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Prevalence and Risk of Active Tuberculosis among Symptomatic Household Contacts of Bacteriologically Confirmed Pulmonary Tuberculosis Subjects Treated at the Buea Regional Hospital of the Southwest Region of Cameroon

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Abstract **Background:** Tuberculosis (TB) remains a serious public health concern worldwide. The predominant global strategy for identifying people with TB is 'passive case detection' which has a low case detection rate therefore is an obstacle to the long-term success of TB control programs, giving the possibility of undiagnosed patients posing great risk of transmitting the infection to others. **Methods:** A hospital/community-based cross-sectional study was conducted on 921 clinically suspected consented TB patients and those confirmed by microscopy of Ziehl Neelsen stain for Acid fast bacilli (AFB) were contacted at their residence so as to identify any household contacts (HHC) with symptoms of TB. AFB Smear negative cases were further investigated using sodium hypochlorite (NaOCl) centrifuge-concentrated smears technique. Data was collected from participants and the results were summarized using descriptive statistics, bivariate and multivariate logistic regression analyses. **Results:** The prevalence of pulmonary TB was 20.6% (190/921) and 7.04% (5/71) among TB suspected cases and symptomatic HHC respectively. In a univariate analysis, age group ($p = 0.011$), marital status ($p = 0.019$), employment status ($p = 0.041$), previous TB contact ($p < 0.001$), HIV status ($p = 0.001$) and family size ($p = 0.003$) were associated with TB occurrence. However, only HIV status (AOR = 4.98, 95% CI = 1.73 - 14.34) and previous TB contact (AOR = 6.08 95% CI = 2.86-12.89) were independently associated with TB occurrence. Approximately 30% of the diagnosed TB cases were detected with sodium hypochlorite (NaOCl) centrifuge-concentrated smears. **Conclusion:** The study showed that, contact investigation can improve case detection rates for active tuberculosis and therefore can augment the existing comprehensive package of interventions that could substantially reduce at the population level TB disease burden. Risk factors such as family size > 5 persons, previous contact with TB patients, marital and HIV status were associated with TB prevalence. Concentration technique is more effective with a higher rate of detection compared to direct smear.

Keywords: *household contacts, bacteriologically confirmed tuberculosis, risks factors, sodium hypochlorite centrifuged-concentrated smear*

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1. Introduction

Tuberculosis (TB) remains a major global health problem. Despite the two billion people infected in 2013 and about 9 million new cases of tuberculosis (TB) reported by WHO in 2014, only 64% of patients worldwide were diagnosed by the current recommended strategy, that is, passive case detection. Those patients who are not diagnosed are not treated, and are therefore at risk of transmitting the infection to others [1]. Active

screening strategies such as contact tracing which will include neglected asymptomatic cases will increase detection rate of new cases, since substantial proportion of TB cases are not detected by conventional passive case-finding strategies [2].

In Cameroon only passive case detection is in place, in which the symptomatic patient comes to the hospital and if found AFB positive, he/she is administered with anti-tubercular treatment. This approach has not resulted in substantial reductions in the prevalence of tuberculosis disease, despite the National Tuberculosis Control Program achieving high treatment completion rates in Cameroon [3]. The estimated incidence rate in Cameroon stands at 235 cases per 100,000 population, with an estimated prevalence rate of 299 cases per 100,000 populations with a total of 24,501 new cases and 7,800 deaths since 2010 [4]. However, given that most deaths from TB are preventable, the death toll from the disease is still unacceptably high and efforts to combat it must be accelerated.

The risk of transmission to household contacts is greatest when index case (first AFB smear positive tuberculosis case identified in the household and has at least one household contact) is sputum smear positive, there is frequent closeness of the index case with contacts, overcrowded living conditions, high bacillary density in respiratory secretions, and degree of lung fields involved [5]. Further, among the household contacts, younger age and immunodeficiency states are at higher risk of acquiring infection from their index case [6]. Although most exposed contacts are usually sputum smear negative and do not contribute to the immediate spread of the disease, they form a pool of infection from which a significant number of future index cases will arise [7]. It is estimated that a single infectious person who remains untreated can infect between ten and fifteen people every year, spreading the infection in the community [8,9].

This cross sectional study was carried out on AFB smear positive cases treated at the Buea Regional Hospital aiming to find the prevalence of active pulmonary tuberculosis and detect the disease in their household contacts (HHC) who are symptomatic. We also tried to identify possible risk factors for acquiring infection.

2. Materials and Methods

2.1. Ethical Approval and Informed Consent

Ethical approval was obtained from the Ethical Review Committee on Health Research, Faculty of Health Science University of Buea. Administrative approval was obtained from the Regional Delegation of Public Health for the Southwest Region and an institutional authorization from the Director of Buea Regional Hospital. Written informed consent was given to each study participant, and for children below 18 years, consent was obtained from parents or legal guardians.

2.2. Study Design, Site and Population Description

This was a hospital/community-based cross-sectional study. This study was carried out at the Buea Regional Hospital located in Buea, Fako Division, Southwest region of Cameroon, from January 2014 to May 2015. Patients who consulted at the hospital and were suspected for TB and later diagnosed positive for TB by Ziehl Neelsen tests (index cases) were recruited in the study. Figure 1 show the patient enrolment flow chart.

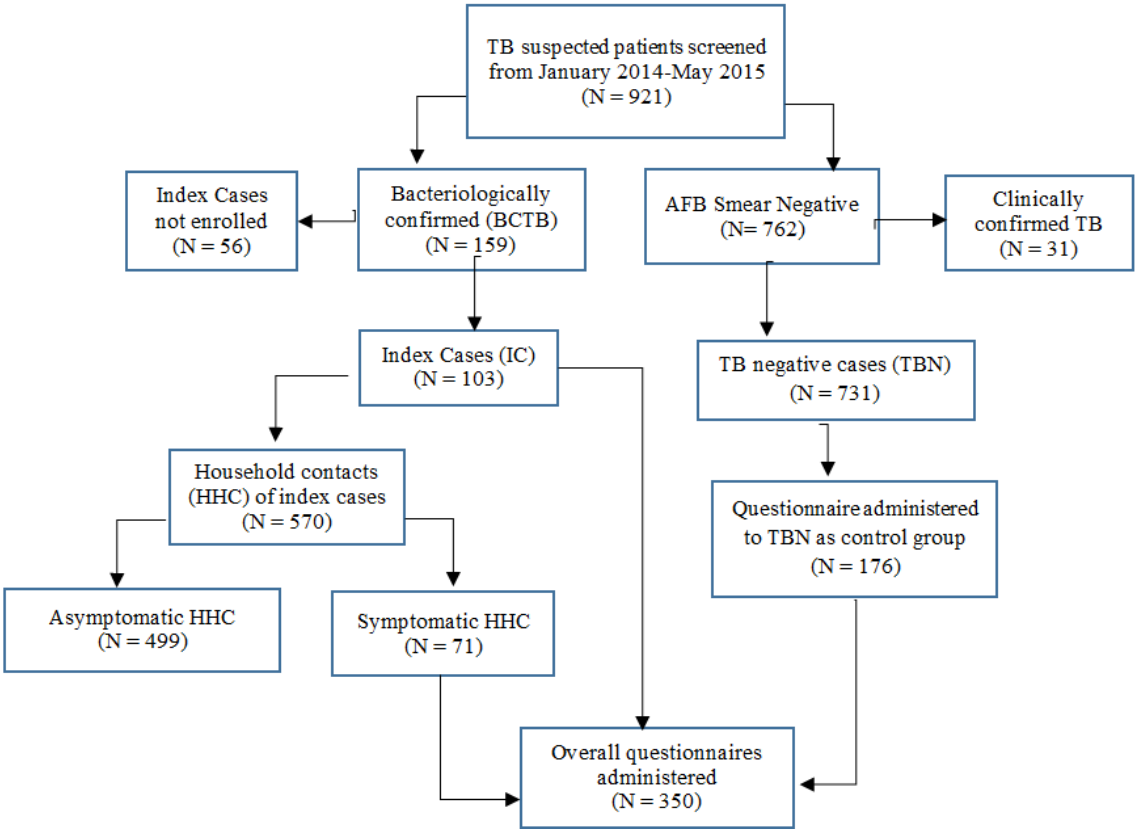

Figure 1. Study population enrolment flow chart

2.3. Data Collection

Demographic data socio-economic status (income level, occupation, level of education, marital status), behavioural pattern (smoking and alcohol intake) and clinical history were collected from study participants using on a pre-tested questionnaire administered. Smoking was categories as ex-smoker (stopped smoking greater than six preceding months to the start of the study), current smoker (including those who stopped smoking less than six preceding months to the start of the study) and non-smoker (never smoked). Alcohol consumers were further classified into two categories based on the AUDIT (Alcohol Used Disorder Identification Test) score: non-hazardous drinkers (AUDIT Score < 8) and hazardous drinkers (AUDIT Score ≥ 8) [10]. Household socio-economic position (SEP) was assess as previously reported [11].

2.4. Specimen Collection and Processing

All suspected pulmonary TB cases enrolled brought two sputum samples as per the WHO standard criteria, that is; one on the spot and one early morning sputum samples. All the symptomatic household contacts of sputum smear positive patients were contacted at their residence. One early morning sputum was collected from each of the symptomatic contact cases. Laboratory analysis were performed following the standard WHO procedure of Ziehl-Neelsen staining technique and Sodium hypochlorite concentration sputum smear technique was done for the smear negative cases [12,13]. All the index cases were followed up during their monthly drug refill to check for any TB related symptomatic of their HHC. After completion of treatment, calls and home visits were made to the index cases to check for TB symptoms among HHC.

2.5. Data Analysis

The data from questionnaires and laboratory results were entered into EPI-INFO software and were analysed using SPSS statistical software package version 16. The results were summarized using descriptive statistics including frequencies and mean. Difference of proportion were evaluated using Chi-square test and $p < 0.05$ was considered as significant. Multiple logistic regression analysis was used and odds ratio calculated to determine the strength of association between variables and lifetime exposure to TB infection and risk of TB infection among household contact.

3. Results

3.1. Demographic Characteristics of Patients Presenting for TB diagnosis at Buea Regional Hospital

From January 2014 to May 2015, a total 921 patients provided at least one sputum sample for diagnosis by AFB microscopy. This population comprised 497 (54.0%) females (mean age: 39 ±16.8 Standard deviation [SD], range: 4-90 years) and 424 (46.0%) males (mean age: 38.3 ±17.3SD, range: 4-89 years). Majority (31.7%) of the study population were aged ≥ 45 years. However, most (29.6%) of bacteriologically confirmed tuberculosis (BCTB) cases were among the age groups 25-34 years and 35-44 years. Out of the 921 patients, 190 (20.6%) were diagnosed with TB (Table 1). A total of 159 (83.7%) were BCTB, with 85 (53.5%) females and 74 (46.5%) males, while 31(16.3%) were clinically confirmed tuberculosis (CCTB). A total of 112 (12.2%) were diagnosed by microscopy of direct smear of sputum sample while 47 (5.10%) were diagnosed by microscopy of smear by the NaOCl concentration technique, improving diagnosis to 17.3% (12.2% + 5.10%). NaOCl concentration was performed only on direct smear negative samples. Therefore 29.6% (47/159) of the overall BCTB cases were diagnosed by microscopy of NaOCl concentrated smear of early morning sputum samples.

Table 1. Demographic characteristic of suspected TB cases attending the Buea Regional Hospital (N = 921)

Characteristic	Categories	n (%)	TB prevalence		P-values
			Positive n (%)	Negative n (%)	
Gender	Male	424 (46.0)	74 (46.5)	350 (45.9)	0.889
	Female	497 (54.0)	85 (53.5)	412 (54.1)	
Age (years)	<15	41 (4.5)	3 (1.9)	38 (5.0)	**< 0.001**
	15-24	161 (17.5)	41 (25.8)	120 (15.7)	
	25-34	231 (25.1)	47 (29.6)	184 (24.1)	
	35-44	196 (21.3)	47 (29.6)	149 (19.6)	
	>45	292 (31.7)	21 (13.2)	271 (35.6)	

3.2. Prevalence of TB among Household Contacts Cases

A total of 570 HHC were identified from 103 enrolled index cases. Of these HHC, 71 (12.5%) were symptomatic (had cough > 2 week) with most of them 276 (78.9%) producing purulent sputum, 40.8% (140/350) with chest pain, fatigue and fever (Figure 2).

The mean age of the symptomatic HHC was 30.6 ± 14.1 SD (95% CI: 27.2 – 33.9, range 4 – 70 years), Twenty-four (33.8%) symptomatic HHC were females. The most common relationship of HHC to the index cases was among the 3rd categories (in-laws, cousins, aunty, and extended relative and neighbours) (62.0%) (Table 5). The prevalence of TB among symptomatic HHC was 7% (5/71), 3 (6.4%) of them being males. Four of the positive HHC had co-prevalent tuberculosis i.e. active TB diagnosed at the time of enrolment, while one was an incident TB case diagnosed after 8 months follow-up. Two of the TB positive symptomatic HHC were HIV positive, one was HIV-negative (5 years old child) while the status of the others two were unknown. There was no positive TB case in the first degree relation while 2nd degree relationship (father, mother, brothers, sisters, sons and daughters), had the highest prevalence (13.6%) (Table 2).

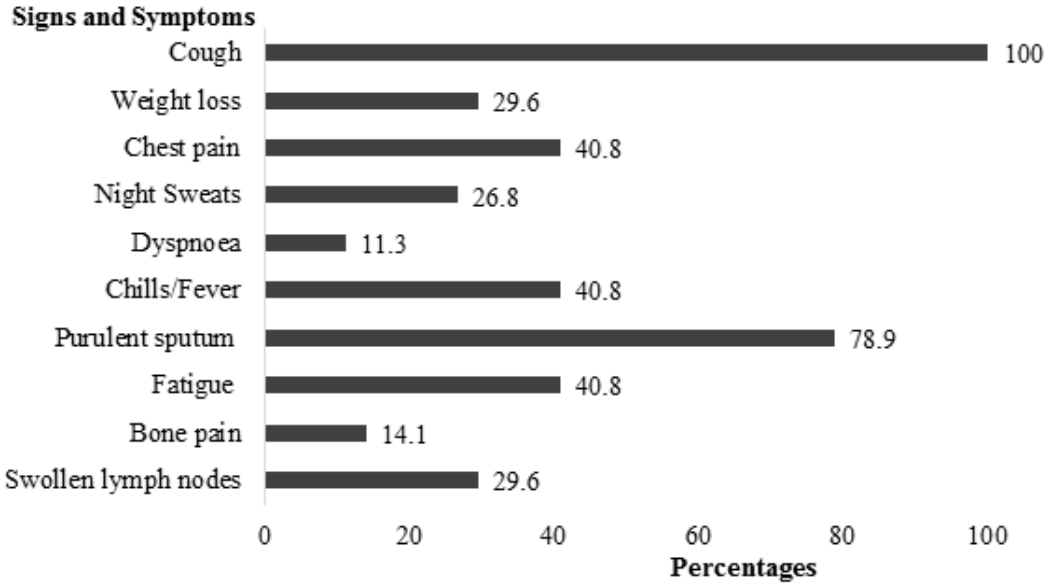

Figure 2. Prevalence of signs and symptoms among household contact

Table 2. Demographic characteristic of index cases (N = 103) and their symptomatic household contact (N = 71) and prevalence of TB among household contacts

Characteristics	Category	Index cases	Symptomatic HHC, n (%)			
		n (%)		P-value	TB Positive	TB Negative
Gender	Male	48 (46.6)	47 (66.2)	**0.011**	3 (6.4)	44 (93.6)
	Female	55 (53.4)	24 (33.8)		2 (8.3)	22 (91.7)
Age (years)	Mean age ± SD	32.6 ±11.7	30.6 ± 14.1	0.316	-	-
Age groups	< 15	1 (1.0)	7 (9.9)	0.30	1 (14.3)	6 (85.7)
	15-24	31 (30.1)	21 (29.6)		1 (4.8)	20 (95.2)
	25 -34	29 (28.2)	20 (28.2)		3 (15.0)	(85.0)
	34-44	29 (28.2)	11 (15.5)		0 (0)	0 (100)
	>45	13 (12.6)	12 (16.9)		0 (0)	0 (100)
Relationship of HHC with Index cases		1st degree	5 (7.0)	0.393	0 (0)	5 (100)
		2nd degree	22 (31.0)		3 (13.6)	19 (86.4)
		3rd degree	44 (62.0)		2 (4.5)	42 (95.5)

1st degree (Spouse), 2nd degree (father, mother, brothers, sisters, sons and daughters), 3rd degree (in-laws, cousins, aunty, and extended relative and neighbours); HHC- Household contact.

Table 3. Prevalence of smoking, alcohol consumption and HIV among prospective study participant categorized by gender, age group and case type (N = 350)

Characteristics	Category	Alcohol, n (%)		Smoking, n (%)		HIV status, n (%)	
		Yes	No	Yes	No	Positive	Negative
Gender	Male	119 (67.6)	57 (32.4)	65 (37.8)	107 (62.2)	25 (18.1)	113 (81.9)
	Female	76 (43.7)	98 (56.3)	2 (1.2)	170 (98.8)	61 (41.5)	86 (58.5)
p – value		**< 0.001**		**< 0.001**		**< 0.001**	
Age group (years)	< 21	4 (10.5)	34 (89.5)	01 (2.8)	35 (97.2)	01 (6.3)	15 (93.8)
	21-39	112 (58.3)	80 (41.7)	33 (17.3)	158 (82.7)	56 (31.1)	124 (68.9)
	≥ 40	41 (34.2)	79 (65.8)	33 (28.2)	84 (71.8)	29 (32.6)	60 (67.4)
p – value		**< 0.001**		**0.002**		**0.097**	
Case type	HHC	46 (64.8)	25 (35.2)	25 (36.2)	44 (63.8)	02 (3.7)	52 (96.3)
	IC	54 (52.4)	49 (47.6)	14 (13.9)	87 (86.1)	42 (43.8)	54 (56.2)
p – value		0.105		**0.001**		**< 0.001**	

HHC: Household contacts, IC: Index case.

3.3. Prevalence of Smoking, Alcohol Consumption and HIV among Study Participant

We compared some behavioural characteristics by gender, age group and among Index cases and household contacts. It was realised that both alcohol consumption (67.6% versus 43.7%, $p < 0.001$) and smoking habits (37.8% versus 1.2%, $p < 0.001$) were significantly higher among male than female participants. Similarly, alcohol consumption was common among participants of the age group 21-39 years (58.3%), while smoking habit was higher in participant ≥ 40 years of age. Conversely, HIV

sero-positivity was higher (p < 0.001) in female (41.5%) than male (18.1%). Among HHC, smoking habit was also common while alcohol consumption was not different between Index cases and HHC (Table 3).

3.4. Risk Factors Associated with Prevalence of TB

Majority of the demographic and socio-economic variables were not statistically significant associated (p > 0.05) with TB prevalence. Nonetheless, TB prevalence was significantly higher [37.5% (72/192), p = 0.011] in the active age group (21-39 years). We also noticed a significant difference of TB occurrence with marital status (P = 0.019). TB occurrence was more associated with those who were currently married (39/113 giving 34.5%) when compared to those who were single or previously married (OR = 0.83, 95% CI = 0.75 - 0.93) (Table 4).

In a univariate analysis, employment status was statistically significant (P = 0.041) with prevalence of TB, self-employed (mechanics, drivers, business men and women, traders, farmers, builders etc.) participants had the highest (OR = 1.40, 95% CI = 1.06 - 1.85) associated risk with TB. Similarly, family size was significantly (p = 0.003) associated with the prevalence of TB, with those having > 5 persons per household having the highest (OR = 1.41, 95% CI = 1.10-1.80) occurrence of TB. There was no significant difference of TB prevalence with religious denomination but we noticed a higher (36.7%) occurrence with those who attained revival denominations (Table 4).

In this study we did not notice any significant occurrence of TB with smoking history (p = 0.096) and alcohol (p = 0.613), Nonetheless, TB occurrence (32.3%) was higher among hazardous alcohol consumers (Table 4). As expected, HIV status (OR = 1.31, 95% CI = 1.09-1.58) and history of contact with an active PTB patient (OR = 2.49, 95% CI = 1.51-4.12) were associated with TB prevalence. Environmental factors such as use of firewood kitchen, incarceration, and living in a congested setting were statistically insignificant (p > 0.05) with occurrence of TB. Nonetheless, those who lived in congested area had a higher (34.4%) 76/221 prevalence of TB than (24.8%) those who did not live in a less congested area (Table 4). In a multivariate logistic regression analysis, including all univariate significant variables i.e. age group, marital status, employment status, family size, HIV status and contact with TB patient, only HIV and previous contact with PTB patient were independently associated with TB occurrence. Participants who were HIV positive were approximately 5 times (AOR = 4.98, 95% CI = 4. 30–31.70) more likely to develop TB than those who were HIV negative; participants who had come in contact with PTB patient were 6 times (AOR= 6.08, 95% CI = 2.86-12.89) more likely to develop TB than those who had not come in contact with a PTB patient. Similarly, family size was borderline independently associated with TB occurrence (AOR = 1.41, 95% CI = 0.94-2.95), with > 5 persons per household with 1.41 times more likely to develop TB than those with < 5 persons per household (Table 4 and Table 5).

Table 4. Demographic and socio-economic factors associated with TB prevalence

Characteristics			TB prevalence, n (%)			Risks estimates (95% CI)	
Demographic	**Categories**	**N**	**TB Positive**	**TB Negative**	**P value**	**Crude odds ratio**	**Adjusted odd ratio**
Gender	Male	176	51 (29.0)	125 (71.0)	0.444	0.92 (0.74 – 1.14)	
	Female	174	57 (32.8)	117 (67.2)		1.0	
Age group (years)	≥ 40	120	26 (21.7)	94 (78.3)	**0.011**	0.83 (0.45 – 1.53)	0.53 (0.25 – 1.75)
	21-39	192	72 (37.5)	120 (62.5)		1.55 (0.94 – 3.03)	1.56 (0.75 – 3.21)
	< 21	38	10 (26.3)	28 (73.7)		1.0	1.0
Socio-economic							
Years school attendance (years)	>12	71	24 (33.8)	47 (66.2)	0.178	1.19 (0.91-1.56)	
	8-12	157	54 (34.4)	103 (65.6)		1.32 (0.96-1.83)	
	≤ 7	122	30 (24.6)	92 (75.4)		1.0	
Income level	High	96	36 (37.5)	60 (62.5)	0.098	1.13 (0.97-1.31)	
	Low	254	72 (28.3)	182 (71.7)		1.0	
Marital status	Currently married	113	39 (34.5)	74 (65.5)	**0.019**	1.03 (0.85-1.24)	0.88 (0.45 – 1.71)
	Previously married	46	6 (13.0)	40 (87.0)		**0.83 (0.75 - 0.93)**	0.44 (0.14 – 1.44)
	Single	191	63 (33.0)	128 (67.0)		1.0	1.0
Employment status	Employed	47	14 (29.8)	33 (70.2)	**0.041**	1.07 (0.89 – 1.30)	0.63 (0.28 – 1.46)
	Self-employed	151	57 (37.7)	94 (62.3)		**1.40 (1.06 – 1.85)**	0.63 (0.30 -1.30)
	Unemployed	152	37 (24.3)	115 (75.7)		1.0	1.0
Marriage type	Monogamy	148	41 (27.7)	107 (72.3)	0.720	0.98 (0.91-1.07)	
	Polygamy	9	2 (22.2)	7 (77.8)		1.0	
Family size	> 5 per household	159	62 (39.0)	97 (61.0)	**0.003**	**1.41 (1.10-1.80)**	1.67 (0.94 – 2.95)
	≤ 5 per household	191	46 (24.1)	145 (75.9)		1.0	1.0
Socio-economic position	High (score > 20)	161	55(34.2)	106 (65.8)	0.217	1.145 (0.92-1.43)	
	Low (Score ≤ 20)	189	53 (28.0)	136 (72.0)		1.0	
Religious denomination	Revival	90	33 (36.7)	57 (63.3)	0.342	1.22 (0.91 - 1.63)	
	Protestant	145	43 (29.7)	102 (70.3)		1.06 (0.78 – 1.46)	
	Catholic	113	31 (27.4)	82 (72.6)		1.0	

Table 5. Clinical, behavioural and environmental risk factors associated with TB prevalence

Characteristic	Category	N	TB Prevalence n (%)			Risks estimates (95% CI)	
Clinical			**TB Positive**	**TB Negative**	**P–value**	**Crude odd ratio**	**Adjusted Odds ratio**
Evidence of BCG scar	Yes	224	64 (28.6)	160 (71.4)	0.217	0.83 (0.62-1.11)	
	No	126	44 (34.9)	82 (65.1)		1.0	
Contact with TB patient	Yes	143	49 (34.3)	94 (65.7)	**< 0.001**	**2.49 (1.51 – 4.12)**	**6.08 (2.86 – 12.89)**
	No	116	13 (11.2)	103 (88.8)		1.0	1.0
HIV status	Positive	86	42 (48.8)	44 (51.2)	**0.001**	**1.31 (1.09-1.58)**	**4.98 (1.73 – 14.34)**
	Negative	199	58 (29.1)	141 (70.9)		1.0	1.0
Being on ARV	Yes	42	20 (47.6)	22 (52.4)	0.83	0.96 (0.63-1.44)	
	No	44	22 (50.0)	22 (50.0)		1.0	
HHC relationship	Immediate	46	14 (30.4)	32 (69.6)	0.585	1.16 (0.68-1.95)	
	Others/friends	97	34 (35.1)	63 (64.9)		1.0	
Previous TB infection	Yes	31	10 (32.3)	21 (67.7)	0.860	1.01 (0.94-1.08)	
	No	319	98 (30.7)	221 (69.3)		1.0	
Environmental							
Use of firewood kitchen	Always	209	66 (31.6)	143 (68.4)	0.702	1.06 (0.79-1.41)	
	Rarely	135	40 (29.6)	95 (70.4)		1.0	
Incarceration	Yes	57	12 (21.1)	45 (78.9)	0.080	0.55 (0.28-1.08)	
	No	293	96 (32.8)	197 (67.2)		1.0	
Live in congested area	Yes	221	76 (34.4)	145 (65.6)	0.61	1.35 (0.97-2.58)	
	No	129	32 (24.8)	97 (75.2)		1.0	
Behavioural							
Smoking	Yes	67	15 (22.4)	52 (77.6)	0.096	0.91 (0.82-1.01)	
	No	277	91 (32.9)	186 (67.1)		1.0	
Duration of smoking	< 10 years	29	8 (27.6)	21 (72.4)	0.391	1.72 (0.46-6.49)	
	≥ 10 years	13	2 (15.4)	11 (84.6)		1.0	
Cigarette per day	≥ 10 sticks/day	6	0 (0)	6 (42.9)	0.398	0.57 (0.36-0.90)	
	< 10 sticks/day	9	1 (11.1)	8 (88.9)		1.0	
Alcohol consumption	Yes	195	58 (29.7)	137 (70.3)	0.613	0.94 (0.73-1.20)	
	No	155	50 (32.3)	105 (67.7)		1.0	
Hazardous alcohol	Yes	76	25 (32.9)	51 (67.1)	0.664	1.03 (0.91-1.16)	
	No	274	83 (30.3)	191 (69.7)		1.0	

4. Discussion

The control of TB in Cameroon has been mainly by passive case detection under the directly observed therapy strategy (DOTS). Although household contacts of TB patients have been shown to have a high risk of contracting the disease [14,15], there is not yet sufficient evidence in Cameroon to determine whether active case finding in contacts will detect more cases than passive case finding alone. This cross-sectional study was carried out on BCPTB cases treated at the Buea Regional Hospital with the aim to determine the prevalence and risk of active pulmonary tuberculosis in patients and to determine the disease in suspected household contacts. This study was limited to contacts of smear positive patients because smear positive patients are more likely to transmit TB and the prevalence of TB among their contacts is high based on their bacterial Load [16]. NaOCl concentration technique for all smear negative cases was performed to evaluate performance of this technique on TB diagnosis.

A significant difference ($p < 0.001$) in the occurrence of TB was observed in the various age groups with 25-44 years having highest (29.6%) occurrence. Similar to previous studies conducted in Ethiopia and other countries TB affects mostly adults in the economically productive age groups [1,16,17]. Our study showed that in both index cases and HHC the prevalence of TB in females were predominant (53.4% and 8.3%) than males, this correlate with other findings, suggesting that females have a higher risk of developing TB than males due to high prevalence of HIV among females which in Cameroon stands at 5.6% for females compared to 2.9% for males[18]. Females have higher risk of HIV infection than males [19] and HIV being modulatory factor of TB they are infected at an early stage [20]. Better health-seeking attitude is also common among females than males [21] therefore accounts for more female index cases.

A total of 5 TB cases out of 71 symptomatic HHC indicates a 7% improvement in case detection and therefore demonstrate the role of contact investigation in prompt diagnosis of TB. Similar studies on prevalence of TB in HHC carried out in Yaoundé, Cameroon in 1996, Peru in 2005 and china in 2014 [3,22,23] support this results. Relationship of HHC with index cases were not statistically significant, however we noticed a higher (13.6%) prevalence of TB with 2nd degree relationships (father, mother, brother, sisters, sons and daughters).

Level of income, years of school attendance, religious denomination and SEP were not significantly associated with TB occurrence. Although not significant, high socio-economic position and high-income level registered more TB cases [24]. It was also noticed that self-employed (mechanics, drivers, business men and women, traders, farmers, builders etc.) were highly (OR = 1.40, 95% CI = 1.06-1.85, p = 0.004) associated with TB occurrence. The nature of jobs of this group of individual exposes them more to interactions with customers daily increasing their risk of exposure to TB patients and this in line with a

study conducted in the Gambia [25]. Households with family size > 5 persons per household (OR = 1.41, 95% CI = 1.10-1.80, p = 0.003) were also at risk of TB occurrence compared to those with < 5 persons. Increased household size and overcrowding has been documented as a risk factor for TB from several other studies in different settings [16,26]. Although previous reports have shown the association of alcohol and smoking with TB [17,27] this was not the case with our observations. However, hazardous alcohol consumer had higher (32.9%) occurrence than non-hazardous alcohol consumption.

Consistent with a WHO report and other studies conducted in different parts of the world [16,17,28,29], a history of contact with an active TB patient (p < 0.001) and HIV-seropositive status (p = 0.001) were significantly associated with PTB. Household contact studies among TB patients and large epidemiological surveys [30] have established that close contact with infectious TB cases including household contacts and care givers/health care workers [31] are at a higher risk of becoming infected with *Mycobacterium tuberculosis.* TB can be transmitted within a short period of contact [32] and the possibility for such opportunities are enormous [6] in endemic settings such as the present the study site and casual transmission is a critical factor in TB transmission dynamics [30]. After adjustment for univariate significant variables in this study, our results demonstrate that HIV patients and previous contact with TB patients were independently associated with contracting TB which corroborate previously reports [16,33,34].

The microbiological diagnosis of pulmonary tuberculosis plays a key role in routine tuberculosis control Programmes in developing countries. Concentration of acid-fast bacilli (AFB) in clinical specimens is an important step in the laboratory diagnosis of mycobacterial diseases. This study demonstrate NaOCl concentration technique improved diagnosis approximately 30% and therefore could increase the diagnostic sensitivity of AFB microscopy. Similar results were obtained from a study carried out in Ethiopia [35]. Gebre-Selassie [14] also demonstrated that concentration methods by sedimentation and centrifugation after treatment with NaOCl, increased the sensitivity of AFB microscopy to 75% and 77.9% respectively, and the specificity to 100% for both techniques. Given the cost of contact investigation in terms of logistics, instead of two sputum samples per symptomatic contact, one early morning good quality sample can be examined using NaOCl concentration technique.

5. Conclusions

The prevalence of smear positive PTB among tuberculosis suspected patients and in HHC of index cases was high (20.6% and 7.0% respectively) at the Buea Regional Hospital. Contact investigations improve case detection rates for active tuberculosis and has the potential to complement existing package of intervention that could substantially reduce the burden of TB endemic communities. Risk factors such as family size > 5 persons, previous contact with TB patients, marital and HIV status were associated with TB prevalence. NaOCl concentration technique could be effective to improve case detection especially in resource limited settings.

Limitations of the Study

Given that culture which is gold standard was not performed, more cases of TB would have been missed in the study.

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Computing Interest

All authors declare there is no competing interest

List of Abbreviation

BCTB - Bacteriologically confirmed tuberculosis
CCTB - Clinically Confirmed Tuberculosis
DOTS - Direct Observed treatment strategy
HHC - Household Contact
IC - Index case
PTB - Pulmonary tuberculosis
NaOCl - sodium hypochlorite
ZN - Ziehl-Neelsen

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