondary	267	23.7	1.39(0.85-2.28)	0.181
	University	16	43.8	3.75(1.29-10.89)	0.015
Good practices	Primary	171	15.8	1	
	Secondary	268	25.0	1.77(1.08-2.92)	0.022
	University	16	37.5	3.2(1.07-9.54)	0.036

OR (95% CI): odd ratio (95% confidence interval); [a]Reference Category.

Table 5: Risk factors of water borne disease in Bamboutos

Suffering from WBD past 2 weeks

	YES	No	OR (95%CI)	P value
Type of water				
Well	96	38	1[a]	NA
Drilling/borehole	73	51	0.57 (0.34-0.95)	0.03
Stream	0	4	0.04 (0-0.84)	0.038
Spring	123	73	0.67 (0.41-1.07)	0.09
Rain water	98	56	0.69 (0.42-1.14)	0.14
Education level				
University	10	6	1	NA
Secondary	162	93	1.04 (0.37-2.97)	0.93
Primary	99	70	0.84 (0.29-2.44)	0.76
Sub-Division				
Babadjou	122	81	1	NA
Mbouda	150	91	1.09 (0.74-1.61)	0.64
House type				
Cements	133	85	1	NA
Brick/block	137	86	1.02 (0.70-1.49)	0.93
Knowledge of WBD				
Good	61	34	1.12 (0.74-1.90)	0.46
Poor	208	138	1	
Practice on WBD				
Good	62	36	1.11 (0.7-1.77)	0.64
Poor	210	136	1	

OR (95% CI): odd ratio (95% confidence interval); **NA: Not applicable; [a]Reference Category.

Table 6: Hygiene practices employed at the household level on daily basis.

Variables	Answers	N	Frequency (%)
Where they defecate	Toilet	455	98.91
	Pigsty	5	1.08
	Farm	10	2.17
Reasons for using toilet	Intimacy	200	43.48
	Diseases prevention	193	41.96
	Hygiene purposes	116	25.22
	Avoid odors	37	8.04
Where they do laundry	At home	408	88.70
	Rivers	144	31.30
	spring	54	11.74
Occasion for hand washing	Before and after food	452	98.26
	Before cooking	149	32.39
	After using the toilet	358	77.82
Hand washing practice	Water	83	18.04
	Water and soap	403	87.60

Note: Percentages do not add up to 100 because these results are from multiple response questions

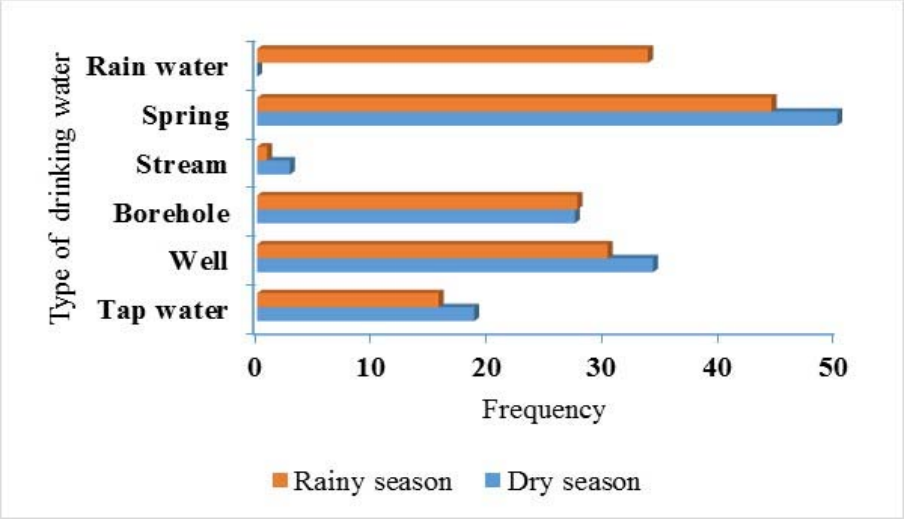

Figure 1: Source of drinking water according to seasons in Bamboutos Division

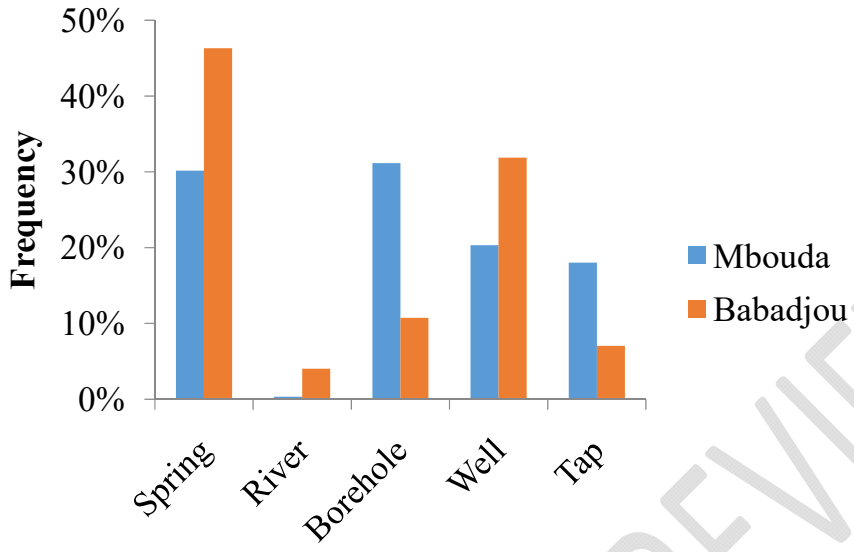

Figure 2: Source of drinking water according to Sub-Divisions