International Journal of Health Sciences and Research
Vol.13; Issue: 10; October 2023
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Yield of Tuberculosis Contact Screening and Predictors of Contact Tuberculosis Diagnosis in Bungoma County Hospital, Kenya

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DOI: https://doi.org/10.52403/ijhsr.20231024

ABSTRACT

Tuberculosis (TB) contact screening though highly recommended is seldom practiced in low- and middle-income countries due to lack of evidence-based approaches best suited to the local setting. We assessed the yield of TB contact screening and predictors of TB diagnosis at a county referral hospital in Western Kenya.

We identified clients with TB disease at Bungoma county referral hospital between January and December 2021, who completed a standard questionnaire and identified potential close contacts. We described the characteristics and yield of TB disease among contacts using means, standard deviation, counts and proportions. We used logistic regression to determine factors associated with TB diagnosis for contacts and reported odds ratios and 95% confidence intervals (95% CI).

We identified 105 index TB cases who identified 358 contacts. The yield of TB disease among the contacts was 11% (39/353). The mean age of the TB contacts was 29.2 years (SD 19.3) and 87.8% (310/353) were household contacts. Body mass index of 18.5 kg/m^2 and above was associated with 89% lower odds of TB disease among contacts (OR 0.11, 95% CI: 0.05-0.25). Contacts who had ever smoked were 3 times more likely to be diagnosed with TB disease (OR 3.10, 95% CI: 1.56-6.15). Contacts who used wood/kerosene for cooking had 3.5 times higher odds of TB disease (OR 3.5 95% CI: 1.05-11.72).

Contact screening has a high yield of TB disease. Targeted approach directed towards contacts with malnutrition, smokers, and those using wood/kerosene for cooking may increase TB yield among contacts.

Keywords: Tuberculosis, Contacts screening and Bungoma

INTRODUCTION

Tuberculosis (TB) is a significant public health challenge, and worldwide 10 million people were estimated to have TB disease and in excess of 1.4 million died in the year 2019[1]. In 2016, World Health Organization (WHO) approximated that two-fifths of new TB cases worldwide are missed, and each country needs to come up with innovative ways of finding the missing cases in order to attain the universal aim of ending the TB scourge by the year 2035[2]. In order to meet the ambitious universal targets of reducing new TB infections and death by 90% by 2030, WHO proposes screening and evaluation for TB disease among the contacts as a strategy for finding missing cases [3]. In Kenya more than half of the people with TB disease are missed as per 2015/16 prevalence survey report [4]. This group of missed TB cases poses an increased risk of ongoing community TB transmission [5]. Most TB programs are accustomed to passive TB case finding

which leads to prolonged suffering among TB patients and uninterrupted spread of the disease within the community [6].

Contact screening and investigation is a step towards detection of missed TB cases, averting onward community transmission, empowering contacts with TB prevention and control knowledge, and reduction in morbidity and mortality from TB disease [7, 8]. Most contacts of TB patients with signs and symptoms of TB disease do not present to health facilities early enough due to poor health seeking behavior and poor knowledge leading to late diagnosis and unfavorable treatment outcomes [9, 10]. Contact screening can be executed by non-expert health workers and is likely to identify more TB cases [8]. Screening of TB contacts is recommended as a strategy for finding of missed TB cases, but is seldom practiced in middle and low-income countries like Kenya due to resource constraints, limited capacity for investigations, and lack of local evidence based approaches [5].

The objective of this study was to assess yield of TB contact screening and predictors of TB disease among contacts in Bungoma county referral hospital.

MATERIALS & METHODS

Research design and setting

This was a cross-sectional study conducted at Bungoma county referral hospital located in Western Kenya. Approximately 20 patients are diagnosed with TB disease and initiated on treatment within this facility monthly. Participants were confirmed TB patients, aged above 18 years who were started on treatment at Bungoma county referral hospital between January 2021 and December 2021 and their contacts.

Procedure for contact screening and investigation

Line listing of TB index patients was done. Research assistants visited index cases and screened their contacts using the WHO standardized symptomatic TB screening tool (WHO, 2013). A close contact was defined as a person who shared the same enclosed living space with the index case for one or more nights or frequently during the day during the 3 months before diagnosis of TB, this included household members, co-workers sharing same enclosed workplace or neighbors [11]. Criteria used in adult contact screening were cough, weight loss, fever and night sweats. In child contacts the criteria included cough, failure to gain weight, reduced playfulness, fever and night sweats [5]. Presumptive TB case was defined as a presence of cough or two or more of the symptoms other than cough persisting for at least two weeks (WHO 2013). All contacts who screened positive were referred for confirmatory Genexpert test [1]. Those who tested positive on GeneXpert were commenced on TB treatment while for those who tested negative, chest x-ray was done. Those with x-ray findings consistent with TB disease were started on TB treatment.

We defined the positive yield as proportion of contacts who were diagnosed with TB disease after screening. Delayed TB treatment was failure to start TB treatment for a period of more than two weeks from onset of TB signs and symptoms in a patient. We enrolled all patients registered over the study period in Bungoma county referral hospital and their contacts.

Data Analysis

Socio-demographic, clinical and environmental characteristics were described using means, frequencies and proportions. Univariate analysis was used to assess association between TB disease yield and socio-demographic, clinical and environmental characteristics. We reported odds ratio, 95% confidence intervals and p-values. Analysis was done using version 20.00 of statistical package for social scientists.

Ethical Considerations

Ethical clearance was sought from Kenyatta National Hospital Ethical and Research Committee (P358/4/2022). Permission from NACOSTI was also obtained

(NACOSTI/P/22/20976). Permission was sought from Bungoma hospital management team to conduct the study within the facility. All participants provided informed written consent before enrolment. Respect and confidentiality were maintained throughout the research process. Data was stored in a password-protected computer only accessed by the research team. Data was delinked of all participant identifiers prior to analysis. Contacts with TB disease were referred for treatment. No monetary benefits were provided for the participation in the study.

RESULT

Characteristics of index cases and their contacts

Out of 105 index cases, 35 (33.3%) were female, and the mean age was 37.5 (standard deviation 12.85) years; 39 (37.1%) had BMI< 18.5 kg/m^2, 26 (24.8%) were HIV positive and 69 (65.9%) had high bacillary load (Table 1).

Table 1: Characteristic of TB index cases

Characteristics		Frequency (%) N=105
Age in Year (mean 37.5, SD 12.85)	<25	17 (16.2)
	25-54	77 (73.3)
	55+	11 (10.5)
Gender	Male	70 (66.7)
	Female	35 (33.3)
BMI category	<18.5 kg/m^2	39 (37.1)
	18.5+ kg/m^2	66 (62.9)
HIV status	Negative	79 (75.2)
	Positive	26 (24.8)
Bacillary Load	High	69(65.7)
	Low	36 (34.3)
Delayed in TB management	Yes	71 (67.6)
	No	34 (32.4)

Contact tracing and screening

A total of 358 contacts were line-listed, 353 (99%) contacts were screened for TB disease, of whom 174 (49.3%) were males. The mean age of the contacts was 29.2 (SD 19.29) years; 154 (43.6%) were married, 175 (49.6%) had primary and higher level of education , and 126 (35.7%) had on average less than three meals in a day; 9 (2.5%) were HIV positive, 124 (35.1%) had BMI <18.5 kg/m^2, 84 (23.8%) were smokers, 110 (31.2%) had history of pneumonia, 216 (61.2%) had houses made of mud, 243 (68.8%) had no separate kitchen, 279 (79.0%) were using wood or kerosene for cooking and 43 (12.1%) were social contacts (Table 2).

Table 2: Characteristic of contacts

Characteristics		Frequency (%) N=353
Age in years (mean 29.22, SD 19.29)	<15	87 (24.6)
	15-34	147 (41.6)
	35-54	81 (22.9)
	55+	38 (10.8)
Gender	Male	174 (49.3)
Marital status	Single	176 (49.9)
	Married	154 (43.6)
	Separated/Widowed	23 (6.5)
Level of education	None	178 (50.4)
	Primary and above	175 (49.6)
Occupation	None	133 (37.7)
	Business	76 (21.5)
	Formal employment	58 (16.4)
	Farmer	86 (24.4)
Average income per month	<5k	174 (49.3)
Average frequency of meals per day	<3	126 (35.7)
HIV status	Negative	168 (47.6)
	Unknown	176 (49.9)
	Positive	9 (2.5)
BMI category	<18.5kg/m^2	124 (35.1)

Smoking status	Ever smoked	84 (23.8)
Alcohol intake	Yes	115 (32.6)
History of pneumonia	Yes	110 (31.2)
Sharing of more than two people per room	Yes	144 (40.8)
Type of floor	Mud	216 (61.2)
	Cement	137 (38.8)
Separate kitchen	Yes	110 (31.2)
Fuel for cooking	Wood/Kerosene	279 (79.0)
	Electricity/gas	74 (21.0)
Type of contact	Household	310 (87.8)
	social	43 (12.2)
Duration stays in years	<1	318 (90.1)
	1+	35 (9.9)

Yield of TB disease among the contacts

Of 105 index TB cases, 5 (4.7%) had no contacts. Five contacts were excluded, 353 contacts were enrolled into the study, and the ratio of index cases to contacts was 1:4. Of the 353 contacts, 99 (28%) had presumptive TB; of those, 39 cases were diagnosed with TB disease, a yield of 11 % (Figure 1).

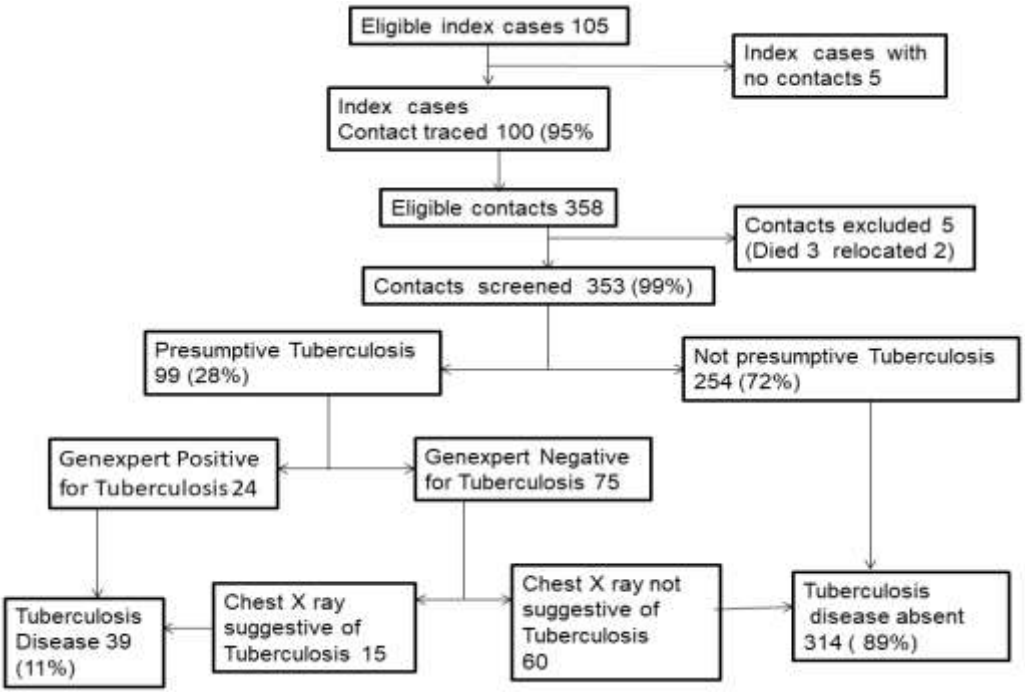

Figure 1: Outcome of TB screening and evaluation among contacts

Characteristics of contacts associated with diagnosis of TB disease among the contacts

Level of education was associated with TB disease among the contacts, and contacts with primary and higher level of education had 77% lower odds of TB disease diagnosis compared to those with no education (OR 0.23, 95% CI:0.10-0.51). Contacts eating meals less than 3 times per day had 5 times higher odds of being diagnosed with TB disease compared to contacts eating more than three meals per day (OR 5.16, 95% CI: 2.68-11.73). Body mass index of 18.5kg/m^2 and above was associated with 89% lower odds of TB disease (OR 0.11, 95% CI: 0.05-0.25). Contacts who had ever smoked were 3 times more likely to be diagnosed with TB disease compared to those who had never smoked (OR 3.10, 95% CI: 1.56-6.15). Contacts with history of pneumonia had 4.8 times higher odds of being diagnosed with TB disease compared to contacts with no history of pneumonia (OR 4.8, 95% CI: 2.39-9.69). Contacts who associated with

more than one person with TB disease had 6.5 times higher odds of being diagnosed with TB disease compared with those who associated with one TB index case (OR 6.5, 95% CI: 3.22-13.13). Contacts who were using firewood or kerosene for cooking had 3.5 times higher odds of being diagnosed with TB disease compared to those using electricity or gas (OR3.5, 95% CI:1.05-11.72). Contacts who were staying in a house with a floor made up of mud had 3.9 higher odds of being diagnosed with TB compared with those in cement floor (OR 3.9, 95% CI: 1.60-6.72). Household contacts had 71% lower odds of being diagnosed with TB disease compared to social contacts (OR 0.29, 95% CI: 0.13-0.64). Period of association with TB index case was associated with TB disease among contacts, and contacts who had associated with TB index case for one year or more had 3.8 times higher odds of TB disease compared to those who had associated with index case for less than one year (OR 3.89, 95% CI: 1.74-9.11) (Table 3).

Table 3: Characteristics of contacts associated with diagnosis of TB disease among contacts

Characteristics	**Categories**	**TB status**		**OR (95% CI)**	**p value**
		Yes (%) N=39	**No (%) N=314**		
Gender	Female	16(8.9)	163(91.1)	Ref	
	Male	23(13.2)	151(88.8)	1.55(0.79-3.05)	0.202
Marital status	Married	14 (9.1)	140 (90.9)	Ref	
	Single	21 (11.9)	155(88.1)	1.55(0.48-5.01)	0.461
	Separated/Widowed	4 (17.4)	19 (82.6)	2.11(0.63-7.06)	0.228
Level of education	None	31 (17.4)	147(82.6)	Ref	
	Primary and higher	8 (4.6)	167 (95.4)	0. 23(0.10-0.51)	<0.001
Occupation	None	15 (11.3)	118(88.7)	Ref	
	Business	13(17.1)	63(82.9)	0.81(0.33-1.10)	0.642
	Formal employment	3(5.2)	55(94.8)	0.50(1.19-1.27)	0.145
	Farmer	8 (9.3)	78(90.7)	1.88(0.48-7.41)	0.367
Average income per month	<Ksh 5,000	22 (12.6)	152(87.4)	Ref	
	Ksh. 5,000 and above	17 (16.1)	89 (83.9	1.2 (0..64-2.42)	0.522
No of meals per day	3+	11(4.8)	216(95.2)	Ref	
	<3	28(22.2)	98(77.8)	5.16(2.68-11.73)	0.001
Previous History of Tuberculosis disease	No	32(10.2)	282(89.8)	Ref	
	Yes	7(17.9)	32(82.1)	1.93(0.79-4.72)	0.151
HIV status	Negative	25(14.9)	143(85.1)		
	Unknown	10(5.7)	166(94.3)	2.90 (1.35-6.25)	0.006
	Positive	4(44.4)	5(55.6)	0.22(0.06-0.87)	0.031
BMI category	18.5+ kg/m^2	8(3.5)	221(96.5)	Ref	
	<18.5 kg/m^2	31(25.0)	93(75.0)	9.21(4.08-20.79)	<0.001
Cigarette Smoking	Never	16(5.9)	253(94.1)	Ref	
	Ever smoked	23(27.4)	61(72.6)	3.10(1.56-6.15)	<0.001
Alcohol intake	No	22(9.2)	216(90.8)	Ref	
	Yes	17(14.8)	98(85.2)	1.70(0.87-3.35)	0.123
History of Pneumonia	No	14(5.8)	229(94.2)	Ref	
	Yes	25(22.7)	85(77.3)	4.81(2.39-9.69)	<0.001
Associating with more than one person with TB	No	15(5.6)	252(94.4)	Ref	
	Yes	24 (27.9)	62(72.1)	6.50(3.22-13.13)	<0.001
Sharing of more than two people per room	No	13(6.2)	196(93.8)	Ref	
	Yes	26(18.1)	118(81.9)	3.32(1.64-6.72)	0.001
Type of floor	Cement	6(4.4)	131(95.6)	Ref	
	Mud	33(15.3)	183(84.7)	3.94(1.60-9.67)	0.003
Fuel for Cooking	Electricity/gas	3(4.1)	71(95.9)	Ref	
	Wood/Kerosene	36(12.9)	243(87.1)	3.51(1.05-11.72)	0.042
Type of contact	Social	11(25.6)	32(74.4)	Ref	
	House hold	28(9.0)	282(91.0)	0.29(0.13-0.64)	0.002
Period of association with TB index case	<1 year	29(9.1)	289(90.9)	Ref	
	1+ year	10(28.6)	25(71.4)	3.89(1.74-9.11)	0.001

Characteristics of index case associated with diagnosis of TB disease among contacts

Contacts of index cases with low bacillary load had 85% lower odds of TB disease compared to contacts of index cases with high bacillary load (OR 0.15,95% CI: 0.04-0.59). Contacts of index cases who got prompt diagnosis and treatment of TB disease were 98% less likely to be diagnosed with TB disease compared to contacts of index cases who delayed in initiating TB treatment (OR 0.02 95%, CI: 0.01-011) (Table 4).

Table 4: Characteristics of index case associated with TB diagnosis among the contacts

Characteristic	Category	TB diagnosis among contacts		COR (91%CI)	P value
		Yes (%) n=25	No (%) N=75		
Gender	Male	15(21.2)	51(78.8)	Ref	
	Female	10 (29.4)	24 (70.6)	0.71(0.28-1.80)	0.466
HIV status	Positive	4(16.7)	20(83.3)	Ref	
	Negative	21(27.6)	55(72.4)	1.91(0.58-6.25)	0.285
Bacillary load	High	18(75.0)	6(25.0)	Ref	
	Low	7(9.2)	69(90.8)	0.03(0.01-0.11)	<0.001
Delayed in TB diagnosis &management	Yes	23(59.0)	16(41.0)	Ref	
	No	2(3.3)	59(96.7)	0.02(0.01-011)	<0.001

DISCUSSION

The yield of TB disease among the contacts in our study was comparable to that in studies done in South Africa and Nigeria. Factors associated with diagnosis of TB disease among the contacts were level of education, frequency of meal per day, BMI category, cigarette smoking, history of pneumonia, associating with more than one person with TB disease, sharing a room with more than two people, type of floor of residential house, fuel for cooking, type of contact and period of association with TB index patient. The characteristics of index case associated with diagnosis of TB disease among the contacts were bacillary load and delay in TB disease management.

The yield of TB disease in our study was higher compared to that in the cross sectional study done in South Africa, which reported a yield of 6.6% [12]. It was however lower compared to that in the quasi-experimental study done in Nigeria by Onuka *et al*, which showed a yield of 22.6% [13]. This difference in yield between our study and that in Onuka *et al*, can be attributed to symptomatic screening, which was used in our study, compared to use of chest x-ray as a screening tool in the study by Onuka *et al*. Some of the contacts in the initial stages of the diseases are likely to be asymptomatic; and use of chest x-ray is able to identify them early enough. Most of the factors associated with diagnosis of TB disease among the contacts are related to low socio-economic status: less number of meals a day, malnutrition, floor of the house made up of mud, use of firewood for cooking, many people sharing a room, high bacillary load and delay in seeking of health care for TB index cases, this correlate with studies done in Ethiopia [14], and Tanzania [15] and Pakistan [16]. Having less than three meals in day predispose to malnutrition which weakens the immune status, accelerating the progression of TB disease. Poor housing and many people sharing a room, is related with enclosed spaces and poor air circulation that accelerate TB transmission, as such houses are likely to have poor ventilation [17]. Our study showed that having no formal education was associated with positive TB disease among contacts and this is likely to be associated with poor health seeking behaviors. Individuals with low level of education are less to observe TB prevention and control measures making them susceptible to TB transmission. Cigarette smoking was associated with TB disease among the contacts, and this agrees with findings in studies done in Pakistan [18] and Myanmar [19]. Cigarette smoke damages the airway epithelial barrier and nicotine affects the continuity of ciliar barrier leading to hyper secretion of mucus and delayed mucous

clearance which is conducive for multiplication of *mycobacterium bacillus* [20]. In addition, smokers tend to smoke in small-enclosed spaces with inadequate ventilation. High bacillary load of the TB patients was associated with TB disease among the contacts. This finding is similar to that in the study done in Peru [21], and France [22], which showed that contacts of index TB patients with high colon of bacilli per field increased the risk of TB disease transmission among the contacts. Tuberculosis patients with high bacillary load expel many bacilli in the atmosphere, and due to close proximity contacts are likely to inhale these bacilli causing TB infection and disease. Time between TB symptom onset and TB treatment initiation among TB patients was associated with TB disease among the contacts. This is similar to findings in studies done in Peru and China that showed association between time of symptoms and time taken to receive TB treatment [21, 23]. This can be attributed to exposure of the contacts to the bacilli for longer duration making them susceptible to progression to TB disease.

Limitation of this study was the small sample size which may have affected our ability to detect association between some factors and positive TB disease among contacts. The yield of TB disease among the contacts that we established in our study setting can be applied to other settings similar to ours.

CONCLUSION

The yield of TB disease among the contacts was high at 11% and was comparable to yield reported in previous studies. Most of the factors associated with TB disease among the contacts were those associated with poor socioeconomic status which supports the fact that TB is a disease of the poor. Active contact tracing and screening is a potential strategy to close a gap in TB case finding.

Recommendation

Contacts screening should be routinely done as it has a high yield of TB disease diagnosis.

A targeted approach targeting contacts with malnutrition, smokers, those with no formal education and those using wood/ kerosene for cooking may increase the yield of TB disease among the contacts.

In-order to reduce TB transmission in the community poverty alleviation program is required.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: We would like to thank Health-Professional Education Partnership Initiative (HEPI) Kenya for financial support. We are also grateful to the study participants for their participation in the study, and valuable information.

Source of Funding: The study was funded by NIH funded project R25TW011212

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: Robert Shihuzire Magomere, Beatrice Mutai. Yield of tuberculosis contact screening and predictors of contact tuberculosis diagnosis in Bungoma County Hospital, Kenya. *Int J Health Sci Res.* 2023; 13(10):177-185.
DOI: *https://doi.org/10.52403/ijhsr.20231024*

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