Diarrheal Diseases and Evaluation of Inhabitants' Knowledge, Attitude and Practices regarding Water Safety, Sanitation and Hygiene in Cholera Endemic Localities of Douala, Cameroon

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Abstract

Purpose: In Cameroon, about 3.8 million people lack access to safe water and sanitation facilities. Frequent outbreaks of diarrhea diseases, particularly cholera, a diarrhea disease caused by *Vibrio cholerae*, occur in Douala due to inadequate water, sanitation and hygiene (WASH). This has qualified the city of Douala as a cholera-endemic area. Recent outbreaks in Douala have increased in size.and occur towards the end of the dry season. This study determined the prevalence of diarrhea and evaluated inhabitants' knowledge, attitude and practices (KAP) regarding WASH in cholera endemic localities of Douala.

Design/methodology/approach: A community-based cross-sectional survey was conducted between July and September 2017 in three health districts: New Bell, Nylon and Deido, to evaluate inhabitants' KAP, and diarrhea prevalence. A retrospective hospital-based study was conducted to determine diarrhea prevalence from 2011-2015. The Chi Square and multivariate regression were used to analyze data.

Findings: Prevalence of diarrhea in community-based study (17.9%) was higher than 11.1% in the retrospective study. Overall, good KAP (mean score of ≥ 50% for knowledge and attitude and ≥ median score for practices) was observed respectively in 38%, 66% and 80% of respondents. Participants with good knowledge (p=0.066), good attitude (p=0.011) and good practices (p=0.084) on WASH were less likely to have diarrhea than those with poor knowledge, poor attitude and poor practices. However, a significant association was observed only for good attitude.

Originality/Value of the paper: This study has identified gaps in KAP and show that there is an urgent need for interventions to enhance behavioral change to prevent WASH-related diseases and promote health. Data generated could be used to monitor Cameroon's progress towards the attainment of SDG 3, SDG 6 and SDG11. The research team intends to collaborate with the Douala Municipality and public health authorities to ensure improvement in WASH and behavioral change.

Keywords: Diarrhea; Knowledge, Attitude and Practices; Water, Sanitation and Hygiene, Douala, Cameroon

Purpose

Diarrhea disease is a global public health problem. It is a threat to health security and a developmental challenge. Global estimates show that in 2016, diarrhea was the eighth leading cause of death claiming over 1.6 million lives, the fifth leading cause of death among children under 5 years and the third cause of disability-adjusted life years (DALYs) (Global Burden of Disease (GBD) 2016 Diarrhea Disease Collaborators, 2018). Diarrhea was the second leading cause of mortality and the leading cause of malnutrition in children under 5 years old in 2017 (WHO, 2017a). The highest burden of diarrhea occurs in low-and middle-income countries (GBD 2016 Diarrhea Disease Collaborators, 2018; UNICEF, 2016), where it disproportionately affects individuals in the low socioeconomic index group. The highest burden occurs in children 5 years and below (Manetu et al., 2021; UNICEF, 2021), accounting for 63% of the global burden due to diarrhea (Zhang et al., 2016). Although global statistics show a significant decline in mortality due to diarrhea, from 1.2 million to 526,000 between 2000 and 2015 (GBD 2016 Diarrhea Disease Collaborators, 2018; UNICEF, 2016), morbidity and mortality due to diarrhea are still a serious concern in low- and middle-income countries (GBD 2016 Diarrhea Disease Collaborators, 2018), particularly in sub-Saharan Africa and south Asia, where there is lack of resources and inadequate infrastructure for diarrhea disease management. In Africa, the burden due to diarrheal disease remains high; there were about 30 million cases of severe diarrhea and 330, 000 deaths in African in 2015 (Reiner et al., 2018).

The occurrence of diarrhea and associated deaths have been linked to lack of clean water, inadequate sanitation and poor hygiene (GBD 2016 Collaborators, 2018; Soboksa et al., 2021; Getahun et al., 2021). Diarrhea diseases caused by unsafe drinking water and poor sanitation were identified as the top two leading risk factors resulting in mortality globally for individuals aged five years and under in 2017 (GBD 2017 Collaborators, 2018). About 88% of diarrheal associated deaths are attributable to unsafe water, inadequate sanitation and insufficient hygiene (CDC, 2020). In addition, water, sanitation and hygiene (WASH) have been linked to the spread of neglected tropical diseases (NTDs), adverse health outcomes such as stunting, wasting and underweight, and social outcomes (WHO, 2017b, WHO, 2021; Pickering et al., 2015; Cumming and Cairncross, 2016; Mbuya and Humphery, 2016; Mills and Cumming, 2017), hence constituting a developmental challenge as it affects the progress towards the attainment of other Sustainable Development Goals (SDGs). Multi-country studies by Fuller et al. (2015) and Esrey et al. (1996) have reported larger impacts on health following concurrent improvement of water and sanitation compared to improvements on water or sanitation alone. Despite the enormous data underscoring the importance of WASH in mitigating the occurrence of diarrhea diseases as well as other waterborne diseases, access to WASH is still a problem in some parts of the world. Global statistics demonstrate an overall increase in access to improved water and sanitation in low-middle income countries (LMICs) between 2000-2017, but this improvement is still very insignificant in sub-Saharan Africa where access is concentrated mainly in urban areas than in rural areas (Local Burden of Disease WASH Collaborators, 2020).

Safe water and sanitation, which contribute to appropriate hygiene, are fundamental determinants of individual and social health and well-being (Bolatova et al., 2021) as they are of paramount importance in the prevention of waterborne diseases including diarrhea. Knowledge, attitudes, and practices (KAP) is one of the corner stones in the fight against a disease as it permits the identification of misconceptions which when addressed will contribute to disease prevention and control. Lack of knowledge, attitude and practices (KAP) is one of the major contributors to the transmission of infectious diseases (Dreilbelbis et al., 2013). Thus, even if appropriate WASH facilities are provided and there is poor compliance due to inadequate KAP, diarrhea disease will continue to occur. This is because access to WASH alone without adequate compliance is ineffective in mitigating health problems associated to unsafe water and poor sanitation and hygiene (Barnard et al., 2013). Thus, since an adequate KAP with regards to WASH are of paramount importance in the prevention of diarrhea diseases, it is necessary to evaluate KAP on WASH to identify gaps which must be addressed so as to achieve a sustainable and effective implementation of WASH programs in communities.

Cameroon, a central African country located in the Gulf of Guinea, bordered by Nigeria to the west and north; Chad to the northeast; the Central African Republic to the east; and Equatorial Guinea, Gabon and the Republic of the Congo to the south, has, over the years, received support on WASH from its partners (Reach Initiative, 2019; Manah, 2014; OCHA, 2022). Even with this, access to WASH is still a challenge particularly in the rural parts of the country and urban slums. According to the United Nations SDG Goal #6: Clean Water and Sanitation snapshot, 79% of the population of Cameroon used safely managed drinking water services, 60% used improved sanitation with 6% practicing open defecation, while 36% had a hand-washing facility with soap available (UN, 2020). This shows that although there is progress in safe water, sanitation and hygiene are still a problem. Frequent outbreaks of cholera occurring in Cameroon indicates that inadequate access to WASH is a public health concern. Recent cholera outbreaks in various parts of Cameroon have been related to poor sanitation (WHO, 2021). The National Health Development Plan (NHDP) of Cameroon for 2016-2020 (MoH, 2016) recognizes low access to potable water, poor hygiene practices and waste management as key health determinants in Cameroon. Studies conducted in various parts of the country have reported a high prevalence of waterborne diseases (Lontuo-Fogang et al., 2021; Gorham et al., 2017; Djaouda et al., 2020) showing that there is an urgent need to address WASH in Cameroon.

Douala, a coastal town and the Economic capital of Cameroon has experienced a rapid, unplanned and unmanaged urbanization due to an influx of rural dwellers in search for employment opportunities. In addition, the socio-political crisis in some parts of the country that started in 2016 has forced people to flee to Douala (and other cities) for safety, further swelling the population. This has placed a heavy burden on the limited WASH infrastructures in Douala. Hence, Douala continues to experience outbreaks of waterborne diseases, particularly cholera despite the WASH interventions carried out. The effectiveness of WASH in diarrhea disease reduction depends on the provision of WASH infrastructure and compliance of individuals. This was observed in a collaborative study in Bamuso Health District between the University of Buea and Plan International, Cameroon (Akoachere, 2015). The present study was therefore aimed at evaluating the prevalence of diarrheal diseases and its association with inhabitants' KAP

regarding WASH in three cholera endemic localities of Douala, Cameroon, in a bid to identify interventions needed to prevent diarrhea and promote health in these localities. Furthermore, the findings of this study may contribute to efforts to monitor Cameroon's progress towards the achievement of the UN Sustainable Development Goals, particularly SDG #6 and #3: Good Health and Well-being.

Design/Methodology/Approach

Study Area and Design

This study was carried out in three health districts in Douala, Cameroon: New Bell, Nylon and Deido. Douala is the economic capital of Cameroon and the county's main port. This coastal city lies between Latitude 4°2'N to 5°4' N and Longitude 9° 9' E to 11°5' E and has an estimated population of over 3.9 million inhabitants (World Population Review, 2022) with an annual growth rate of 3.51%. Douala has an average annual rainfall of 3174 mm and average annual temperature of 26.9^{o}C (Climate-Data.org). It has an equatorial climate of two seasons: the dry season which runs from November to April, with January and February being the hottest months, and the rainy season which lasts from May to October (Climate-Data.org). The months of July, August and September have the highest rainfall in Douala. The city has poor drainage due to poorly constructed drainage system which often get blocked as a result of arbitrary refuse dumping, and causes flooding after heavy rains. Douala lacks a sewage system and sewage treatment facilities hence untreated sewage is discharged indiscriminately into the environment (The New Humanitarian, 2004). The three health districts which are the focus of this study: New Bell, Nylon and Deido were purposively selected because they are cholera hotspots in Douala (Ateudjieu et al., 2019).

This was a quantitative community-based cross-sectional study conducted between July and September 2017, and a retrospective hospital-based cross-sectional study, involving a review of patients' records for diarrheal cases from 2011-2015, in one major health facility in each of the three health districts. This study was conducted in the Department of Microbiology and Parasitology, University of Buea, in partnership with the Littoral Regional Delegation of Public Health.

Sample Size Determination

The sample size was calculated using the formula for estimation of single proportion (Berhe et al., 2020). An anticipated population proportion of 0.5 (50%) was used since the population proportion was unknown. Absolute precision (i.e. margin of sampling error) tolerated was set at 5%, at 95% confidence interval, using the formula:

$n = Z^2_{1-\alpha/2} [P (1-P)]/d^2$

Where

n = sample size, P = Population proportion = 50% (0.5), q = 1 – p (1-P) = 1- 0.5 = 0.5

d^2= margin of sampling error tolerated at 95% confidence interval = 5%. Hence, n = $(1.96)^2$ x 0.5 (1-0.5)/ $(5)^{2,}$ n = 368.00. Adjusting for non-compliance rate (Maumita and Pranita, 2016) of 30%, noncompliance = 30/100 x 368.00 = 110.40. Thus, the adjusted sample size = 368.00 + 110.40 = 478.40. Working sample size ≈ 480 subjects. Accounting for a design effect of 1.5, gave 1.5 x 480 = 720 subjects as minimum sample size.

Sampling Technique

In the community-based study, three health districts in Douala: Nylon, New Bell and Deido were purposively selected based on their history of cholera outbreak. In the district of Deido, Bepanda health area was selected purposively because of its high cholera attack rate during cholera outbreaks. In Nylon and New Bell, simple random sampling was used to select participating health areas. Four out of ten health areas in New Bell (Camp Yabassi, Youpwe, Kassalafarm and Nkololoun) and three out of seven health areas in Nylon (Tergal, Oyack, and Madagasca I) were selected. In Bepanda health area, 3 out of six quarters (Bepanda TSF Cacoa Barry, Bepanda TSF and Bepanda Voirie) were selected.

Those included in the community-based study were household heads, male or female adult adults responsible for the organization and care of the household (or a representative ≥ 21 years when household head was absent), who granted consent and has been living in the study site for more than one year. For the retrospective study, all patients who sought care in the selected health facilities, had diarrhea as diagnosed by a clinician and were residing in study health districts were recruited.

Data Collection

Data was collected using a pre-tested structured questionnaire and an on-the-spot observation checklist. The structured questionnaire was prepared in English and translated to French, as French is the most widely used language in Douala. The questionnaire was adapted from relevant literature (Pachori, 2016; Shriya et al.,2014; Sah *et al*., 2015; Rima et al., 2017). It consisted of five sections: Section A captured information on the socio-demographic characteristics of participants; Section B, knowledge on WASH; Section C, attitudes towards WASH; Section D, practices on WASH, while section E had questions on diarrhea occurrence. Occurrence of diarrhea was defined as having loose or watery stool at least three times in 24 hours period one month prior to the survey, as reported by the respondent. The questionnaire included several close ended questions which helped to evaluate participants' knowledge, attitude and practices on WASH. An observational checklist was also used to evaluate WASH facilities, compound cleanliness, excreta and refuse disposal. Three research assistants were recruited and trained to assist in data collection. The training was on the objectives of the study, content of the questionnaire, approaches to be used during data collection and how to double check filled questionnaires.

In the retrospective study, data on diarrhea was obtained by reviewing patients' hospital records for diarrhea as diagnosed by a physician in selected health care facilities in the study site. Data

of patients who sought health care from 2011-2015 was collected using a data capture form. The socio-demographic characteristics of the patients were also recorded.

Data Entry and Analysis

Data was entered into Microsoft Excel and Epidata version 7 and analyzed using the statistical software SPSS version 20. Descriptive statistics were employed to analyze participants' KAP on WASH. The Chi square test was used to analyze the association between diarrhea occurrence, socio-demographic factors and KAP of respondents. Multiple logistic regression analysis was used to investigate the association between good KAP and socio-demographic factors and an association between KAP and diarrhea occurrence. P-values less than 0.05 were considered significant.

To evaluate KAP on WASH, respondents, were required to provide either "yes"/"no" responses or to select a response from options provided. Each correct response on knowledge, attitude and practices was assigned a score of one (1) and an incorrect response was assigned a score of zero (0). For those questions in which participants had to select a response from options provided, a score of one (1) was assigned to a correct response and zero (0) to an incorrect response. A composite score was calculated for knowledge and attitude, and respondents ranked into two categories based on the mean value: good knowledge and good attitude for those who scored above the mean (50-100%), and poor knowledge and poor attitude for those who scored below the mean (<50%). With regards to practices on WASH, since data was not normally distributed, the median was used as the cut-off point. Those who scored less than median scores were classified as having poor practices on WASH while those that scored equal-to or more than median scores were classified as having good practices.

Ethical Considerations

Ethical approval of the study was obtained from the Faculty of Health Sciences Institutional Review Board of the University of Buea (Ref. 2017/027/UB/SG/IRB/FHS). Administrative approval was obtained from the Regional Delegation of Public Health for Littoral Region (Ref. 1551/AAR/MINSANTE/DRSPL/BCASS) and from the District Medical Officers of the respective study districts. Verbal permission to work in the selected communities was obtained from the Quarter Heads of those areas. The purpose of the study was explained to the participants. Participation was voluntary. Participants indicated their willingness to participate by signing an informed consent form.

Findings

Socio-demographic Characteristics of Retrospective Study Participants

A total of 7,884 patients' records were reviewed. This comprised 3,037(38.5%) from Despansaire Catholique Barcelone in Nylon health district, 2,315 (29.4%) from CMA Nkololoun in New Bell health district and 2,532 (32.1%) from CMA Bepanda in Deido health district. The majority of

participants were female (57.8%), 1-5 years old (18.6%) and consulted in the year 2013 (26%) (Table 1).

Table 1 Socio-demographic Characteristics of Retrospective Study

Indicator	Categories	n	(%)
Health facility (Health Area)	CMA Nkololoun (New Bell)	2315	29.4
	CMA Bepanda (Deido)	2532	32.1
	Despansaire Catholique Barcelone (Nylon)	3037	**38.5**
Gender	Female	4558	57.8
	Male	3326	42.2
Health areas	Bepanda	2532	**32.1**
	Camp yabassi	295	3.7
	Kassalafam	362	4.6
	KM5	256	3.2
	Madagasca1	251	3.2
	Makae	73	.9
	New bell bamileke	745	9.4
	Ngangue	42	0.5
	Nkolmitag	34	0.4
	Nkololoun	474	6.0
	Nkongmondo	27	0.3
	Oyack	**1597**	**20.3**
	Tergal	1203	15.3
	Youpwe	6	**0.1**
Age categorized	<1Years	147	1.9
	1-5	1463	**18.6**
	6-10	672	8.5
	11-15	474	6.0
	16-20	628	8.0
	21-25	914	11.6
	26-30	852	10.8
	31-35	558	7.1
	36-40	397	5.0
	41-45	302	3.8
	46-50	262	**3.3**
	50+	1215	15.4
Occupation of the Patients	Business	974	12.4
	Civil Servant	143	1.8
	Informal sector	862	10.9
	Student	1626	**20.6**

Indicator	Categories	n	(%)
	Retired	212	2.7
	Infants	1042	13.2
	Housewife	1540	19.5
	Pupil	1137	14.4
	None	336	4.3
	Farmer	12	**0.2**
	2011	1175	**14.9**
	2012	1387	17.6
Year of consultation	**2013**	2051	**26.0**
	2014	1793	22.7
	2015	1478	18.7
Total		**N=7884**	**100**

N=Total number of participants; n=number of participants per category; %=percentage

Socio-demographic Characteristics of Community Participants

A total of 738 household heads participated in this study. The majority were female (66.7%), age 21-30 years (47.3%), had attained secondary education (52.3%) and were from New Bell (49.1%). Over half of the participants lived in rented houses (51.5%) of size 1-3 rooms (76.6%) and the majority had a household size of 4-6 persons (44.4%) (Table 2).

Table 2: Socio-demographic Characteristics of Participants (N=738) from Various Communities

Indicator	Categories	n	(%)
	Deido	196	26.6
Health District	**New Bell**	**362**	**49.1**
	Nylon	180	24.4
	Bepand TSFCacao Barry	59	7.9
	Bepanda TSF	57	7.7
	Bepanda voirie	80	10.3
	Camp yabassi	70	9.5
Quarters	Kassalafarm/KM5	131	17.8
	Madagasca 1	60	8.1
	Nkololoun	22	3.0
	Oyack	56	7.6
	Tergal	64	8.7
	Youpwe	**139**	**18.8**
	21-30 years	**349**	**47.3**
Age	31-40 years	188	25.5
	41-50 years	88	12.0

	>50 years	113	15.3
Gender	**Female**	**492**	**66.7**
	Male	246	33.3
Household size categorized	1-3	187	25.3
	4-6	**328**	**44.4**
	7+	223	30.2
Is the house owned or rent	Owned	345	46.7
	Rented	**380**	**51.5**
	Rent free	11	1.5
	Other(specify)	2	.3
How many rooms are in your house	**1-3**	**565**	**76.6**
	4-6	163	22.5
	7+	7	0.9
Highest level of education	None	66	8.9
	Primary	184	24.9
	Secondary	**386**	**52.3**
	Tertiary	84	11.4
	Don't know	18	2.4
Occupation of the participant	**Business**	**320**	**43.4**
	Civil servant	64	8.7
	Informal sector	43	5.8
	Farmer	9	1.2
	Student	60	8.1
	Not working	242	32.8
Religion of the participants	**Christian**	**626**	**84.8**
	Muslim	103	14.0
	Ancestority/Traditional religion	9	1.2
Marital status of participants	**Married**	**433**	**58.7**
	Single	273	37.0
	Divorced/widow	32	4.3

N=Total number of participants; n=number of participants per category; %=percentage

Knowledge of Participants on WASH and Diarrhea Prevention

Over two-thirds of participants did know that diarrhea can be prevented by drinking potable water (72.2%), defecating in a toilet (84.6%) and by cooking food hygienically (70.1%). However, more than three-quarters of them were aware of hand washing as a method of diarrhea prevention (76.4%) though only 67.8% reported using soap to wash hands (Table 3). Overall, only 38.3% of participants had good knowledge (had a mean knowledge score of ≥ 50%) on WASH in diarrhea prevention (Fig. 1). Analyzing the socio-demographic factors independently associated with good knowledge revealed health district of residence that was significantly associated with good knowledge. Respondents from Bepanda (Deido Health district) and New Bell were 7.16 and 3.89

times, respectively more likely to have good knowledge on WASH compared to those from Nylon. Household size was associated with good knowledge though this was not significant (Table 4).

Table 3: Knowledge of Participants on WASH and Diarrhea Prevention

		Health District			
Parameter	**Response**	**Deido n (%)**	**New Bell n (%)**	**Nylon n (%)**	**Total n(%)**
Can diarrhea be prevented by drinking treated water?	Yes	52 (26.5)	04 (28.7)	49 (27)	205 (27.8)
	No	144(73.5)	258 (71.3)	131(73)	533 (72.2)
Diarrhea can be prevented by defecating in the toilet	Yes	28 (14.3)	64 (17.7)	22(12)	114 (15.4)
	No	168(85.7)	298 (82.3)	158 (88)	624 (84.6)
Proper handwashing is a method to prevent diarrhea	Yes	144 (73.5)	287 (79.3)	133(73.9)	564 (76.4)
	No	52 (26.5)	75 (20.7)	47 (26.1)	174 (23.6)
Diarrhea can be prevented by using soap to wash hands	Yes	127 (64.8)	253 (69.9)	120 (66.7)	500 (67.8)
	No	69 (35.2)	109 (30.1)	60 (33.3)	238 (32.3)
Cooking food hygienically is important in preventing diarrhea	Yes	73 (37)	100 (27.6)	48 (26.7)	221 (29.9)
	No	123 (63)	262 (72.4)	132 (73.3)	517 (70.1)

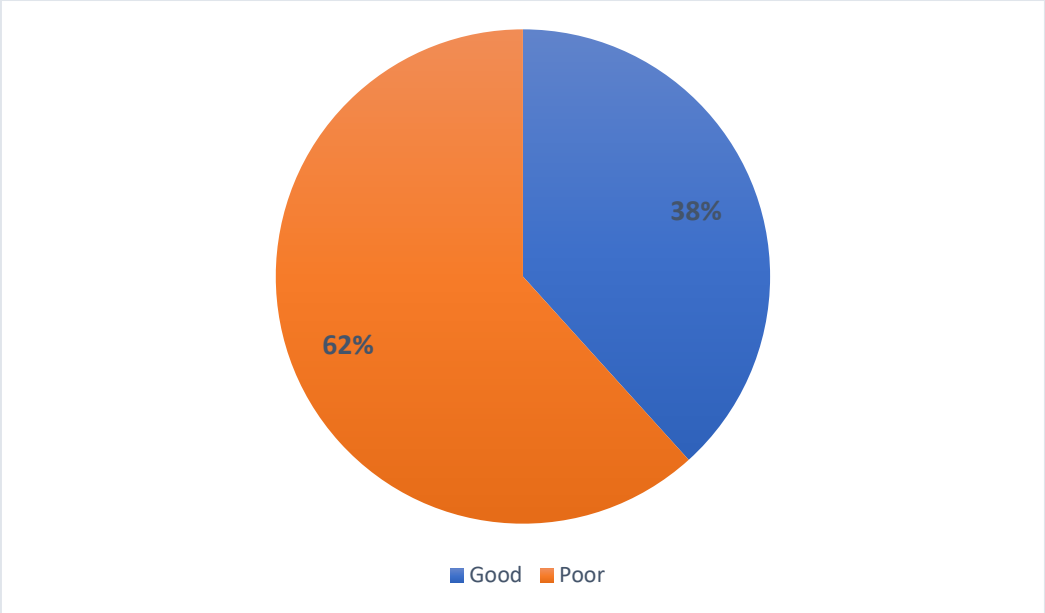

Fig. 1: Level of knowledge of participants of WASH and diarrhea prevention

Table 4: Factors Independently Associated with Good Knowledge

Variable	Categories	AOR	Sig.	95% CI	
				Lower	Upper
	Bepanda (Deido HD)	7.16	**0.000**	4.3	11.8
	New Bell	3.89	**0.000**	2.4	6.2
Health district	Nylon	1			
	Female	0.86	0.357	0.61	1.19
Gender	Male	1			
	> 10	1.68	0.141	0.84	3.34
	1_3	1.52	0.072	0.96	2.40
	4_6	1.30	0.212	0.86	1.95
Household size	7_10	1			
	Christian	0.36	0.171	0.08	1.56
	Muslim	0.27	0.096	0.06	1.26
Religion	Traditional	1			

HD: Health District; AOR: Adjusted Odds Ration; CI: Confidence interval; sig: significance

Attitude of Participants on WASH

Most of respondents (80.9%) considered their drinking water as safe. Those who regarded their drinking water as unsafe complained of its taste or smell (48.9%), microbial pollution (27%), the fact that it made them ill (24.1%) and also, its colour (6%). Littering the environment with rubbish was considered a big problem in the study area by the majority of participants (72.1%) with most of these being respondents from New Bell (77.6%). This causes blockage of the drainage system, which results in flooding after heavy rains and consequently, contamination of water sources, resulting in outbreaks of diarrhea disease. Over three-quarters of respondents (76.6%) considered littering the environment with rubbish as a crime (Table 5). Overall, 66% of respondents had a good attitude on WASH (Fig. 2).

Table 5: Attitude of Participants on WASH

Parameter	Response	Health District			Total
		Deido	New Bell	Nylon	
		n (%)	n(%)	n(%)	n (%)
How do you consider water shortage?	A big problem	36 (69.4)	268 (74.0)	130 (72.0)	534 (72.4)
	Not a problem	60 (30.6)	94 (26.0)	50 (28.0)	204 (27.6)
Do you think your water is safe drinking?	Yes	146 (74.5)	304 (84.0)	147 (82.0)	597 (80.9)
	No	50 (25.5)	58 (16.0)	33 (18.0)	137 (18.6)
If No, why?	It's appearance	45 (90)	46 (85.2)	29 (87.9)	120 (87.6)
	Bugs/worms/bacteria	18(36)	14 (25.9)	5(15.2)	37 (27)
	Chemical/pesticide	11 (22.0)	8 (14.8)	6 (18.2)	25 (18.2)

	Too much chlorine	13 (26)	8 (14.8)	2 (6.1)	23 (16.8)
	Tastes or smells bad	21 (42)	27 (50)	19 (57.6)	67 (48.9)
	Makes me ill	12 (24)	14 (25.9)	7 (21.2)	33 (24.1)
How do you consider your environment littered with rubbish?	A big problem	124 (63.3)	281 (77.6)	126 (70)	532 (72.1)
	Not a problem	72 (36.7)	81 (22.4)	54 (30)	206 (27.9)
Do you consider polluting the environment a crime?	Yes	112 (18.6)	263 (43.7)	86 (14.3)	461 (76.6)
	No	35 (5.8)	46 (7.6)	60 (10)	141 (23.4)

n=number of participants per category; %=percentage

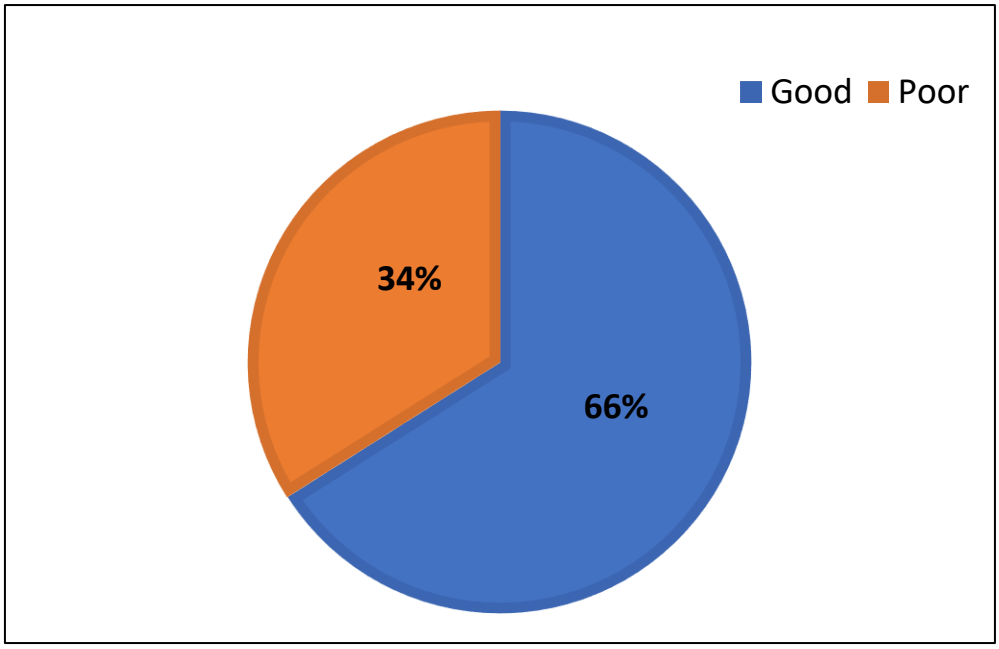

Fig. 2: Attitude of respondents to WASH

Being a student (AOR= 0.53, CI 0.30-0.93, p=0.026) or civil servant (AOR=0.56, CI0.32-0.96, p=0.036) was 0.53 times, and 0.56 times respectively less likely to have good attitude to WASH and this was statistically significant (Table 6).

Table 6: Factors Independently Associated with Good Attitude

Variable	Categories	Sig.	AOR	95% CI	
				Lower	Upper
Household size	7_10	0.421	0.74	0.36	1.54
	4_6	0.167	0.61	0.31	1.23
	1_3	0.105	0.55	0.27	1.13
	>10	.	1	.	.

Occupation	Unemployed	0.747	0.94	0.66	1.35
	Students	**0.026**	0.53	0.30	0.93
	Farmer	0.524	1.68	0.34	8.26
	Informal sector	0.495	1.29	0.62	2.67
	Civil service	**0.036**	0.56	0.32	0.96
	Business	.	1	.	.

AOR: Adjusted Odds Ration; CI: Confidence interval; sig: significance

Participants' Practices on WASH

The majority of participants obtained drinking water from a public tap (42%). Other major sources of water reported were rainwater (37%), well water (32%), tap inside the house (29.1%) and private tap in yard (25.6%) (Table 7). Overall, 97% of participants took less than 30 minutes to get water and return home, with the majority (41.1%) taking 5-10 minutes. Only 23% of participants sometimes did not have access to tap water for 24 hours. However, only 38.3% treated drinking water at home, mainly by filtration (89%). Most respondents stored drinking water in a container (90.4%) with 98.1% ensuring that container was closed.

Proper hand washing was a common practice in study communities as 99.1% of respondents reported washing their hands with soap though regular hand washing was practiced by 77% of respondents. With regards to critical periods for hand washing, all participants (100%) washed hands before eating, 78.6% washed hands after using the toilet, 65.7% washed hands before handling food while only 34.2% washed hands after changing diapers. Hand washing facilities were found in 33.1% of homes of which only 32.7% had soap (Table 7). Refuse was disposed mainly into vats (86.7%) which were subsequently emptied by the waste disposal company. However, a few respondents disposed refuse in a river (4.1%) or burnt it (3.3%). The environment of 72.1% of the houses was clean as it was not littered with refuse (Table 7).

With regards to sanitation practices, respondents used mainly pit latrine (59.3%) to dispose human waste. Half of them (50.5%) shared these facilities. Feces was observed in the environment of 7.9% of houses, though only 0.8% reported open defecation. 68.4% reported cleaning the toilet daily, while 30.2% cleaned after one week (Table 7). Overall, 80% of participants had good practices on WASH (Fig.3).

Table 7: Participants' Practices on WASH

	Health District			
	Deido n(%)	**New Bell n(%)**	**Nylon n(%)**	**Total n (%)**
What are the sources of water for drinking and domestic use				
Tap inside house	62 (31.6)	99 (27.3)	54 (30)	215 (29.1)
Private tap in the yard	61 (31.1)	94 (26)	34 (19)	189 (25.6)

Public or shared standpipe	76 (39)	151(41.7)	83 (46.1)	**310 (42)**
Neighbor's tap	20 (10.2)	57 (15.7)	29 (16.1)	106 (14.4)
Purchased bottled water	30 (15.3)	58 (16)	34 (19)	122 (16.5)
Rainwater collection	60 (30.6)	139(38.4)	74 (41.1)	273 (37)
Boreholes	10 (5.1)	10 (3)	12 (7)	32 (4.3)
Well water collection	56 (28.6)	113(31.2)	67 (37.2)	236 (32)
How long does it take for you to fetch water and back home?				
< 5 minutes	108(14.6)	198(26.8)	108(14.6)	241 (32.7)
5-10 minutes	36 (4.9)	56 (7.6)	38 (5.1)	303 (41.1)
10-30 minutes	48 (6.5)	92 (12.5)	32 (4.3)	172 (23.3)
> 30 minutes	4 (0.5)	16 (2.2)	2 (0.3)	22 (3)
Do you have access to tap water for all 24 hours of the day?				
Yes	159(81.1)	269 (76)	134(74.4)	562 (77)
No	37 (18.9)	85 (24)	46 (25. 6)	168 (23)
Do you normally treat your drinking water at home?				
Yes	195(99.5)	87 (24.0)	1 (0.6)	283 (38.3)
No	1 (0.5)	275(76.0)	179(99.4)	455 (61.7)
If yes, how do you normally treat it?				
Boil	45 (23.1)	20 (23.0)	0 (0.0)	65 (23.0)
Filter	169 (87)	82 (94.3)	1 (100)	252 (89.0)
Add chlorine	53 (27.2)	20 (23.0)	0 (0.0)	73 (25.8)
Do you normally keep drinking water in a drinking water container?				
Yes	180(91.8)	322 (89)	165(91.7)	667 (90.4)
No	16 (8.2)	40 (11)	15 (8.3)	71 (9.6)
If yes, in what sort of container do you store your drinking water				
Closed container	179(99.4)	314(97.5)	160 (97)	654 (98.1)
Opened container	1 (0.6)	8 (2.5)	5 (3)	13 (1.9)
Do you use soap to wash your hands?				
Yes	196 (100)	358(98.9)	177(98.3)	731 (99.1)
No	0 (0.0)	4 (1.1)	3 (1.7)	7 (0.9)
If Yes, how often do you wash your hands?				
Always	148(75.5)	281(78.5)	134(75.7)	563(77)
Sometimes	48(24.5)	77(21.5)	43(24.3)	168(23)
When do you wash your hands?				
Before eating	196(26.6)	362(49.1)	180(24.4)	738 (100)
After using the toilet	163(22.1)	276(37.4)	141(19.1)	580 (78.6)
Before handling food	119(16.2)	242(32.8)	123(16.7)	484 (65.7)

After changing the baby's diaper	65 (8.8)	111 (15)	76 (10.3)	252 (34.2)
Hand washing facilities present				
Yes	84(11.4)	136(18.4)	24 (3.3)	244 (33.1)
No	112 (15.2)	226 (30.6)	156 (21.1)	494 (66.9)
Soap available				
Yes	79 (10.7)	141(19.1)	21 (2.9)	241 (32.7)
No	117(15.9)	221 (30)	159(21.5)	497 (67.3)
How do you dispose your domestic waste?				
Into a vat and then Collected by disposal company	172(87.6)	289(79.8)	149(82.8)	640(86.7)
Burn	6(3.1)	13 (3.6)	5 (2.8)	24 (3.3)
Bury	0 (0)	0 (0)	2 (0.3)	2 (0.3)
Dispose in a river	6 (3.1)	16 (4.4)	8 (4.4)	30 (4.1)
Household environment clean				
Yes	146(19.8)	236 (32)	150(20.3)	532 (72.1)
No	50 (6.8)	126(17.1)	30 (4.1)	206 (27.9)
How do you dispose of human waste?				
Flush Toilet	79(40.3)	114(31.5)	85(47.2)	78(37.7)
Pit Latrine	112(57.1)	235(64.9)	91(50.6)	438(59.3)
Both	5(2.6)	9(2.5)	2(1.1)	16(2.2)
Open defecation	0(0)	4(1.1)	2(1.1)	6(0.8)
Human or animal feces around the house				
Yes	18 (2.4)	35 (4.7)	5 (0.7)	58 (7.9)
No	178 (24)	327(44.3)	175(23.7)	680 (92.1)
Do you share your toilet/latrine with neighbour?				
Yes	96(49)	201(55.5)	76(42.2)	73(50.5)
No	100(51.0)	161(44.5)	104(57.8)	365(49.5)
How often do you clean and disinfect your latrines/toilet?				
Daily	143(73)	240(66.3)	122(67.8)	505(68.4)
After one week	52(26.5)	117(32.3)	54(30)	223(30.2)
When it is dirty	1(0.5)	5(1.4)	4(2.2)	10(1.4)

n=number of participants per category; %=percentage

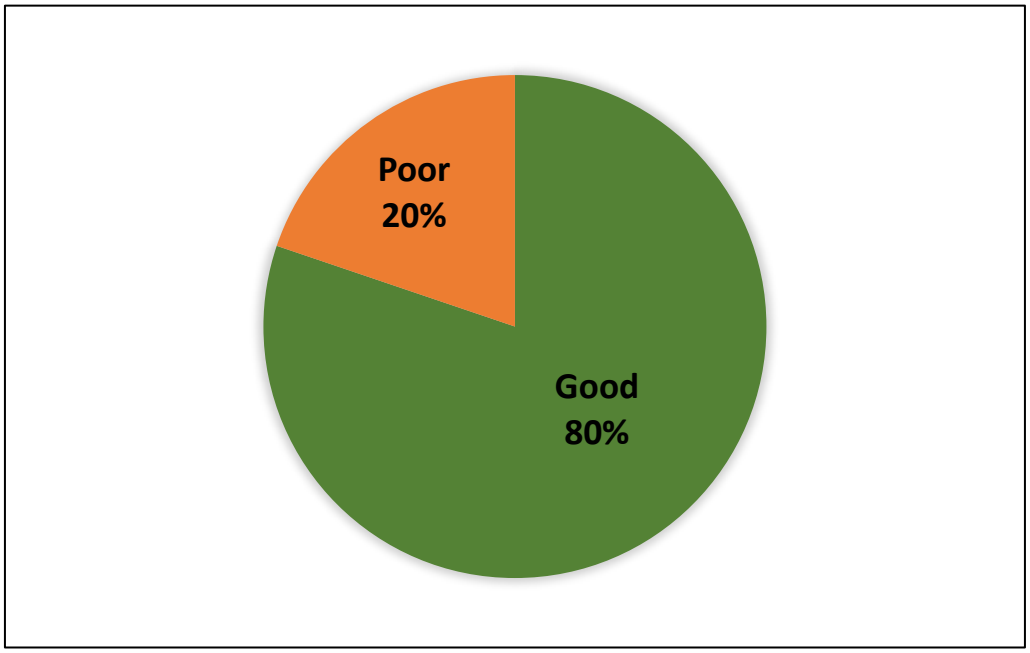

Fig: Level of Practices of participants on WASH

With regards to factors associated to good WASH practices, participants residing in New Bell (p=0.027, AOR=0.57, 95% CI: 0.35-0.94) were 0.57 times significantly less like to have good practices compared to those from Nylon. Those house owners were 2.17 times significantly more likely to have good practices on WASH (p=0.000, AOR=2.17, 95% CI: 1.42-3.31)(Table 8).

Table 8: Factors Independently Associated with Good Practice

				95% CI	
Variable	**Categories**	**Sig.**	**AOR**	**Lower**	**Upper**
	Bepanda	0.396	0.78	0.45	1.38
	New Bell	**0.027**	0.57	0.35	0.94
Community	Nylon		1		
	> 10	0.094	0.52	0.24	1.12
	1_3	0.288	1.37	0.76	2.47
	4_6	0.793	0.94	0.57	1.53
Household size	7_10		1		
	Yes	**0.000**	2.17	1.42	3.31
House owner	No		1		
	Christian	0.287	2.20	0.52	9.42
	Muslim	0.204	2.68	0.59	12.27
Religion	Others		1		
	Married	0.118	2.02	0.84	4.87
	Single	0.264	1.65	0.68	4.01
Marital status	Divorce/widow	.	1	.	.

AOR: Adjusted Odds Ratio; CI: Confidence interval; sig: significance

Prevalence of Diarrhea based on Household Survey

Diarrhea was reported by 129 of respondents giving a prevalence of 17.5%. The highest prevalence (34.1%, 44) was in children 1 to 5 years, followed by those < l year old (14.7%, 19). The difference with respect to age group was significant (χ^2= 738, P= 0.00). Diarrhea prevalence was highest (23.3%, 52) in household with more than 7 persons (23.3%) and lowest in households with 1-3 persons (11.8%). The difference was significant (χ^2=9.620, p=0.008). The highest prevalence of diarrhea (19.2%, 74) was observed in participants with secondary education and the lowest (10.7%, 9) among those with tertiary education. Participants from New Bell District reported highest prevalence (22.4%, 81). There was no significant difference in diarrhea prevalence based on level of education (P>0.05), but the difference with respect to health district ($\chi^{2=}$ 14.487, p=0.001), household size ($\chi^{2=}$ 9.620,p=0.008) and age (χ^2= 73.8, p=0.000) was significant.

Table 9: Prevalence of Diarrhea in Study Communities

Predictor	Categories	Diarrhea?	
		Yes n/N (%)	χ2-test
Age groups	Less than 1 year	19/129 (14.7)	χ2=738.000 **P=0.000**
	1-5 years	**44/129 (34.1)**	
	6-10 years	9/129 (7.0)	
	11-15 years	7/129 (5.4)	
	16-20 years	7/129 (5.4)	
	21-25 years	12/129 (9.4)	
	26-30 years	10/129 (7.6)	
	31-35 years	3/129 (2.3)	
	36-40 years	1/129 (0.9)	
	41-45 years	5/129 (3.9)	
	46-50 years	3/129 (2.3)	
	>50 years	9/129 (7.0)	
Household size categorizes	1-3	22/187 (11.8)	χ2=9.620 **P=0.008**
	4-6	55/328 (16.8)	
	7+	**52/223 (23.3)**	
The level of education	None and primary	46/268 (17.2)	χ2= 3.449 P= 0.178
	Secondary	74/386 (19.2)	
	Tertiary	9/84 (10.7)	
Health Districts	Deido	19/196 (9.7)	χ2= 14.487 **P= 0.001**
	New Bell	**81/362 (22.4)**	
	Nylon	29/180 (16.1)	

N=Total number of participants; n=number of participants per category; %=percentage

Association between Knowledge, Attitude and Practices of WASH and Occurrence of Diarrhea in the Community

Multiple regression analysis of the association between participants' level of KAP with the occurrence of diarrhea indicates that the odds of participants with good attitude developing diarrhea was 0.6 times significantly less than those with poor attitudes (p=0.011, AOR=0.600, 95% CI: 0.404-0.891). Participants with good knowledge (p=0.066, AOR=0.682, 9% CI: 0.454-1.025) and good practices (p=0.084, AOR=0.666, 95% CI:0.420-1.056) were less likely to have diarrhea compared to those with poor knowledge and poor practices but the associations were not significant (Table 10).

Table 11: Association between Knowledge, Practice, Attitude of WASH and Diarrhoea Occurrence

Variable	Categories	Sig.	AOR	95% CI	
				Lower	Upper
Knowledge	Good	0.066	0.682	0.454	1.025
	Poor		1		
Attitude	Good	0.011	0.600	0.404	0.891
	Poor				
1					
Practice	Good	0.084	0.666	0.420	
1.056					
	Poor				
1					

AOR: Adjusted Odds Ratio; CI: Confidence Interval; Sig: Significance

Prevalence of Diarrhea based on the Retrospective Study

Overall, the prevalence of diarrhea based on the retrospective study was 11.1%. The prevalence was significantly higher in male (13.0%) than in female ($\chi 2=23.889$, p=0.000) (Table 12), and highest in CMA Nkololoun in New Bell health district (13.5%) ($\chi 2 = 57.617$, p=0.000). With regards to age, the prevalence was highest in children < 1 year old (23.1%) followed by those 1-5 years old (16.1%) ($\chi^{2=}$ 95.710, p=0.000). More cases were recorded in 2011 (14.1%) ($\chi 2=23.432$, p=0.000).

Table 12: Prevalence of Diarrhea based on the Retrospective Study

Predictor	Categories	Diarrhea?	Chi-square (χ2-test)
		Yes n/N (%)	*P-values*

Gender of the patient	Male	436/3326 (13.0)	χ2=23.889 **P=0.000**
	Female	438/4558 (9.6%)	
	Total	**874/7884 (11.1%)**	
Health facility	CMA Nkololoun (New Bell)	312/2315 (13.5%)	χ2=57.617 **P=0.000**
	CMA Bepanda (Deido)	328/2532 (13.0%)	
	Despansaire Catholique Barcelone (Nylon)	234/3037 (7.7%)	
Occupation of the patients	Business	98/974 (10.1%)	χ2=100.141 **P=0.000**
	Civil Servant	11/143 (7.7%)	
	Informal sector	78/862 (9.0%)	
	Student	166/1626 (10.2%)	
	Retired	22/212 (10.4%)	
	Child	201/1042 (19.3%)	
	Housewife	122/1540 (7.9%)	
	Pupils	145/1137 (12.8%)	
	None	29/336 (8.6%)	
	Farmer	2/12 (16.7%)	
Age Categorized	<1	34/147 (23.1%)	χ2=95.710 **P=0.000**
	1-5	235/1463 (16.1%)	
	6-10	100/672 (14.9%)	
	11-15	49/474 (10.3%)	
	16-20	50/628 (8.0%)	
	21-25	85/914 (9.3%)	
	26-30	76/852 (8.9%)	
	31-35	54/558 (9.7%)	
	36-40	39/397 (9.8%)	
	41-45	29/302 (9.6%)	
	46-50	20/262 (7.6%)	
	50+	103/1215 (8.5%)	
Year	**2011**	**166/1175 (14.1%)**	χ2=23.432 **P=0.000**
	2012	178/1387 (12.8%)	
	2013	208/2051 (10.1%)	
	2014	167/1793 (9.3%)	
	2015	155/1478 (10.5%)	

Research Implications/Limitations

This was a cross-sectional community-based study that investigated the prevalence of diarrhea disease and evaluated the KAP of participants on WASH, and their association to diarrhea in three cholera endemic localities: Deido, New Bell and Nylon in Douala, Cameroon. In addition, a retrospective hospital-based study was also conducted to understand the trend of occurrence of

diarrhea in these localities over a period of five years, from 2011 to 2015. The prevalence of reported diarrhea in the community was 17.5% as against 11.1% in the retrospective study. This shows that more cases of diarrhea were managed in the community than in health facilities. The study site has witnessed several outbreaks of cholera. During these outbreaks, community members were educated on first aid management of mild cases. The higher prevalence of diarrhea in the community than in the retrospective study could be that they were mild and could be managed at home, while severe cases sought medical care. Also, some patients might have presented in other health facilities not included in our study resulting in an underestimation of diarrhea in the hospital- based study. The highest prevalence of diarrhea was observed in 2011. This coincided with the period when there was an outbreak of cholera in Douala and other parts of Cameroon (UNOCHA, 2015). There was a general decline from 2011 to 2015. The prevalence of diarrhea in the community-based study is similar to 17.6% reported in children in Ethiopia (Getahun et al., 2021), but higher than 10.77% reported in the general population in Southeastern Nigeria (Ugochukwu et al., 2020). This study focused on cholera endemic localities where there is a likelihood of a high prevalence of other diarrhea diseases. In addition, participants reported diarrhea within a period of one month while in the study of Ugochukwu et al. (2020) diarrhea reported was two weeks prior to the study, explaining the large difference. The prevalence of diarrhea was significantly highest in household with more than 7 persons (23.3%) compared to those with a household size of 1-3 person (11.8%), highlighting the contribution of overcrowding in diarrhea spread. Children <5 years had the highest prevalence of diarrhea in both the community-based study and the retrospective study, confirming reports on the high vulnerability of this age group to diarrhea (Manetau et al., 2021; UNICEF, 2021). Recurrent diarrhea in children affects growth, cognitive development and also causes malnutrition (Pickering et al., 2015; Cumming and Cairncross, 2016). Thus, there is a need to fight against diarrhea in the study community.

With regards to participants' knowledge on WASH and diarrhea prevention, participants were more knowledgeable on hand hygiene and diarrhea prevention as the majority of them knew diarrhea can be prevented by proper hand washing. They were not knowledgeable on diarrhea prevention by drinking treated water (72.2%), defecating in the toilet (84.6%) and cooking food hygienically (70.1%). This reflects their practices, as only 38.3% treated drinking water and 0.8% practiced open defecation though feces were observed around the houses of 7.9% of respondents showing that respondents were not sincere on their response to open defecation.

The high level of awareness of hand hygiene in diarrhea disease prevention could be due to the numerous sensitization campaigns during cholera outbreaks. Overall, only 38% of participants had good knowledge on WASH (Fig. 1). This is lower than 42.2% with good knowledge on WASH in Tigray region, Ethiopia (Berhe et al., 2020). The overall low level of knowledge on diarrhea prevention in our study is surprising because during cholera outbreaks in these localities, interventions have been conducted to educate inhabitants on prevention measures. Our findings underscore the need for frequent sensitization campaigns on diarrhea prevention in study sites. Of the factors analyzed for association with good knowledge, only health district of residence had a significant association, as the odds of having good knowledge among participants from Bepanda (Deido health district) and New Bell were 7.16 times (p=0.000, AOR=7.16, 95% CI: 4.3-

11.8) and 3.89 times (p=0.00, AOR= 3.89, 95% CI: 2.4-6.2), respectively more likely to have good knowledge compared to those from Nylon (Table 6). Participants with good knowledge were 0.682 times less likely to have diarrhea compared to those with poor knowledge though this association was not significant (p= 0.066, AOR=0.682, 95% CI: 0.454-1.025).

With regards to attitude on WASH, the majority of participants considered water shortage a problem, regarded their drinking water as safe, considered littering of the environment as a problem and a crime. Arbitrary refuse dumping causes the blocking of the drainage system and this results in flooding, particularly after heavy rainfall. Flooding contaminates water sources and causes diarrhea diseases. Among those who perceived the quality of water as unsafe, over three-quarters mentioned its appearance while almost half (48.9%) complained of its taste or smell. Good attitude on WASH was observed in about two-thirds (66%) of study participants. This is higher than 48.5% reported in northern Ethiopia (Berhe et al., 2020), but less than 73.6% in Northwest Ethiopia (Abera et al., 2018). The odds of having a student (p=0.026, AOR=0.53, 95% CI:0.30-0.93) and civil servant (p=0.036, AOR=0.56, 95% CI: 0.32-0.96) having good attitude was 0.53 times and 0.56 times, respectively significantly less than in business men. Participants with good attitude (p=0.011, AOR=0.600, 95% CI: 0.404-0.891) were 0.600 times less likely to have diarrhea compared to those with poor attitude and the difference was significant. This is because poor attitude may influence practices, increasing the risk of infection.

Concerning the practices of participants on WASH, the majority of participants obtained drinking water from improved sources, while up to 32% obtained drinking water from wells. Previous reports from our study site (Akoachere et al., 2013a; 2013b) showed that the water quality of most wells is poor. In addition, toxigenic *V. cholerae* was isolated from some wells (Akoachere et al., 2014). Thus, participants obtaining drinking water from wells are at risk of cholera and other diarrhea diseases particularly as treatment of drinking water was practiced by few of them (38.3%). Treatment of drinking water was mainly by filtration (89%) among those who reported treating water, similar to the report of Berhe et al. (2020). This is a low-cost, convenient method of water treatment. However, we did not find out from participants whether they changed the filter as required to ensure its efficiency. Only 29.1% had tap inside the house. Most participants obtained water from public standpipes and from taps in the yard. Such a practice increases the risk of contamination when the water is transported home. Notwithstanding, our findings showed that participants had good access to water as the majority of them took less than 10 minutes to obtain water and back. To ensure availability of water during periods when the tap was not running, participants stored water (90.4%) in closed containers (98.1%). This is a good practice as it ensures hygiene and prevents contamination.

Almost all participants (99.1%) reported washing hands with soap, though regular hand washing was practiced by only 77% participants. Regular hand washing using soap is a good practice, which must be encouraged as this is important not only in the prevention of diarrhea but also several infectious diseases. Hand washing facilities were found in only 33.1% of homes and of these, soap was found in only 32.7%. This is lower than the national rate of 36% of households with hand washing facilities with soap (UN, 2020). Based on this observation, respondents might not have been sincere in some of their responses to hand hygiene practices. Notwithstanding,

participants were aware of the critical times to wash hands except hand washing after changing diapers (34.2%).

Participants had good basic sanitation practices. 86.7% disposed refuse in vats which are subsequently emptied by the waste disposal company. This prevents littering of the environment which may block drainage ditches resulting in flooding and may also serve as breeding sites for mosquitos. Participants used mainly pit latrines for human waste disposal. This is because it is cheap and only 0.8% of respondents reported open defecation, though feces was observed in the surroundings of 7.9% of homes, which is evident of open defecation. This is higher than the national open defecation rate of 6% (UN, 2020). To prevent contamination of food and water, the practice of open defecation should be discouraged. Sharing of toilet with other households was reported by half of the respondents. Ugochokwu et al. (2020) reported sharing of toilet facilities as a risk factor for diarrhea disease. This is because when these facilities are shared, users never ensure proper hygiene. Most participants (68.4%) reported cleaning the toilets daily. Overall, good practices on WASH were observed in 80% of respondents. This is higher than 48.5% reported among rural residents in Ethiopia (Berhe et al., 2020). This indicates a higher quality and coverage of community health services in this study area. In this study, the odds of having good practices in WASH were 0.57 times significantly less in New Bell than in Nylon (p=0.027, AOR=0.57, 95% CI, 0.35-0.94). This association was significant and may confirm the significantly high prevalence of diarrhea in New Bell observed in the community-based study and in the hospital-based study. This was further confirmed in the multivariate analysis which revealed that participants with good practices were o.666 times less likely to have diarrhea compared to those with poor practices (p=0.084, AOR=0.666, 95% CI:= 0.420-1.056) though the association was not significant.

The limitations of this study were reporting bias that would have resulted in participants providing answers that did not represent their real practices and recall bias for some variables. The retrospective study involved only one all health care facility of the numerous health care facilities in each health district, thus the reported diarrhea prevalence might be an underestimation. This study was a quantitative study and issues that can be addressed through qualitative study to better understand WASH in study area were not addressed.

The study has revealed a high diarrhea prevalence in study areas and also shows that overall, only 38% of participants had good knowledge of diarrhea prevention. Participants with good attitude towards WASH were significantly less likely to have diarrhea while those with good knowledge and good practices were less likely to have diarrhea though the association was not significant. This study has also identified gaps in WASH that need to be addressed to prevent the occurrence of diarrhea disease and suggest frequent WASH education to improve respondents' knowledge of diarrhea disease prevention and promote good attitude and practices towards WASH.

Originality/Value of Paper

Findings of this study may contribute to efforts to monitor Cameroon's progress towards the achievement of the UN Sustainable Development Goals, particularly SDG #6: Clean Water and Sanitation, Goal #3: Health and Well-being and also Goal #11: Creating Inclusive and Sustainable Cities. Our findings show that there is an urgent need for interventions on WASH in the study areas; continuous health education on the prevention and control of water borne diseases to further enhance a change in behavior and reduce the occurrence of gastrointestinal diseases. The research team intends to collaborate with the Douala Municipality and public health authorities to ensure improvement in WASH and behavioral change of inhabitants of study localities.

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