

Community Knowledge, Attitudes and Perceptions Regarding Buruli Ulcer in Bafia Health District, Centre Region-Cameroon

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Authors' contributions

This work was carried out in collaboration among all authors. The author ENT conceived. Authors ENT, CAD, INN, LDP, CTN, EBAB, and CKW did data curation. Authors ENT, CAD, INN, LDP, CTN, EBAB, FEW, and LV did the methodology. Authors ENT, CAD, INN, LDP, and CTN did data analysis. Authors ENT, CAD, INN, and LDP wrote the original draft. Authors ENT, CAD, INN, LDP, CTN, EBAB, CKW, FEW, and LV did review and editing of manuscripts. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Buruli ulcer (BU), a neglected tropical disease, occurs in about thirty-three countries worldwide. Misconceptions about BU leads to poor health-seeking behaviors. We explored community knowledge, perceptions and attitudes regarding BU in a new endemic district.

Study Design: It was a cross-sectional community-based survey.

Place and Duration of Study: Bafia Health District (BHD), Centre region of Cameroon, in between November 2023 and February 2024.

Methodology: We recruited 1341 participants through a three-stage cluster sampling design. A structured questionnaire was administered to 2 or 3 members aged 10-87 years of each household visited. Descriptive statistics were performed, chi-square tests used to assess associations, and forward stepwise binary logistic regression models used to identify independently associated factors of attitudes.

Results: Of 1341 participants, 30.1% had heard of and 21.1% knew someone with BU. Only 17.2% correctly identified BU lesions, 2.3% knew its cause, and 19.2% believed BU was curable. Regarding attitudes towards persons with BU (PWBU) only 27.4% would show them respect, 19.5% would shake hands, and 16.4% would share the same plate with them. Additionally, only 17.3% approved of their participation, and 14.1% and 12.2% respectively would allow their child to play with or marry a PWBU. Positive attitudes towards PWBU were significantly associated with: head about BU, knowing a PWBU, and understanding that BU is curable. Negative attitudes were significantly associated with beliefs that: BU is caused by supernatural forces, poor hygiene, or living with a PWBU.

Conclusion: There were poor community knowledge and negative perceptions about BU in the BHD, which negatively influenced community attitudes towards PWBU. A community education intervention focusing on the natural occurrence, biological etiology, non-hereditary nature, the non-human-to-human transmission, and the curable nature of BU could improve upon the situation in BHD.

Keywords: Knowledge; perceptions; attitude; Buruli Ulcer; Bafia Health District.

1. INTRODUCTION

Buruli ulcer (BU), a neglected tropical diseases (NTD) is caused by *Mycobacterium ulcerans*, a microorganism belonging to the same genus of bacteria as those responsible for tuberculosis and leprosy, ranking it the third most common human mycobacterial infection (Doig et al., 2012; Williamson et al., 2008; Walsh et al., 2011). BU occurs in remote areas of tropical Africa, Latin American, Southeast Asia, around aquatic environments characterized by stagnant or slow flowing water bodies or marshy areas (Omansen et al., 2019; Ebong et al., 2012; Ruf et al., 2016). The exact mode of transmission is still unclear (Evans et al., 2000; Sizaire et al., 2006), although some studies have suggested the involvement of an animal reservoir or of insect vectors (Doig et al., 2012; Portaels et al., 2001; Bratschi et al., 2014; Marsollier et al., 2007; Stinear & Johnson, 2008). No human-to-human

transmission has been described (Sizaire et al., 2006). BU affects persons of both gender and of all ages, although children below 15 years of age are more vulnerable compared to adults (Bratschi et al., 2013; Capela et al., 2015). BU disease begins as a non-ulcerative and non-analgesic skin lesion (in the form of papule, nodule, plaque or oedema) after an incubation period of 21 to 90 days. Each lesion ulcerates and progresses to an extensive ulcer, if not detected and treated early (Bratschi et al., 2013; Capela et al., 2015; Tabah et al., 2016; Mensah-Quainoo et al., 2008). The extensive ulcers leads deformities, limitation of joint movement and eventually to functional disability, loss of economic productivity (Agbenorku, 2011; Asiedu & Etuaful, 1998; Grietens et al., 2008; Adamba, 2011). The deformities and disabilities consequent to BU has led to fear of diseases in endemic communities as well as stimulating erroneous perceptions and poor attitudes like

stigma and social exclusion BU victims and those affected by it (Grietens et al., 2008; Akoachere et al., 2016; Koka, 2018). Although BU is curable through specific anti-biotherapy combined or not with limited surgery, physiotherapy, nutritional and psychosocial support (Sizaire et al., 2006; Converse et al., 2011; Almeida et al., 2018; Fleischer, 2013), many affected persons in endemic communities still resort to non-conventional and traditional remedies as first means of treatment (Akoachere et al., 2016; Koka, 2018; Alferink et al., 2013; Owusu-Sekyere et al., 2013; Ackumey et al., 2011; Grietens et al., 2012). As the exact mode of BU transmission remains elusive (Evans et al., 2000; Sizaire et al., 2006), early detection and adequate treatment remain the most effective measures to prevent BU and its damaging consequences (Sizaire et al., 2006; Converse et al., 2011; Mitjà et al., 2017; World Health Organization, 2020). Effective implementation of these measures relies on proper mobilization and sensitization of populations living in endemic communities; to dissipate fear and change the erroneous perceptions and poor attitudes towards PWBU held in these communities and increase the community uptake of BU control interventions and services that are provided to them (Tabah et al., 2016).

Cameroon, has been implementing BU control activities for over 25 years today (Tabah et al., 2016; Noeske et al., 2004). Over this period, new BU endemic health district have continued to emerge (Tabah et al., 2016; Marion et al., 2005). The Bafia health district (BHD) in the Centre region of Cameroon was recently confirmed endemic for BU, within the frameworks of a project for integrated surveillance of skin neglected tropical diseases (Skin-NTDs) implemented there from August 2023 to November 2024. As a prelude to extending Buruli ulcer control activities to Bafia health district, we embarked on conducting a community-based study to assess the knowledge, perceptions and attitudes regarding BU there, with the aim of adapting interventions to the specific context of the district.

2. METHODOLOGY

2.1 Study Design

We conducted a cross-sectional descriptive and analytical community-based survey in which a structured questionnaire was administered face-to-face to two or three people in each household

visited to assess knowledge, perceptions and attitudes regarding Buruli ulcer. This study conducted in between November 2023 and February 2024, was carried out within the framework of an ANESVAD sponsored project for integrated surveillance of skin-NTDs implemented from August 2023 to November 2024 in Bafia health district, Centre Region of Cameroon.

2.2 Study Site

The Bafia health district (BHD) is situated some 130 km to the northwest of Yaounde, the capital city of Cameroon (Fig. 1). It is found in the country's central plateau, with dense forest vegetation. The climate is equatorial, with two rainy seasons and two dry seasons. It is crossed by the Mbam and the Sanaga rivers and share borders with seven other health districts. The BHD is made up of 179 villages/communities, distributed into 19 health areas, 16 of which are rural; and had an estimated population 180 733 in 2024 (Health Informations Unit, 2024). The population is constituted of many tribal groups, with the major ones being: the Yambassa, Banen, Bafia, Nyokon, and Yambetta tribes (Le Cercle Histoire, Géographie et Archeologie, 2020).

2.3 Participants, Sampling and Data Collection

2.3.1 Participants

We included individuals of both sexes who were 10 years of age and older. People below 10 years of age, community health workers, health personnel and those who did not give their consent to participate in the study were excluded.

2.3.2 Sample size

Based on the assumed proportion of good community knowledge of Buruli ulcer of 84.4% obtained in the southwest of Cameroon (Akoachere et al., 2016), and for a 95% confidence interval, an acceptable difference of 0.05 and an estimated non-response rate of 10%, for a cluster sampling with a design effect of 2, a minimum sample size of 404 participants was determined for the study.

2.3.3 Sampling

A three-stage cluster sampling was used. The 19 health areas of BHD (Fig. 1) constituted the

primary sampling units. The survey teams visited 3 villages (secondary sampling units), randomly selected within each of the 19 health areas. In each selected village, the survey teams introduced themselves to the village Chief, to whom they explained the study objective and procedures, and then sought for his approval to collect data for the study in his village. When approval was granted, the survey teams were then directed to the main square of the village. At this position, they tossed a pencil and then took the street in the direction pointed by the pencil. A systematic random sampling was then used to select households (tertiary sampling unit) along the street where every fifth household was

selected. If a selected household was locked or did not consent to the study, the immediate next household was visited. This went on until 10 households were visited in each selected village. Within each selected household, informed consent was sought from the household head or any other adult member of the household present during the visit. The household head and two other persons randomly selected within the household who fulfilled the inclusion criteria and who gave their consent were recruited into the study. The household head gave consent for children under 18 years of age. Additionally, the child-participants assented to participate in the study.

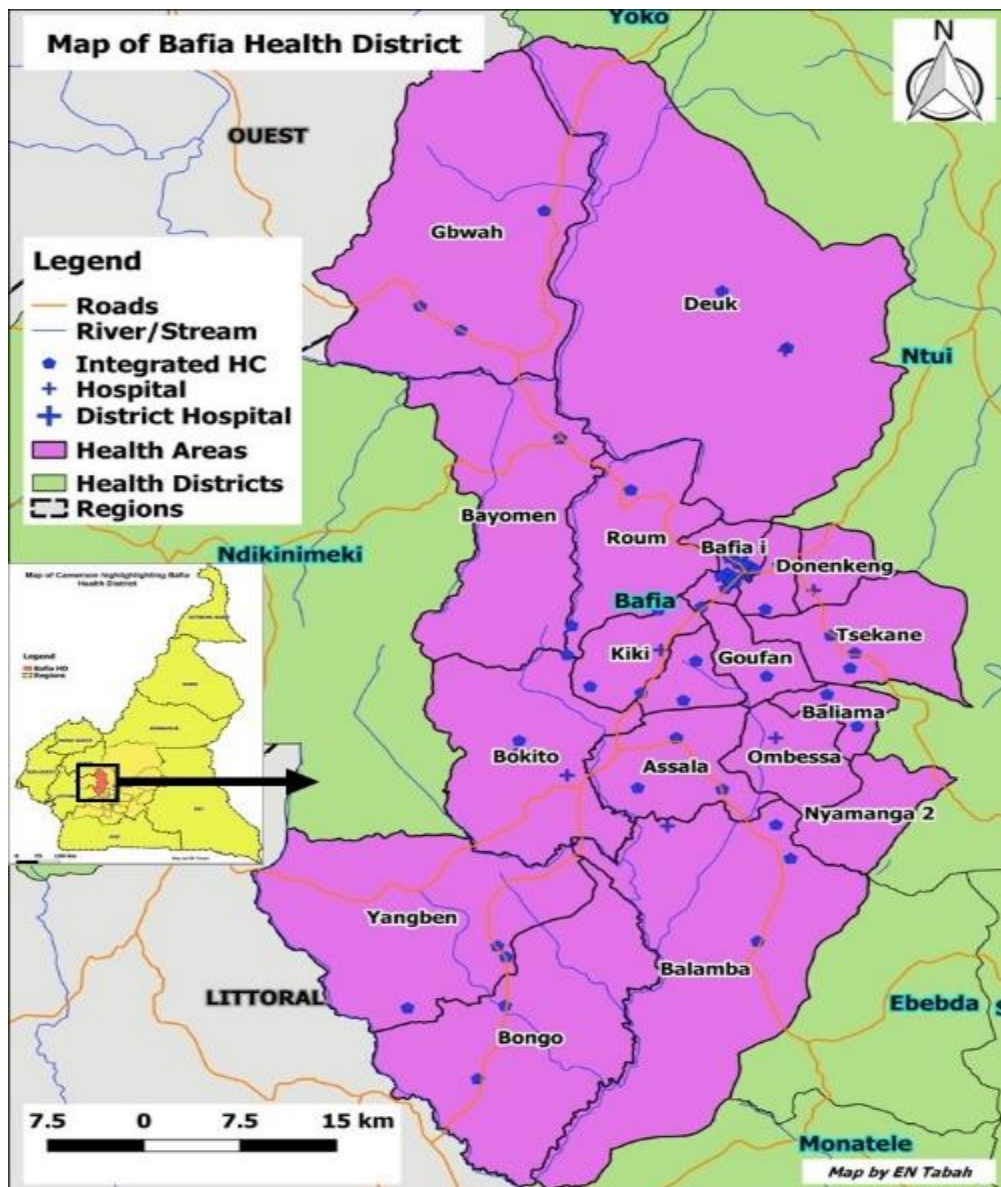


Fig. 1. Map of the Bafia Health District (Source: CNLP2LUB-MISANTE)

2.3.4 Data collection

Data was collected using a closed ended questionnaire designed to collect demographic data and to evaluate knowledge, perceptions and attitudes regarding Buruli ulcer, adapted from the one that was used for KAP-leprosy study in Ekondotiti and Mbonge health districts in the Southwest region of Cameroon (Tabah et al., 2018). Excluding demographic data, the questionnaire had 11 questions on knowledge, 6 questions on attitudes and 4 questions on perceptions regarding Buruli ulcer (Table 1).

Four survey teams of three members each, fluent in the French language were trained on the questionnaire by the principal investigator. The training included full understanding of the questionnaire and techniques of face-to-face interviews. For the practical session of the training, the survey teams were dispatched to four quarters of a semi-urban health area in Yaounde, where they field-tested the

questionnaire. Three questions were modified for better understanding after the field-testing exercise. The survey teams were then dispatched to Bafia health district for a period of ten days, where each team covered 4 to 5 health areas and 12 to 15 villages for the data collection phase of the survey.

2.3.5 Operational definitions

High community knowledge of Buruli ulcer: A “Yes” answer by 50% and above of the participants to each knowledge question was considered as good community knowledge of regarding Buruli ulcer. Otherwise, it was considered as poor community knowledge.

Positive attitudes towards Buruli ulcer: A “Yes” answer by 50% and above of the participants to each attitude question was considered as positive community attitude regarding Buruli ulcer. Otherwise, it was considered as negative community attitude.

Table 1. List of study variables (questions)

Group of questions	Question Number	Question
Questions on Knowledge and perceptions regarding Buruli ulcer	Q1	Have you heard about Buruli ulcer?
	Q2	If yes, by which means?
	Q3	Have you ever seen somebody suffering from Buruli ulcer?
	Q4	Do you know anybody suffering or who suffered from Buruli ulcer?
	Q5	Do you have a relative who's suffering or who suffered from Buruli ulcer?
	Q6	If yes, who is this person to you?
	Q7	How does Buruli ulcer manifest?
	Q8	What could be the cause of Buruli ulcer?
	Q9	If your relative is affected by Buruli ulcer, where would you advise her to go for treatment?
	Q10	Do you think there is a cure for Buruli ulcer?
	Q11	What can you do to prevent Buruli ulcer?
Attitudes questions	Q12	Can you shake hands with somebody suffering from Buruli ulcer?
	Q13	Can you eat from the same plate with someone who has Buruli ulcer?
	Q14	Would you be ashamed of a family member suffering from Buruli ulcer?
	Q15	Would you be willing to let your relative/friend know if you had Buruli ulcer?
	Q16	Would you let your child play with a person affected by Buruli ulcer?
	Q17	Would you accept that your child gets married to someone with Buruli ulcer?
	Q18	Do you think a person with Buruli ulcer should take part in social activities in the community like any other person?
	Q19	Do you think a person with Buruli ulcer should be employed in the same way as anyone else?
	Q20	Do you think a person with Buruli ulcer should be respected in the community like any other person?
	Q21	What kind of difficulties do you think people with Buruli ulcer face in your community?

Erroneous perceptions: Participants who indicated the cause of Buruli ulcer to be any of the following: curse, divine punishment, witchcraft, heredity, bad food, bad blood; or who believed that BU is not curable; or that victims of BU should not be respected, nor participate in the society nor employed like anyone else, were considered as having erroneous perceptions towards BU

2.4 Data Management and Statistical Methods

All filled questionnaires were checked for completeness and then anonymized and coded with a unique identifier. The data was then stored in a safe and secure manner until they were analyzed. There was strict observance of confidentiality in handling and analyzing the data. Data was entered on Microsoft Excel spreadsheet and cleaned before being exported into IBM SPSS statistics Processor Version 20 for analysis. Proportions were calculated and associations between variables were examined using the Chi-square test, with level of significance set at $P\text{-value} < 0.05$. Binary logistic regression using a forward likelihood stepwise entry method was performed by inputting variables that were significant in univariate analyses, to determine predictors of attitudes.

3. RESULTS

3.1 Characteristics of Respondents

Five hundred and ten households were visited in 57 villages selected from 19 health areas of Bafia health district. In these households, 1710 individuals were approached and 1341 accepted to participate in the study, for a response rate of

78.42%. The median age was 31 (10 - 87) years. There were 708 (52.8%) females, and 50.1% were married. Most of the respondents were of the Christian faith, with the most represented being: Catholics (44.7%) and Protestants (29.5%). Muslims constituted 8.4% while animist accounted for 4.2% of the respondents. Majority of the participants were of the Bafia (35.0%) tribe followed by the Yambassa (28.3%), and the smaller tribes regrouped as Mbamois (24.4%) respectively. Participants originating from tribes outside the district accounted for 12.4%. The majority had secondary (54.8%) and primary (35.0%) education levels respectively. The main occupation of the respondents was farming (45.4%) followed by schooling (27.1%).

3.2 Familiarity, Knowledge, Perceptions Regarding BU

The knowledge and familiarity of our respondents regarding BU were generally low as only 30.1% had heard about the disease, 21.1% knew and 16.8% had seen someone with the condition, and about 11% of respondents had relatives with BU (Table 2). For the 404 respondents who had heard about BU, their sources of information were from family members (29%) friends (21%) school (14%), churches or mosques (5%), community health workers (5%) and radio or television (5%) (Fig. 2). Familiarity with BU was influenced by age, religion occupation and marital status (Table 2). Older people were most likely to have heard about, knew or seen someone with BU ($P < 0.001$). The same pattern was seen with Christians of the Pentecostal denomination ($P < 0.001 - 0.023$), people having attained higher education ($P < 0.001$), salaried workers ($P < 0.001$) and singles ($P < 0.001$).

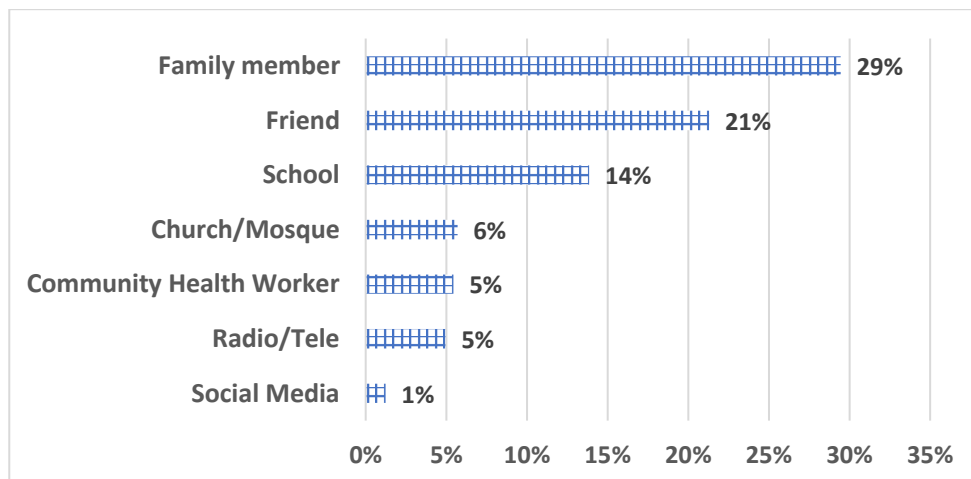


Fig. 2. Sources of community information on BU

Table 2. Relationship between socio-demographic variables and knowledge of Buruli ulcer

Variable	Category	N	Q1		Q3		Q4		Q5		Q7		Q8		Q9		Q10		Q11	
			Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value
	Total	1341	30.1%		21.1%		16.8%		11.0%		17.2%		2.3%		26.3%		19.2%		10.8%	
Age	10-19yrs	373	15.0%	<0.001	10.5%	<0.001	9.1%	<0.001	6.7%	0.001	7.2%	<0.001	0.8%	0.159	14.7%	<0.001	11.5%	<0.001	4.6%	<0.000
	20-29yrs	263	31.9%		23.2%		20.5%		12.2%		17.5%		3.0%		31.9%		21.7%		10.3%	
	30-39yrs	186	34.4%		28.0%		21.5%		16.7%		17.2%		2.7%		27.4%		18.3%		14.0%	
	40-49yrs	190	35.8%		21.6%		15.3%		8.4%		21.1%		2.6%		27.4%		23.7%		15.3%	
	50-59yrs	158	38.6%		20.9%		14.6%		9.5%		19.6%		4.4%		33.5%		24.1%		12.0%	
	60yrs+	171	41.5%		33.3%		26.3%		17.0%		32.2%		1.8%		33.9%		23.4%		15.8%	
Sex	Female	708	27.8%	0.052	19.4%	0.096	15.4%	0.152	9.2%	0.022	15.0%	0.021	1.7%	0.112	23.3%	0.008	16.1%	0.003	8.5%	0.004
	Male	633	32.7%		23.1%		18.3%		13.1%		19.7%		3.0%		29.7%		22.6%		13.4%	
Religion	Animist/ No Religion	56	21.4%	0.003	8.9%	<0.001	8.9%	0.001	8.9%	0.023	8.9%	0.001	1.8%	0.681	19.6%	0.010	14.3%	0.004	7.1%	0.006
	Catholic	600	29.5%		19.2%		14.5%		10.2%		15.8%		2.2%		24.5%		18.2%		9.8%	
	Islam	113	31.0%		20.4%		15.0%		12.4%		16.8%		3.5%		34.5%		26.5%		12.4%	
	Pentecostal	177	41.8%		33.3%		27.1%		18.1%		28.2%		3.4%		34.5%		27.1%		18.6%	
	Protestant	395	26.8%		20.5%		17.2%		9.1%		15.7%		1.8%		24.1%		15.7%		8.9%	
Education	None	70	21.4%	<0.001	15.7%	<0.001	11.4%	<0.001	7.1%	0.004	8.6%	<0.001	1.4%	<0.001	18.6%	<0.001	11.4%	<0.001	1.4%	<0.001
	Primary	470	30.4%		21.3%		16.2%		10.9%		17.2%		1.1%		24.9%		18.5%		9.1%	
	Secondary	735	27.9%		19.0%		15.9%		10.3%		15.8%		2.0%		25.2%		17.8%		10.9%	
	Higher	66	62.1%		48.5%		36.4%		24.2%		42.4%		15.2%		57.6%		47.0%		31.8%	
Occupation	Pupil/Student	363	17.4%	<0.001	12.1%	<0.001	9.9%	<0.001	6.9%	0.001	8.5%	<0.001	1.1%	<0.001	16.5%	<0.001	13.2%	<0.001	5.5%	<0.001
	Unemployed	124	31.5%		20.2%		15.3%		6.5%		19.4%		4.0%		27.4%		14.5%		15.3%	
	Hocker	115	32.2%		22.6%		20.0%		12.2%		20.9%		4.3%		30.4%		20.9%		12.2%	
	Trader	65	35.4%		30.8%		27.7%		18.5%		26.2%		4.6%		30.8%		21.5%		18.5%	
	Farmer	609	33.0%		22.5%		17.7%		12.3%		17.9%		1.3%		27.4%		20.5%		9.9%	
	Salaried worker	65	63.1%		47.7%		32.3%		21.5%		40.0%		9.2%		56.9%		43.1%		30.8%	
Marital status	Minor	298	12.8%	<0.001	8.4%	<0.001	7.7%	<0.001	6.7%	0.050	6.0%	<0.001	0.7%	0.061	14.4%	<0.001	11.1%	<0.001	5.4%	0.006
	Single	301	38.5%		27.9%		22.9%		13.0%		22.3%		3.3%		33.2%		25.6%		13.0%	
	Divorced/	70	30.0%		15.7%		12.9%		10.0%		17.1%		0.0%		24.3%		14.3%		10.0%	
	Widowed	70	30.0%		15.7%		12.9%		10.0%		17.1%		0.0%		24.3%		14.3%		10.0%	
	Married	672	34.1%		24.3%		18.5%		12.2%		19.9%		2.8%		28.7%		20.4%		12.4%	

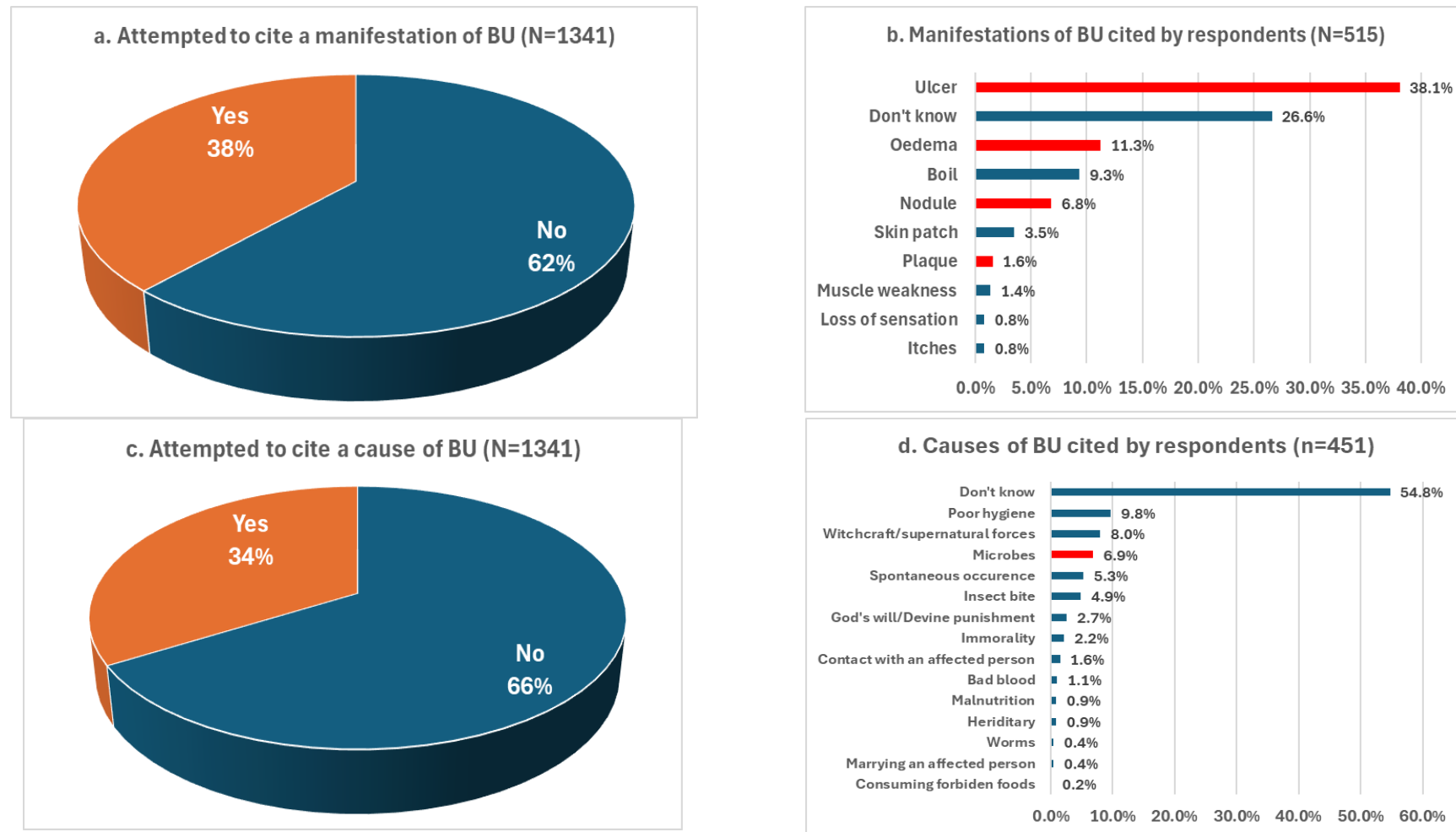


Fig. 3. Community knowledge on the causes and manifestations of BU

Regarding knowledge of clinical manifestations BU, 515(38%) of our respondents attempted to cite, with 231(17.2%) of them citing the correct manifestations of BU including: ulcers(38.1%), oedema(11.3%), nodule(6.8%) and plaque(1.6%) (Table 2 and Fig. 3a & b, correct manifestations heightened in red bars). Of the respondents, 451(34%) indicated the cause of BU, and as low as 2.3% knew that BU is caused by a microbe. Majority (54.8%) did not know any cause at all and many cited erroneous causes of BU that were probably based on cultural beliefs and misconceptions (Table 2 and Fig. 3c & d). For instance, 9.8% cited poor hygiene, 8.0% cited witchcraft or supernatural forces, 5.3% spontaneous occurrence, 4.9% insect bite, as causes of Buruli ulcer (Fig. 3c & d). Regarding knowledge of treatment and prevention of BU, only 19.2% of our respondents believed that BU was curable and a smaller proportion (10.8%) understood its correct preventive measures (Table 2). Of the 449(33.5) of respondents who gave their opinions on where to seek treatment for BU, 78.6% would advise PWBU to visit the hospital for treatment, and 8.2% and 0.9% would prefer traditional healers or prayer homes respectively (Fig. 4a & b). Elderly persons, those with a secondary or higher level of education and the male gender were more likely to have better Knowledge of manifestations, causes, correct source of treatment and preventive measures of BU among our respondents (P-value <0.05) (Table 2).

Thirty-eight percent of respondents attempted to cite the manifestations of BU (Fig. 3a), of whom some correctly cited ulcers (38.1%), oedema(11.3%), nodule(6.8%) and plaque(1.6%) highlighted in red (Fig. 3b). Equally, 34% attempted to cite the causes of BU (Fig. 3c) and only 6.9% of rightly indicated microbes. The rest cited erroneous causes including witchcraft, poor hygiene, insect bite and spontaneous occurrence (Fig. 3d).

Nineteen percent of respondents believed that BU is curable (Fig. 4a). Of those who gave opinions on BU treatment source, 78.6% advised health facilities meanwhile, 8.2% and 0.9% preferred traditional healers and prayer homes respectively (Fig. 4b). some 39% cited BU preventive measures, of whom 16.5% indicated daily baths with soap, 13.5% good hygiene, 5.5% advising early diagnosis and 6.8% correct

treatment, that were deemed plausible and highlighted in red(Fig 4d).

3.3 Attitudes Regarding BU

The attitudes of our respondents regarding BU were very poor (Table 3). Only 19.5% of respondents would shake hands and 16.4% would share the same plate with a PWBU; 23.7% would conceal from relatives or friends if they had BU; 14.1% would allow their children play with PWBU and 12.2% would accept their child marry someone who has or had BU. About 17% of our respondents would accept equal employment for PWBU or allow their participation in the community. Only 27.4% held that PWBU should be respected in the community. Attitudes of our respondents regarding BU were influenced by their socio-demographic characteristics as elderly persons, those of the male gender, widows or currently married persons, Christian of the Pentecostal denomination and those who had attained secondary and higher levels of education had better attitudes towards PWBU (P-values <0.05) (Table 3).

An analysis of the effect of knowledge and perceptions regarding BU on the attitudes of our respondents towards PWBU is shown in Table 4. All the attitudes considered were positively influenced by high levels of familiarity with BU, knowledge of the correct cause and clinical manifestations of BU, the understanding that BU is curable, and treatable at the hospital, as well as the knowledge of BU preventive measures (P-values <0.05).

3.4 Problems Faced by People with Buruli Ulcer (PWBU)

About a quarter (26%) of our respondents admitted that PWBU do face some challenges in society, at a personal level and/or with their families. The challenges included difficulties getting employment (53.2%), interacting with people (58.9%), getting married (27.9%), getting admission into school (15.8%) or even buying food (9.9%). At the level of family, the respondents held that PWBU have problems with their spouses (16.6%), are a source of problems (13.0%) and shame (8.2%) to their families, and the reason why their family members have difficulties getting married (17.7%) (Fig. 5).

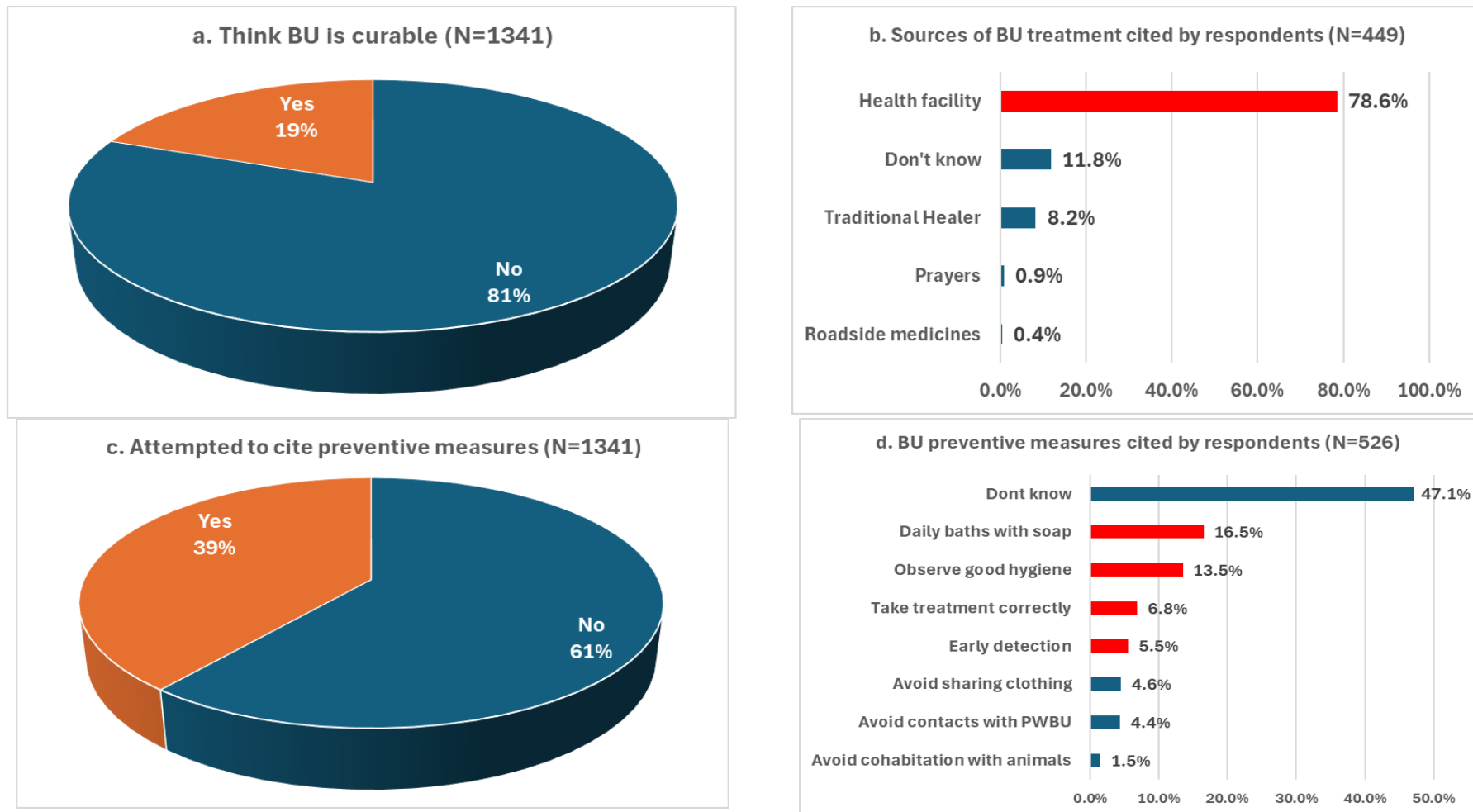


Fig. 4. Community knowledge regarding treatment and prevention of BU

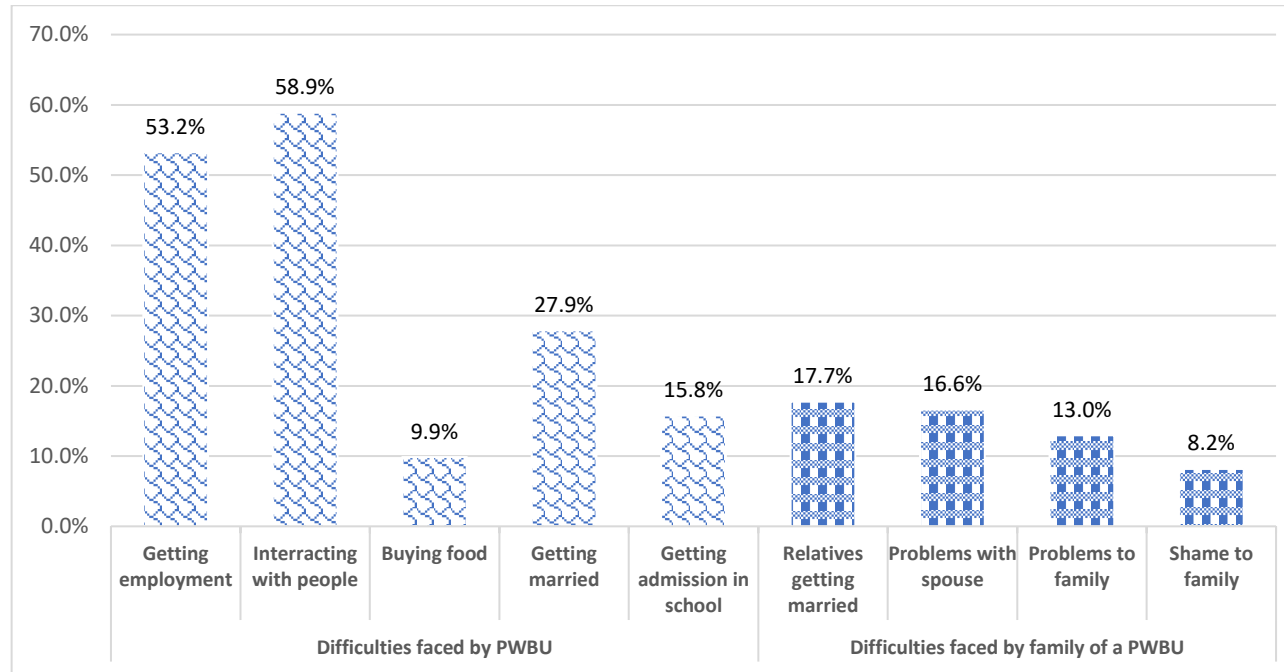


Fig. 5. Difficulties faced by people with Buruli ulcer

Table 3. Relationship between socio-demographic variables and attitudes and perceptions regarding Buruli ulcer

Variable	Category	N	Q12		Q13		Q14		Q15		Q16		Q17		Q18		Q19		Q20	
			Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value
	Total	1341	19.5%		16.4%		5.9%		23.7%		14.1%		12.2%		17.3%		17.2%		27.4%	
Age	10-19yrs	373	11.5%		8.8%		5.1%		14.5%		7.0%		5.4%		8.8%		8.3%		15.5%	
	20-29yrs	263	19.0%		17.1%		2.3%		28.5%		12.9%		13.3%		14.8%		19.4%		31.9%	
	30-39yrs	186	22.0%		16.7%		7.0%		22.6%		18.8%		15.1%		20.4%		16.7%		26.3%	
	40-49yrs	190	20.0%		17.9%		8.9%		22.6%		15.8%		13.2%		17.9%		17.4%		26.3%	
	50-59yrs	158	22.2%		17.7%		5.7%		29.1%		15.8%		15.8%		22.8%		24.1%		34.2%	
	60yrs+	171	31.6%	<0.001	28.7%	<0.001	8.8%	0.025	33.9%	<0.001	22.8%	<0.001	18.1%	<0.001	30.4%	<0.001	26.9%	<0.001	42.7%	<0.001
Sex	Female	708	17.4%		14.3%		4.7%		22.3%		12.3%		11.7%	0.549	15.0%		15.7%		24.2%	
	Male	633	21.8%	0.041	18.8%	0.025	7.3%	0.043	25.3%	0.203	16.1%	0.044	12.8%		19.9%	0.017	18.8%	0.130	31.1%	0.004
Religion	Animist/ No	56	17.9%		14.3%	0.146	1.8%		21.4%	0.815	8.9%		19.6%	0.066	17.9%	0.509	17.9%		28.6%	0.652

Variable	Category	N	Q12		Q13		Q14		Q15		Q16		Q17		Q18		Q19		Q20	
			Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value	Yes %	P-Value
	Religion																			
	Catholic	600	18.3%		15.5%		4.2%		23.2%		11.7%		9.7%		16.5%		15.3%		25.7%	
	Islam	113	15.9%		12.4%		8.0%		24.8%		15.0%		12.4%		15.9%		11.5%		31.9%	
	Pentecostal	177	28.2%	0.034	22.6%		13.0%	<0.001	27.1%		21.5%	0.014	15.3%		22.0%		24.9%	0.021	29.4%	
	Protestant	395	18.5%		16.5%		5.3%		23.0%		14.9%		13.7%		16.7%		18.0%		27.8%	
Education	None	70	8.6%		11.4%		2.9%		17.1%		11.4%		8.6%		14.3%		11.4%		20.0%	
	Primary	470	19.1%		14.9%		7.0%		23.2%		14.9%		13.4%		17.2%		16.4%		26.2%	
	Secondary	735	18.6%		15.9%		5.3%		21.9%		12.2%		10.5%		15.1%		15.8%		26.4%	
	University/ Professional	66	42.4%	<0.001	37.9%	<0.001	7.6%	0.386	54.5%	<0.001	31.8%	<0.001	27.3%	0.001	45.5%	<0.001	43.9%	<0.001	56.1%	<0.001
Occupation	Pupil/Student	363	13.8%		9.9%		5.2%		17.1%		8.3%		6.6%		10.5%		11.0%		17.1%	
	Unemployed	124	20.2%		16.1%		4.0%		23.4%		13.7%		12.9%		17.7%		21.0%		33.1%	
	Hocker	115	24.3%		25.2%		5.2%		27.8%		17.4%		14.8%		23.5%		24.3%		36.5%	
	Trader	65	21.5%	0.006	18.5%	<0.001	9.2%	0.738	24.6%	0.001	20.0%	0.004	18.5%	0.006	23.1%	<0.001	15.4%	0.001	30.8%	<0.001
	Farmer	609	20.2%		17.4%		6.4%		25.1%		15.6%		13.8%		17.7%		17.7%		28.4%	
	Salaried worker	65	32.3%		26.2%		6.2%		40.0%		21.5%		16.9%		33.8%		27.7%		46.2%	
Marital status	Minor	298	9.7%		7.4%		4.7%	0.796	12.4%		6.0%		4.7%		8.1%		7.4%		14.1%	
	Single	301	21.9%		20.9%		6.3%		28.6%		17.6%		15.6%		20.3%		21.3%		31.2%	
	Divorced/ Widowed	70	20.0%		18.6%	<0.001	5.7%		27.1%	<0.001	17.1%	<0.001	22.9%	<0.001	22.9%	<0.001	18.6%		28.6%	
	Married	672	22.6%	<0.001	16.7%		6.3%		26.2%		15.8%		12.9%		19.5%		19.5%	<0.001	31.5%	<0.001

Table 4. Relationship between attitudes/perceptions and knowledge of Buruli ulcer

Knowledge question	Response	N	Q12		Q13		Q14		Q15		Q16		Q17		Q18		Q19		Q20	
			Yes %	P- value	Yes %	P- value	Yes %	P- value	Yes %	P- value	Yes %	P- value	Yes %	P- value	Yes %	P- value	Yes %	P- value	Yes %	P- value
Heard about BU	Total	1341	19.5%		16.4%		5.9%		23.7%		14.1%		12.2%		17.3%		17.2%		27.4%	
	No	937	1.5%		1.2%		0.9%		2.8%		0.6%		0.9%		1.7%		1.7%		5.4%	
	Yes	404	61.1%	<0.001	51.7%	<0.001	17.6%	<0.001	72.3%	<0.001	45.3%	<0.001	38.6%	<0.001	53.5%	<0.001	53.0%	<0.001	78.5%	<0.001
Has seen someone with BU	No	1058	6.5%		6.0%		2.5%		9.5%		4.7%		4.5%		6.4%		6.6%		12.9%	
	Yes	283	67.8%	<0.001	55.5%	<0.001	18.7%	<0.001	76.7%	<0.001	49.1%	<0.001	41.0%	<0.001	58.0%	<0.001	56.5%	<0.001	81.6%	<0.001
Know someone who had/has BU	No	1116	9.1%	<0.001	7.8%	<0.001	3.3%	<0.001	12.9%	<0.001	6.6%	<0.001	5.6%	<0.001	9.1%	<0.001	8.7%	<0.001	16.0%	<0.001
	Yes	225	71.1%		59.1%		18.7%		77.3%		51.1%		44.9%		58.2%		59.1%		84.0%	
Has a relative who suffered BU	No	1193	13.0%		11.1%		3.8%		16.6%		9.3%		8.0%		12.0%		11.6%		20.5%	
	Yes	148	71.6%	<0.001	58.8%	<0.001	23.0%	<0.001	81.1%	<0.001	52.7%	<0.001	46.6%	<0.001	60.1%	<0.001	62.2%	<0.001	83.1%	<0.001
Knows how BU manifests	No	1288	16.8%		14.4%		5.3%		21.1%		12.3%		10.9%		15.5%		15.6%		25.0%	
	Yes	53	84.9%	<0.001	64.2%	<0.001	20.8%	<0.001	86.8%	<0.001	58.5%	<0.001	43.4%	<0.001	60.4%	<0.001	54.7%	<0.001	86.8%	<0.001
Knows the cause of BU	No	1310	18.2%		15.2%		5.8%		22.5%		13.1%		11.2%		16.1%		16.1%		26.1%	
	Yes	31	71.0%	<0.001	67.7%	<0.001	9.7%	0.365	74.2%	<0.001	54.8%	<0.001	54.8%	<0.001	67.7%	<0.001	61.3%	<0.001	83.9%	<0.001
Know that BU is treatable at the hospital	No	988	5.5%		4.3%		1.2%		6.8%		3.8%		3.1%		4.8%		5.5%		8.6%	
	Yes	353	58.6%	<0.001	50.4%	<0.001	19.0%	<0.001	71.1%	<0.001	42.8%	<0.001	37.7%	<0.001	52.4%	<0.001	49.9%	<0.001	80.2%	<0.001
Understands that BU is curable	No	1084	10.1%		8.8%		2.8%		11.9%		6.9%		6.2%		9.1%		9.5%		14.8%	
	Yes	257	59.1%	<0.001	48.6%	<0.001	19.1%	<0.001	73.5%	<0.001	44.4%	<0.001	37.7%	<0.001	51.8%	<0.001	49.4%	<0.001	80.9%	<0.001
Knows preventive measures of BU	No	1284	17.8%		14.3%		5.1%		21.7%		12.7%		10.9%		15.5%		15.6%		25.2%	
	Yes	57	57.9%	<0.001	63.2%	<0.001	22.8%	<0.001	70.2%	<0.001	45.6%	<0.001	42.1%	<0.001	57.9%	<0.001	52.6%	<0.001	78.9%	<0.001

These difficulties were at two levels. At the individual level where PWBU were perceived to face challenges interacting with people, getting employment, getting married or getting admission to schools. The perceived challenges extended from the individual patient his/her family, bringing shame to family members and problems especially with spouses and with relatives getting married.

3.5 Independent Predictors of Attitudes towards PWBU

A binary logistic regression analysis inputting socio-demographic variables, familiarity, knowledge and perceptions that influenced

attitudes of our respondents as independent variables, and each of the attitudes under evaluation as dependent variable; in a stepwise forward likelihood model was carried out to identify independent predictors attitudes regarding BU. Table 5 shows detail of the outcome. The prominent predictors of positive attitudes identified were: Having heard about BU, knowing that BU is treatable in the hospital, and thinking that BU occurs spontaneously, as they were predictors of 5 to 8 positive attitudes. Equally, the belief that BU is caused by supernatural forces, or poor personal hygiene or staying with a PWBU were identified as predictors of negative attitudes towards PWBU.

Table 5: Predictors of attitudes regarding Buruli ulcer

Positive attitudes	Predictors	OR	95%CI		P-value
			Lower	Upper	
Would shake hands with someone suffering from Buruli ulcer	Has attained secondary education	3.92	1.17	13.16	0.027
	Has attained Higher education	5.40	1.38	21.19	0.016
	Has head about BU	33.14	16.61	66.12	<0.001
	Know someone with BU	2.26	1.45	3.53	<0.001
	Think BU occurs spontaneously	17.82	2.32	136.96	0.006
	Know that BU is treatable in the hospital	2.72	1.68	4.41	<0.001
Would eat from the same plate with someone who has Buruli ulcer	Has head about BU	40.51	19.79	82.9	<0.001
	Think BU is caused by supernatural forces	0.04	0.01	0.54	0.015
	Think BU occurs spontaneously	2.69	1.02	7.11	0.046
	Know that BU is treatable in the hospital	2.86	1.76	4.45	<0.001
Would not be ashamed of a family member suffering from Buruli ulcer	Being 50yrs or older	0.39	0.16	0.98	0.044
	Being a Pentecostal Christian	2.36	1.13	4.92	0.022
	Has head about BU	8.65	3.31	22.6	<0.001
	Know that BU is treatable in the hospital	5.54	2.46	12.51	<0.001
Would be willing to let a relative/friend know about it if he/she had Buruli ulcer	Being 30-39yrs old	0.41	0.19	0.88	0.022
	Being 40-49yrs old	0.44	0.21	0.92	0.030
	Has head about BU	24.72	13.98	43.69	<0.001
	Has a relative with BU	1.97	1.15	3.38	0.014
	Know that BU is treatable in the hospital	3.33	2.06	5.4	<0.001
	Think BU is curable	1.78	1.11	2.85	0.017
Would allow his/her child to play with a person affected by Buruli ulcer	Has head about BU	76.13	30.9	187.58	<0.001
	Think BU occurs spontaneously	2.67	1.08	6.61	0.034
	Know that BU is treatable in the hospital	1.99	1.23	3.23	0.005
Would accept his/her child marry someone who has/had Buruli ulcer	Being divorced	5.12	1.75	14.99	0.003
	Has head about BU	29.77	12.64	70.12	<0.001
	Know someone with BU	1.76	1.14	2.71	0.011
	Think BU occurs spontaneously	2.51	1.04	6.07	0.041
	Think BU is caused by living with a PWBU	0.08	0.01	0.71	0.023
	Know that BU is treatable in the hospital	2.26	1.34	3.81	0.002
Think that a person with Buruli ulcer should take part in	Has head about BU	25.99	13.97	48.36	<0.001
	Know that BU is treatable in the hospital	3.07	1.93	4.87	<0.001
	Being 60 yrs or older	2.34	1.18	4.67	0.015

Positive attitudes	Predictors	OR	95%CI		P-value
			Lower	Upper	
social activities in the community like anyone else	Know the correct cause of BU	3.07	1.93	4.87	<0.001
Think that a person with Buruli ulcer should be employed like anyone else	Has heard about BU	30.74	16.89	55.95	<0.001
	Has a relative with BU	1.93	1.23	3.01	0.004
	Think BU is caused by supernatural forces	0.23	0.06	0.99	0.049
	Think BU is due to poor personal hygiene	0.38	0.18	0.79	0.009
Think that a person with Buruli ulcer should be respected in the community like anyone else	Has heard about BU	13.08	7.94	21.56	<0.001
	Think BU occurs spontaneously	3.62	1.05	12.46	0.041
	Know that BU is treatable in the hospital	5.51	3.34	9.07	<0.001
	Think BU is curable	1.82	1.08	3.08	0.026

4. DISCUSSION

4.1 Knowledge and Perceptions Regarding BU

This study has revealed low community knowledge and familiarity regarding BU in the Bafia Health District as only 30.1% had heard about the disease, 21.1% knew and 16.8% had seen someone with BU, and 11% declared having a relative with the condition. This contrasts with findings in the Southwest (Akoachere et al., 2016) and Centre (Kamga et al., 2012) regions of Cameroon, and Obom district in Ghana (Koka, 2018) where 84.4%, 44.9% and 95.5% of respondents respectively had heard about BU, but comparable with findings in southern Nigeria where 35% of respondents knew of BU (Nwafor et al., 2019). The studies in the southwest of Cameroon and Ghana were carried out in known BU endemic health districts where some BU control activities including community awareness had been ongoing, unlike in our study setting in Bafia health district and study areas in southern Nigeria that were newly confirmed for BU and control activities had not begun. The major sources of BU information to our respondents were family members (29%), friends (21%) and schools (16%) rather than health personnel, community health workers (5%) and the media (5%) (Fig. 2) often considered as traditional sources of health information. This corroborates with findings by Koka in Ghana where 60% of respondents got their information on BU from community members and only 6.3% and 4.6% got their information from health personnel and the media respectively (Koka, 2018). Having attained secondary education or higher, being elderly or being a male were associated with

better knowledge of BU (p-value <0.05) (Table 2). The few respondents (17.2%) with good knowledge of BU manifestations in our study were aware of its early signs and symptoms, citing Ulcer, oedema, nodule and plaque (Fig. 3b), which were consistent with clinical forms of the diseases (Sizaire et al., 2006; Tabah et al., 2016; Mensah-Quainoo et al., 2008; Sakyi et al., 2016). Information on the cause of BU was very unreliable and erroneous for the most part, as majority of respondents did not know the cause at all and some of them attributed BU to witchcraft, immorality, divine punishment, insect bite or spontaneous occurrence (Fig. 3d). These findings corroborates with those in the southwest of Cameroon (Akoachere et al., 2016) and southern Nigeria (Nwafor et al., 2019; Adeneye et al., 2022) where majority of respondents did not know the cause of BU and those who attempted cited witchcraft, worms, poor hygiene, insect bites, with very few correctly indicating bacterial infection as cause. The erroneous causes of BU cited by respondents in our study correlates with low familiarity and awareness of BU, but were interestingly consistent with findings in known endemic areas where control activities are being implemented (Akoachere et al., 2016; Koka, 2018; Ackumey et al., 2011; Nwafor et al., 2019). These findings demonstrate deep entrenchment in cultural beliefs and perceptions regarding BU. In Bankim, an endemic health district of Cameroon, BU is said to have four origins, three of them being related to witchcraft, ancestral curse or some inborn supernatural power denoted as *Mgbati* (Awah et al., 2018; Tohnain, 2023). In Ayos and Akonolinga, health districts around the Nyong River valley in Cameroon, BU locally known as *atom*, is attributed to a spell or witchcraft affliction following transgression of social norms like

stealing from someone's farm (Grietens et al., 2012). These beliefs have contributed to poor health-seeking behaviors among victims of BU in endemic communities, where a good proportion would prefer traditional healers or prayers as first source of BU treatment (Akoachere et al., 2016; Ackumey et al., 2011; Grietens et al., 2012; Nwafor et al., 2019; Tohnain, 2023). leading to delays in correct diagnosis and adequate treatment (Koka, 2018; Ackumey et al., 2011; Grietens et al., 2012; Tohnain, 2023).

About 19.2% of our respondents believed that BU was curable, and 78.6% of those who gave their opinion on where to seek BU treatment, would advise victims to go to a health facility, and 8.2% and 0.9% advised traditional healers and prayer homes (Fig. 4b) for treatment of BU. These findings are poor compared to those in the southwest of Cameroon, where 87.1% of participants believed that BU was curable, but better than same study when considering treatment-seeking attitudes as 63%, 20% and 17% would respectively refer patients to the hospital, traditional healers and prayers homes (Akoachere et al., 2016). The belief in mystical origins of BU held in almost all BU endemic zones across Africa is one of the main drivers for seeking traditional or herbal medicine for BU treatment. This has been demonstrated in Ayos, Akonolinga (Grietens et al., 2012) and Bankim (Awah et al., 2018) health districts, as well as in the southwest (Akoachere et al., 2016) of Cameroon, and also in Ghana (Koka, 2018; Ackumey et al., 2011) and southern Nigeria (Nwafor et al., 2019). The implications of low knowledge level and poor community perceptions regarding BU as revealed in this study for BU control in Bafia health district is enormous. Even though low, existing community knowledge could be a foundation upon which to develop a successful BU control intervention in the Bafia health district. The national control programme may however need to engage an in-depth anthropological exploration of cultural beliefs and practices regarding BU, and outcomes considered in the development of control strategies adapted to the district as was the case in Bankim health district (Awah et al., 2018).

4.2 Attitudes towards PWBU

The attitudes of our respondents towards PWBU were generally very negative (Table 3). Less than 20% would shake hands or share from the same plate with a PWBU. This could probably

explain why 23.7% of our respondents declared that they would conceal it if they had BU. Similar attitudes were described in southern Nigeria and Ghana where community members would not interact with PWBU for fear of contamination (Koka, 2018; Nwafor et al., 2019). Close to 6% of our respondents admitted that they would be ashamed if they had a relative with BU, and 23.7% of them would conceal from relatives and friends if they had BU. These kinds of attitudes obviously take their root in cultural beliefs about the cause of BU (Fig. 3d). In the Ayos and Akonolinga health districts of Cameroon where BU (*Atom*) is attributed to transgression of some social norms (Grietens et al., 2012), victims of BU who fear to be tagged would prefer concealment. Our study also revealed that only 14.1% and 12.2% would respectively allow their child to play or marry someone with BU. The perceptions that BU was caused by poor hygiene, heredity, contact with an affected person or marrying an affected person (Fig. 3d) could form the basis of these attitudes. Sensitization messages within the framework of a BU control strategy in Bafia health districts must take these into consideration, and package counter information focused on facts about BU including: its natural occurrence, biological etiology, its non-hereditary nature, the non-human-to-human transmission of BU, and its curable nature through early diagnosis and adequate biomedical management (Evans et al., 2000; Roltgen & Pluschke, 2015; Berkowitz et al., 2015).

About 17% of our respondents approved of PWBU participating in normal social activities or being given equal employment like anyone else. In these aspects, attitudes towards PWBU in this study were worse compared to those reported in the south west of Cameroon and in southern Nigeria, where higher proportions of respondents would allow free interaction of PWBU as well as equal employment for them (Akoachere et al., 2016; Nwafor et al., 2019). Only 27.4% of our respondents felt that PWBU should be respected in the community. These depict the high level of community stigma PWBU could face in Bafia health district. In endemic zones where BU control activities are being implemented, community attitudes towards PWBU tend to be much more improved (Akoachere et al., 2016; Nwafor et al., 2019; Koka et al., 2016). In this study, community attitudes regarding BU were influenced by sociodemographic variables (Table 3) as well as knowledge of and familiarity with BU ($P < 0.05$) (Table 4). The male gender, being

elderly, having attained at least primary level of education, and being of the Pentecostal Christian denomination were more likely to portray positive attitudes towards PWBU ($P < 0.05$).

Answering the question on what problems PWBU face, our respondents cited a litany of problems that could be grouped into individual level and family level problems (Fig. 5). More than half of those who responded to this question indicated that PWBU face difficulties interacting with people in society or getting employment, and over a quarter said they face challenges getting married. These difficulties extended beyond the individual patients to affecting their families as respondents indicated that family members of PWBU do face problems including feeling ashamed, difficulties getting married themselves (Fig. 5). Of course, these difficulties faced by PWBU correlate with community attitudes towards them. The consequences on PWBU would be self-stigma manifested by concealment, self-isolation, and delay in seeking treatment (Koka, 2018; Tabah et al., 2014).

Our study evaluated nine attitudes altogether. Three to six independent predictors were identified for each of the nine attitudes. The beliefs that BU is caused by supernatural forces, or by living with someone with BU, or by poor personal hygiene, or being 30 years of age and older, were predictors of negative attitudes (Table 5). On the other hand: having heard of BU, knowing someone with BU, having a relative with BU, the beliefs that BU is curable and treatable at the hospital, and that BU occurs spontaneously, having attained at least secondary education, being a Christian, were identified as predictors of positive attitudes (Table 5). The implication of public health here is that a BU control intervention in Bafia health district with a strong component of education for behavior change that focuses on enhancing community knowledge on BU and using schools and churches and channels of communication could ensure its effectiveness.

5. STUDY LIMITATIONS

Households were visited just once and only the household members who were present at moment of passage of the survey team were considered, and this could have introduced a selection bias, posing a problem of representativeness of the sample. Furthermore, our study recruited children as young 10 years for reasons that children are usually more

affected by BU compared to adults. However, children could have lacked the capability to understand the survey questions and give clear answers. Although we tried to assess associations between variables, we could not establish causal relationships using a cross-sectional design. However, we believe that these limitations had little or no effect on the outcome of the study.

6. CONCLUSION AND RECOMMENDATIONS

We conclude that familiarity with and knowledge of BU were low in Bafia health district. The major sources of BU information were family, friends and schools. The community knowledge of BU was marked by erroneous perceptions regarding its cause, manifestations. A relatively low proportion of respondents understood that BU is curable, of whom more than 2/3rd advised treatment at health facility. Attitudes regarding BU were equally poor among our respondents. Negative attitudes were independently associated with the beliefs that BU is caused by supernatural forces, or by living with someone with BU, or by poor personal hygiene, or being 30 years of age and older, meanwhile positive attitudes were driven by: having heard of BU, knowing someone with BU, having a relative with BU, the beliefs that BU is curable and treatable at the hospital, and that BU occurs spontaneously, having attained at least secondary education, being a Christian.

We recommend that a BU control intervention in Bafia health district must embed a strong component of education for behavior change that focuses on enhancing community knowledge on BU and using schools and churches and channels of communication, with information on: its natural occurrence, biological etiology, its non-hereditary nature, the non-human-to-human transmission of BU, and its curable nature through early diagnosis and adequate biomedical management. This could improve community knowledge and attitudes towards PWBU and ultimately lead to an effective and efficacious BU control intervention in the district.

CONSENT

An informed consent was gotten from each participant after the study objectives and the intended use of the outcome to guide BU control strategies in the Bafia Health District and for publication in scientific journal were explained

and they had the chance to ask questions of clarifications. For minors (<18years), their parents or guardians consented and then assent sought from them.

ETHICAL APPROVAL

Ethical approval for the study was obtained from the Centre Regional Committee for Research in Human Health, Yaounde, Cameroon (CE N° 0749/ CRERSHC/2023) and administrative authorization from the Regional Delegation of Public Health for the Centre Region.

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COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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