Journal of Innovative Research (JIR)

ISSN: 2837-6706 (ONLINE)

VOLUME 3 ISSUE 1 (2025)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

Journal of Innovative Research (JIR)

Volume 3 Issue 1, Year 2025
ISSN: 2837-6706 (Online)
DOI: https://doi.org/10.54536/jir.v3i1.3949
https://journals.e-palli.com/home/index.php/jir

Evaluating Tuberculosis Awareness and Screening Outcomes among Household Contacts of Index Cases: A Cross-Sectional Study in Ghana

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Article Information

Received: October 21, 2024

Accepted: November 29, 2024

Published: February 08, 2025

Keywords

Awareness, Household Contacts, Index Case, Screening, Tuberculosis

ABSTRACT

This study assessed TB prevalence and factors affecting screening among household contacts in Ga West Municipality, Ghana. A cross-sectional descriptive study was conducted with 107 household contacts of TB index cases identified from health facility records. A structured questionnaire collected data on demographics, TB knowledge, screening, and treatment status. Utilizing STATA 14, the statistical analysis included descriptive statistics and Pearson chi-square tests, with a significance level set at $p < 0.05$. The mean age of participants was 35.7 years (SD ± 11.8), predominantly male (58.9%) and urban dwellers (78.5%). Of the participants, 57.9% were screened for TB, with a positive rate of 20% (n=9). Among those diagnosed, 88.9% (n=8) initiated treatment. Awareness of TB was high (90.7%), yet only 6.7% could identify five key symptoms of TB. Significant associations were found between educational level and TB awareness ($\chi^2(4) = 17.237$, $p = 0.002$), between residence and screening likelihood ($\chi^2(1) = 4.26$, $p = 0.039$), and individuals residing within 5 km of a health facility had a higher likelihood of being screened compared to those living farther away ($\chi^2(1) = 10.41$, $p = 0.001$). This study found that despite high awareness of TB transmission, screening rates among household contacts were low; enhanced outreach and education efforts are needed to improve knowledge and screening, particularly for urban residents. The predominance of male pulmonary cases was noted, highlighting the necessity for targeted efforts to mitigate TB transmission and further research on barriers to screening.

INTRODUCTION

Tuberculosis (TB) is a contagious bacterial infection caused by Mycobacterium tuberculosis, primarily affecting the lungs but capable of impacting other organ systems. TB remains a significant global health challenge (Litvinjenko *et al.*, 2023) (MacNeil *et al.*, 2020; Ternaa *et al.*, 2022; Onyango *et al.*, 2024). According to the World Health Organization (WHO), approximately 5.8 million new TB cases were reported globally in 2022, with about 1.5 million deaths attributed to the disease (World Health Organization, 2022). Globally, the incidence rate of tuberculosis (new cases per 100,000 populations per year) experienced a 3.6% increase from 2020 to 2021, reversing a trend of approximately 2% annual declines that had persisted for most of the preceding two decades. Between 2015 and 2021, the overall reduction was 10%, which falls short of the initial milestone set by the End TB Strategy (USAID, 2023).

Sub-Saharan Africa bears a substantial burden of TB, with an estimated incidence rate of 280 cases per 100,000 population. This region accounts for a significant proportion of the world's TB cases, exacerbated by factors such as high rates of HIV co-infection, socio-economic challenges, and inadequate healthcare infrastructure. The WHO reports that in 2020, the African region had over 2.5 million new TB cases (World Health Organization, 2022).

In Ghana, TB remains a critical public health issue (Iddrisu *et al.*, 2024). According to the World Health Organization, Ghana has a tuberculosis incidence rate of 148 cases per 100,000 population per year, ranking it as the 19th most affected country in Africa and among the 48 countries globally with the highest TB burden (Afum *et al.*, 2021). Efforts to combat the disease have included

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the implementation of the directly observed treatment short-course (DOTS) strategy (Ghana Health Service, 2022). However, despite these efforts, the country faces significant barriers, including limited awareness and stigma associated with TB.

In the Greater Accra Region, TB statistics reveal both challenges and progress (Quarcoopome & Tornu, 2022). In 2020, the Greater Accra region reported a higher number of tuberculosis cases compared to most other regions (Abdul *et al.*, 2020). The Ga West Municipality's case detection rate fell short of both regional and national targets, highlighting an urgent need for enhanced screening and awareness programs in this urban area (Ga West Health Directorate, 2016).

Household contacts of TB index cases are at elevated risk of infection due to close exposure. Effective identification and screening of these individuals are crucial for preventing further transmission and ensuring timely treatment (Laghari *et al.*, 2019). Studies have shown that awareness of TB symptoms and transmission methods is often inadequate among these contacts, leading to delays in seeking care and increased risk of disease spread (Reichler *et al.*, 2020; Alsayed & Gunosewoyo, 2023).

Awareness of TB symptoms, transmission, and treatment options is essential for early diagnosis and effective management (Japan Anti-Tuberculosis Association, 2021). Knowledge gaps among the population can significantly hinder early detection and treatment. Furthermore, screening for TB among household contacts can lead to better health outcomes (Artawan Eka Putra *et al.*, 2023; Yayan *et al.*, 2024). However, various barriers, including stigma and misinformation, often limit the effectiveness of screening programs (Biermann *et al.*, 2019) This study therefore assessed tuberculosis (TB) awareness and screening outcomes among household contacts of index cases in the Ga West Municipality of Ghana. Specifically, the study sought to determine: the proportion of household contacts screened for TB, the proportion diagnosed with TB, the proportion treated for TB, and the factors associated with TB knowledge, screening, and outcomes among these contacts.

MATERIALS AND METHODS

Study Area

Ga West Municipality, part of the Greater Accra Region since 2008, spanned approximately 305.4 square kilometers and had a projected population of 245,224 in 2016 (GSS). It borders several districts and municipalities in the northern part of the region. The area is rapidly urbanizing, with 67.8% of the population living in urban areas and 32.2% in rural areas. The municipality features a three-tier health service system with 81 public and private health facilities, including 14 providing TB services. The municipal hospital serves as a diagnostic centre, supported by 12 other facilities for TB treatment.

Study Design

The study was a cross-sectional descriptive study that applied quantitative methods to answer the research questions.

Study Outcome and Exposure Variables

The primary outcome variables for this study included the diagnosis of pulmonary-positive tuberculosis, TB screening status, and awareness of tuberculosis among household contacts. The exposure variables included age, sex, place of residence, educational level, relationship to the index case, presence of a cough, presence of a BCG scar, and sputum examination results. The study also evaluated household contacts' knowledge of tuberculosis, their screening and treatment status for sputum smear-positive TB, and whether treatment was initiated following a positive sputum smear laboratory result.

Sample Size Calculation and Sampling Method

Sample size calculations were conducted using Cochran's formula (1963):

$n=((Z_{(\partial/2)})^2 p(1-p)\ )/d^2$

where n represents the sample size, p is the prevalence of household contacts (7.6%), d is the margin of error (5%), and Z=1-α/2= 1.96) corresponds to a 95% confidence level. Substituting these parameters into the formula: To account for a 10% anticipated loss rate, the final sample size was 118. Ultimately, 107 participants were contacted and interviewed. The reduction from the calculated sample size was due to the relocation of index cases and unreachable household contacts. Attempts were made to interview at least two household contacts per index case to meet the target sample size. If an index case and their contacts had moved, only the index case details were recorded. TB patients with extra pulmonary tuberculosis or those receiving treatment outside the municipality were excluded from the study.

Participants were enrolled based on the number of household contacts associated with each index case, and no additional sampling was conducted during data collection. The study was conducted in the catchment areas of fourteen facilities within the municipality that provide TB contact investigation services. Facility records detailing TB index cases and their household contacts (HHC) were reviewed. Standardized data extraction forms were used to ensure consistent data collection across facilities. In 2015, 109 TB index cases were recorded. Their household contacts were identified, traced, and interviewed at their homes, according to the TB contact investigation register. Contact tracing followed a systematic approach, utilizing both facility records and community-based methods to ensure comprehensive identification. Additional household contacts not captured during initial contact tracing were also documented. Only individuals who had resided with the index case for at least three months before the TB diagnosis were included in the study. To confirm eligibility, a verification process was conducted, including interviews and cross-referencing with TB registers. Written informed consent was obtained from each household contact before they participated in the

study. Ethical approval for the study was obtained from the relevant institutional review board.

Data Collection Procedures, Processing and Validation

The study utilized a data extraction tool and a structured questionnaire for data collection. The data extraction tool recorded information on TB index cases and their treatment supports. Index case addresses were used to trace and interview their household contacts. Extracted variables included names, ages, and sexes of TB index cases, the type of TB diagnosed, and details of identified household contacts. For household contacts, data collected included names, contact information, ages, sex, place of residence, level of education, presence of BCG scar, duration of cough, and sputum smear results.

A structured questionnaire was administered to household contacts to evaluate their knowledge of tuberculosis, determine if they had been screened, and verify their treatment status if diagnosed with TB. The questionnaire underwent pre-testing in Ga South Municipality, chosen for its demographic similarity to the study area. Revisions were made based on feedback from the pre-test to improve clarity and relevance.

Data were obtained from the tuberculosis contact investigation register at health facilities within the catchment area. Index cases were identified from this register, and their household contacts were enrolled by confirming the listed contacts and conducting follow-ups in their communities. Written informed consent was secured from all participants before their inclusion in the study. Additionally, hospital records of TB index cases and their household contacts were reviewed and extracted. The structured questionnaire was meticulously designed to gather comprehensive information from household contacts.

Two research assistants were trained to review records from the tuberculosis contact investigation register and the TB microscopy laboratory register. Another team of two research assistants, including community health nurses and community-based surveillance volunteers (CBSVs), received orientation on administering the questionnaire to household contacts.

Data from the tuberculosis contact investigation register on index case records were captured in Microsoft Excel. Laboratory findings were validated against records from the tuberculosis laboratory microscopy register. Responses from the structured questionnaire administered to household contacts were double-entered into Microsoft Excel. To ensure accuracy, data entry was cross-checked for consistency and errors were corrected.

Data Analysis

Initial data processing was conducted using Microsoft Excel (version 16), after which the cleaned dataset was imported into STATA 14 (Stata Corp, College Station) for in-depth statistical analysis. Descriptive statistics were calculated to summarize demographic variables, including mean age and frequency distributions for categorical data. Pearson chi-square tests were employed to assess associations between background characteristics and TB awareness, as well as to evaluate the relationships between screening outcomes and demographic factors, with degrees of freedom (df) reported for each test. Statistical significance was determined at p-values less than 0.05. The analysis output was presented in tables, clearly displaying descriptive statistics, chi-square values, degrees of freedom, and corresponding p-values to facilitate interpretation and comparison of results.

RESULTS AND DISCUSSIONS

Demographic and Living Conditions of Study Participants

The mean age was 35.7±11.8 years, with the largest age groups being 21-30 years (30.8%) and 31-40 years (25.2%). The sample was predominantly male (58.9%) and resided largely in urban areas (78.5%). Educational attainment varied, with 31.8% having completed Junior High School (JHS) and 27.1% having completed Senior High School (SHS).

A significant majority had a BCG scar (73.8%). Most participants lived in large households, with 63.5% having eight or more members. Housing conditions showed that 43% had 3-4 bedrooms and the majority (84.1%) had 2-4 windows in their rooms (Table 1).

Table 1: Demographic and Living Conditions of Study Participants

Variable (n=107)	Frequency	Percentage (%)
Age Mean=35.7 (SD± 11.8)		
≤ 20 years	7	6.5
21-30 years	33	30.8
31-40 years	27	25.2
41-50 years	25	23.4
51-60 years	13	12.1
> 60 years	2	1.9
Sex		
Male	63	58.9
Female	44	41.1
Residence		

Urban	84	78.5
Rural	23	21.5
Educational level		
None	14	13.1
Primary	10	9.3
JHS	34	31.8
SHS	29	27.1
Tertiary	20	18.7
Presence of BCG scar		
Yes	79	73.8
No	28	26.2
Household members		
2-4 members	17	15.9
5-7 members	22	20.6
≥ 8 members	68	63.5
Number of bedrooms in household		
1-2 rooms	15	14
3-4 rooms	46	43
> 4 rooms	46	43
Windows in room		
< 2 windows	16	15
2-4 windows	90	84.1
> 4 windows	1	0.9

Demographic and Clinical Characteristics of TB Index Cases

The median age of the 109 index cases was 39 years, with a range spanning from 6 to 84 years. The cohort comprised 71.7% males and 28.4% females. A predominant 69.7% of the cases were classified as pulmonary positive TB, while 18.4% were categorized as pulmonary negative and 11.9% as extrapulmonary TB. Regarding sputum smear results before treatment, 20.2% of cases were negative, 5.5% were scanty, 25.7% were positive, 17.4% had ++, and 21.1% had +++ (Table 2).

Table 2: Demographic and Clinical Characteristics of TB Index Cases in Ga West Municipality

Variable (n=109)	**n (%)**
Age (median and range)	39 (6-84) years
Sex	
Male	78 (71.7)
Female	31 (28.4)
TB classification	
Pulmonary Positive	76 (69.7)
Pulmonary Negative	20 (18.4)
Extra Pulmonary TB	13 (11.9)
Sputum smear result before treatment	
Negative	22 (20.2)
Scanty	6 (5.5)
+	28 (25.7)
++	19 (17.4)
+++	23 (21.1)

Key: n=frequency; %= percentage

Knowledge and Distribution of Tuberculosis Screening and Treatment among Household Contacts

The data indicates that while 90.7% of participants are aware of tuberculosis (TB), knowledge of its signs and symptoms is poor, with only 6.7% able to identify five correct signs. Additionally, 48.6% did not know any signs. Most participants (77.6%) understood that TB is curable, and 78.5% recognized its transmissibility. Overall, there is a significant need for enhanced education on TB's specifics. Of the total participants, 57.9% (n=45) underwent TB screening, while 42.1% (n=62) did not. Among those screened, 20.0% (n=9) tested positive for tuberculosis, and 80.0% (n=36) tested negative. Of those who tested positive, the majority (88.9%, n=8) received treatment, while a minority (11.1%, n=1) did not (Table 3).

Table 3: Knowledge and Distribution of Tuberculosis Screening and Treatment Among Household Contacts in Ga West Municipality

Variable	Frequency	Percentage (%)
Ever heard of TB?		
Yes	97	90.7
No	10	9.3
Signs and Symptoms		
Mentioned 5 correct signs and symptoms	7	6.7
Mentioned 4 correct signs and symptoms	9	8.6
Mentioned 3 correct signs and symptoms	4	3.8
Mentioned 2 correct signs and symptoms	9	8.6
Mentioned 1 correct signs and symptoms	51	48.6
Mentioned know correct signs and symptoms	25	23.8
Know TB is curable		
Yes	83	77.6
No	24	22.4
Transmittable		
Yes	84	78.5
No	20	18.7
Don't know	3	2.8
Screen for TB?		
Yes	45	57.9
No	62	42.1
TB screening outcome		
Positive	9	20.0
Negative	36	80.0
Treatment for TB		
Yes	8	88.9
No	1	11.1

Associations between Background Characteristics and Awareness of Tuberculosis

A Pearson chi-square test was used to examine the relationship between various background characteristics and TB awareness. The analysis revealed a significant association between educational level and TB awareness, with higher education correlating with better awareness ($\chi^2(4) = 17.237$, $p = 0.002$). However, no significant associations were found for age, sex, residence, or BCG scar presence, indicating that these factors did not significantly influence TB awareness in this sample (Table 4).

Table 4: Associations between Background Characteristics and Awareness of Tuberculosis in Ga West Municipality

Variable	Heard of TB n (%)		df	χ2	P-value
	Yes	No			
Age					

≤ 20 years	6 (85.7)	1 (14.3)	37	47.985	0.107
21-30 years	31 (93.9)	2 (6.1)			
31-40 years	26 (96.3)	1 (3.7)			
41-50 years	20 (80.0)	5 (20.0)			
51-60 years	12 (92.3)	1 (7.7)			
> 60 years	2 (100.0)	0 (0.0)			
Sex					
Male	57 (90.5)	6 (9.5)	1	0.006	0.940
Female	40 (90.9)	4 (9.1)			
Residence					
Urban	77 (91.7)	7 (8.3)	1	0.473	0.492
Rural	20 (87.0)	3 (17.0)			
Educational level					
None	11 (78.6)	3 (21.4)	4	17.237	0.002*
Primary	6 (60.0)	4 (40.0)			
JHS	32 (94.1)	2 (5.9)			
SHS	28 (96.6)	1 (3.4)			
Tertiary	20 (100.0)	0 (0.0)			
Presence of BCG scar					
Yes	73 (92.4)	6 (7.6)	1	1.092	0.296
No	24 (85.7)	4 (14.3)			

**=p-value<0.05; n (%)=frequency (percentage)*

Bivariate Analysis of Screening for TB and Background Characteristics of Participants

A chi-square test of independence was conducted to examine the relationship between TB screening and various background characteristics.

Significant associations were observed for residence and distance to a health facility. Specifically, rural residents were more likely to be screened for TB than those living in urban areas ($\chi^2(1) = 4.26$, $p = 0.039$). Additionally, individuals residing within 5 km of a health facility had a higher likelihood of being screened compared to those living farther away ($\chi^2(1) = 10.41$, $p = 0.001$). No significant associations were found between TB screening and age, sex, educational level, presence of a BCG scar, or duration of living with an index TB case ($p > 0.05$) as shown in Table 5.

Table 5: Bivariate analysis of screening for TB and background characteristics of participants in Ga West Municipality

Variable	Screened for TB n (%)		df	χ2	P-value
	Yes	No			
Age					
≤ 20 years	2 (28.6)	5 (71.4)	37	42.16	0.257
21-30 years	13 (39.4)	20 (60.6)			
31-40 years	11 (40.7)	16 (59.3)			
41-50 years	9 (36.0)	16 (64.0)			
51-60 years	8 (61.5)	5 (38.5)			
> 60 years	2 (100.0)	0 (0.0)			
Sex					
Male	29 (46.1)	34 (53.9)	1	0.99	0.319
Female	16 (36.4)	28 (63.6)			
Residence					
Urban	31 (36.9)	53 (63.1)	1	4.26	0.039*
Rural	14 (60.9)	9 (39.1)			
Educational level					

None	5 (35.7)	9 (64.3)	4	6.65	0.155
Primary	3 (30.0)	7 (70.0)			
JHS	15 (44.1)	19 (55.9)			
SHS	9 (31.0)	20 (69.0)			
Tertiary	13 (65.0)	7 (35.0)			
Presence of BCG scar					
Yes	30 (38.0)	49 (62.0)	1	2.06	0.151
No	15 (53.6)	13 (46.4)			
Months lived with index TB case					
< 3 months	7 (63.6)	4 (36.4)	2	2.36	0.307
> 3 months	35 (39.8)	53 (60.2)			
Distance to Health Facility					
< 5 km	27 (33.3)	54 (66.7)	1	10.41	0.001*
> 5 km	18 (69.2)	8 (30.8)			

**=p-value<0.05; n (%)=actual value (frequency) and percentage*

Association between TB Screening Outcomes and Background Characteristics

A chi-square test of independence was performed to assess the association between TB screening outcomes and various background characteristics. The results showed no significant associations with age, sex, residence, educational level, presence of a BCG scar, number of household members, number of windows in the bedroom, or months lived with the index TB case (Table 6).

Table 6: Bivariate analysis of socio-demographic characteristics of study participants and TB screening outcome in Ga West Municipality

Variable	Screening Outcome n (%)		df	χ2	P-value
	Positive	Negative			
Age					
≤ 20 years	0 (0.0)	2 (100.0)	48	40.974	0.754
21-30 years	5 (41.7)	7 (58.3)			
31-40 years	2 (25.0)	6 (75.0)			
41-50 years	1 (12.5)	7 (87.5)			
51-60 years	1 (11.1)	8 (88.9)			
> 60 years	0 (0.0)	2 (100.0)			
Sex					
Male	6 (23.1)	20 (76.9)	2	1.716	0.424
Female	3 (20.0)	12 (60.0)			
Residence					
Urban	5 (17.9)	23 (82.1)	2	2.891	0.236
Rural	4 (30.8)	9 (69.2)			
Educational level					
None	2 (40.0)	3 (60.0)	8	9.804	0.279
Primary	0 (0.0)	3 (100.0)			
JHS	5 (33.3)	10 (66.7)			
SHS	0 (0.0)	6 (100.0)			
Tertiary	2 (16.7)	10 (83.3)			
Presence of BCG scar					
Yes	7 (25.9)	20 (74.1)	2	1.25	0.535
No	2 (14.3)	12 (85.7)			
Household members					

2-4 members	3 (23.1)	10 (76.9)	4	2.082	0.721
5-7 members	2 (20.0)	8 (80.0)			
≥ 8 members	4 (22.2)	14 (77.8)			
Windows in bedroom					
< 2 windows	1 (14.3)	6 (85.7)	2	0.5	0.779
2-4 windows	8 (23.5)	26 (76.5)			
Months lived with index TB case					
< 3 months	2 (28.6)	5 (71.4)	4	0.723	0.948
> 3 months	7 (21.2)	26 (78.8)			

n (%)=actual value (frequency) and percentage

Discussion

Our study analyzed hospital records and identified that many TB index cases were male and predominantly pulmonary positive. This finding collaborates with similar studies conducted in Zimbabwe (Humayun *et al.*, 2022), Uganda (Miller *et al.*, 2021), Nigeria (Okoro *et al.*, 2024) and elsewhere in sub-Sahara Africa (Law *et al.*, 2020).

The age range of index cases in our study was 6 to 84 years, with a median age of 39 years. This is consistent with (Zhu *et al.*, 2018), who reported a median age of 31 years and an age range of 15 and greater than 65 years. This broad age range, including children, suggests that TB affects individuals of all ages (Ross *et al.*, 2021; World Health Organization, 2023). However, this finding contradicts other studies which found that age is a significant risk factor for TB, underscoring the need for robust preventive measures for children, who may be less equipped to take protective actions independently (Olmo-Fontánez & Turner, 2022; Dong *et al.*, 2022).

The current study also found that most household contacts were male, with an average age of 35 years (SD ±11.8), closely reflecting the demographic profile of the index cases. This suggests uniformity in the demographic characteristics within the study area. These findings align with (Ohene *et al.*, 2018; Turusbekova *et al.*, 2022), who also reported a predominance of males and a broad age range among contacts.

The educational level of contacts was generally above primary education, differing from findings in Sudan, where a significant proportion of respondents did not complete primary education (Yousif *et al.*, 2021). The high proportion of urban dwellers in our study is consistent with (Ncayiyana *et al.*, 2016), who observed higher TB rates in urban areas, potentially due to factors such as overcrowding.

The current study found that over 90% of contacts were aware of tuberculosis (TB), likely due to their exposure to TB index cases. While this high level of awareness is encouraging, it does not automatically result in effective prevention measures or health-seeking behaviour. Additionally, knowledge regarding the transmission of TB was notably high, with 72% of participants correctly identifying airborne transmission as the primary mode of spread, supporting the finding (Iddrisu *et al.*, 2024), However, this finding contrasts with a study in Saudi Arabia (Almalki *et al.*, 2022), which reported low levels of tuberculosis knowledge among participants.

Moreover, a significant portion of contacts understood that TB is both transmissible and curable, which is essential for motivating individuals to engage in preventive actions and seek timely medical treatment. Despite this positive awareness, knowledge of tuberculosis symptoms was significantly limited, with most participants able to identify only one symptom. This finding is notably lower than those reported in other studies (Abu-humaidan *et al.*, 2022; Angelo *et al.*, 2020). This gap in symptom recognition is particularly concerning, as it may hinder early medical care-seeking behaviour, a critical factor in controlling the disease's spread.

Interestingly, the educational level of participants significantly influenced their awareness of TB. Those with Senior High School (SHS) or tertiary education demonstrated greater awareness compared to their less educated counterparts. This finding aligns with a study in South Africa, which noted a similar correlation (Kigozi *et al.*, 2017). Higher educational attainment often correlates with improved health literacy, which can significantly enhance awareness and understanding of TB. Therefore, targeted educational interventions are crucial to bridge the knowledge gap regarding TB symptoms and encourage proactive health-seeking behaviour among all demographic groups.

More than half of the contacts had not undergone TB screening, which is crucial for early detection and treatment. This low screening rate contrasts with (Kazibwe *et al.*, 2021), who reported a higher screening rate. The WHO recommends regular screening for high-risk groups, including household contacts of TB patients (Angelo *et al.*, 2020). The low screening rate observed in our study may be attributed to the passive case-finding strategy implemented in Ghana's National Tuberculosis Control Program (Ghana Health Service, 2022).

Screening was significantly associated with residence and proximity to health facilities. Urban contacts and those living within 5 km of health facilities were more likely to be screened. This finding aligns with previous studies showing that access to healthcare services impacts screening rates and diagnosis timelines (Jenkins *et al.*, 2022) (Der *et al.*, 2022).

Among contacts who underwent screening, 20% tested

positive for TB, which is lower than the 24.2% reported in Uganda (Kazibwe *et al.*, 2021). This difference may be due to the smaller sample size in our study (45 contacts) compared to the larger sample (9,874) in their study.

Interestingly, in this study, contacts with BCG scars had a higher rate of positive TB screening outcomes, though this finding was not statistically significant. This conforms to a study in India which found BCG scars to be protective against TB (Dhanawade *et al.*, 2015). It is established that BCG vaccination is primarily protective for children under 5 years old (Martinez *et al.*, 2022).

The present study further revealed that environmental factors also influenced TB screening outcomes. Contacts living with more than eight household members and those staying more than three months with index cases had higher positive TB outcomes, although these differences were not statistically significant. These findings are in line with a study in South Africa which reported higher TB rates in overcrowded settings (Vyambwera & Witbooi, 2021). However, contrary to their findings, we observed that contacts with 2-4 windows in a room had higher positive TB outcomes compared to those with fewer windows, suggesting that ventilation might not have a uniform effect on TB risk.

This current study found that 88.9% of TB-positive contacts received treatment, similar to the high treatment rates observed in Pakistan (Laghari *et al.*, 2019). This high treatment rate is encouraging as effective treatment reduces the risk of TB transmission. Guo et al noted that while TB cure rates have improved, case detection remains low, highlighting the need for enhanced detection and treatment strategies (Guo *et al.*, 2019).

Strengths and Limitations

This study offers significant insights into the characteristics of tuberculosis (TB) index cases and their household contacts. A major strength lies in the comprehensive assessment of awareness and screening practices, which highlights critical gaps in both knowledge and access to care. However, the study is not without limitations. The review of index TB cases from 2015 revealed a reduced number of contacts due to factors such as relocation or changes in contact information, which impeded tracing efforts. Nevertheless, the sample size of 107 household contacts was sufficient to adequately address the research questions. Additionally, the reliance on self-reported data may introduce bias, and the cross-sectional design restricts the ability to establish causal relationships. Addressing these limitations in future research could enhance our understanding and inform the development of effective TB intervention strategies

CONCLUSION

This study highlights critical characteristics of tuberculosis (TB) index cases and their household contacts. The predominance of male index cases with pulmonary TB underscores the need for targeted interventions within this demographic. While contacts exhibited a strong awareness of TB transmission, their knowledge of symptoms remains inadequate. Additionally, screening rates were insufficient, indicating a pressing need for enhanced outreach and education. Urban residents had better access to screening, which reveals significant disparities in healthcare access.

To mitigate TB transmission and improve early detection and treatment outcomes, it is essential to strengthen educational and screening initiatives. Future research should focus on identifying barriers to screening and treatment across diverse demographics. Furthermore, investigating the impact of community-based interventions on TB awareness and prevention will be crucial in reducing transmission rates.

RECOMMENDATIONS

Based on the study's findings, we propose the following recommendations:

- Municipal Health Authorities should lead the overall coordination and oversight of sensitization campaigns and screening initiatives, ensuring alignment with national health policies and guidelines.
- Local Healthcare Facilities should enhance outreach efforts by conducting home visits for screening contacts and promoting facility-based screening services to ensure broader access.
- Community Health Workers (CHWs) should be instrumental in delivering sensitization campaigns, educating contacts on preventive measures, and providing ongoing support directly to households.
- Non-Governmental Organizations (NGOs) should assist in mobilizing community resources, facilitating training sessions, and providing educational materials focused on TB awareness and prevention.
- Local Government should allocate necessary resources, support funding initiatives, and ensure logistical backing for outreach programs to maximize impact.
- Educational Institutions should play a vital role in promoting TB awareness among students and their families, fostering community-wide understanding and engagement.
- Community Leaders and Organizations should help rally community support and encourage participation in awareness and screening activities.

REFERENCES

Abdul, I. W., Ankamah, S., Iddrisu, A. K., & Danso, E. (2020). Space-time analysis and mapping of prevalence rate of tuberculosis in Ghana. *Scientific African, 7,* 1–10. https://doi.org/10.1016/j.sciaf.2020.e00307

Abu-humaidan, A. H. A., Tarazi, A., Hamadneh, Y., Al-leimon, A., Al-leimon, O., & Aljahalin, M. (2022). practices toward tuberculosis among Jordanian university students. *Frontiers in Public Health, 10,* 1–14. https://doi.org/10.3389/fpubh.2022.1055037

Afum, T., Asare, P., Asante-Poku, A., Darko-Otchere, I., Morgan, P. A., Bedeley, E., Asandem, D. A., Musah, A. B., Siam, I. M., Tetteh, P., Adusi-Poku, Y., Frimpong-Manso, R., Kofi Bonney, J. H., Ampofo, W., & Yeboah-Manu, D. (2021). Diagnosis of tuberculosis among

COVID-19 suspected cases in Ghana. *PLoS ONE, 16*(12 December), 1–8. https://doi.org/10.1371/journal.pone.0261849

Almalki, M. E., Almuqati, F. S., Alasmari, R., Enani, M. J., Bahwirith, A. A., Alloqmani, A. A., Alqurashi, A., & Hassan-Hussein, A. (2022). A Cross-Sectional Study of Tuberculosis Knowledge, Attitude, and Practice Among the General Population in the Western Region of Saudi Arabia. *Cureus, 14*(10), 1–11. https://doi.org/10.7759/cureus.29987

Alsayed, S. S. R., & Gunosewoyo, H. (2023). Tuberculosis: Pathogenesis, Current Treatment Regimens and New Drug Targets. *International Journal of Molecular Sciences, 24*(6), 1–23. https://doi.org/10.3390/ijms24065202

Angelo, A. T., Geltore, T. E., & Asega, T. (2020). Knowledge, attitude, and practices towards tuberculosis among clients visiting tepi general hospital outpatient departments, 2019. *Infection and Drug Resistance, 13,* 4559–4568. https://doi.org/10.2147/IDR.S287288

Artawan Eka Putra, I. W. G., Purnama Dewi, N. P. E., Probandari, A. N., Notobroto, H. B., & Wahyuni, C. (2023). The Implementation of Comprehensive Health Education to Improve Household Contacts' Participation in Early Detection of Tuberculosis. *Health Education and Behavior, 50*(1), 136–143. https://doi.org/10.1177/10901981211001829

Biermann, O., Lönnroth, K., Caws, M., & Viney, K. (2019). Factors influencing active tuberculosis case-finding policy development and implementation: A scoping review. *BMJ Open, 9*(12), 1–12. https://doi.org/10.1136/bmjopen-2019-031284

Der, J. B., Grant, A. D., Grint, D., Narh, C. T., Bonsu, F., & Bond, V. (2022). Barriers to tuberculosis case finding in primary and secondary health facilities in Ghana: perceptions, experiences and practices of healthcare workers. *BMC Health Services Research, 22*(1), 1–14. https://doi.org/10.1186/s12913-022-07711-1

Dhanawade, S., Kumbhar, S., Gore, A., & Patil, V. (2015). Scar formation and tuberculin conversion following BCG vaccination in infants: A prospective cohort study. *Journal of Family Medicine and Primary Care, 4*(3), 384. https://doi.org/10.4103/2249-4863.161327

Dong, Z., Wang, Q. Q., Yu, S. C., Huang, F., Liu, J. J., Yao, H. Y., & Zhao, Y. L. (2022). Age period cohort analysis of pulmonary tuberculosis reported incidence, China, 2006 to 2020. *Infectious Diseases of Poverty, 11*(1), 1–10. https://doi.org/10.1186/s40249-022-01009-4

Ga West Health Directorate. (2016). *Annual Report 2016*.

Ghana Health Service. (2022). *National Tuberculosis Control Programme*. Ghana Health Service. https://ghs.gov.gh/national-tuberculosis-control-programme-ntp/

Guo, J., Yang, M., Wu, Z., Shen, X., Wang, Y., & Zhao, G. (2019). High incidence and low case detection rate among contacts of tuberculosis cases in Shanghai, China. *BMC Infectious Diseases, 19*(1), 1–10. https://doi.org/10.1186/s12879-019-3942-2

Humayun, M., Chirenda, J., Ye, W., Mukeredzi, I., Mujuru, H. A., & Yang, Z. (2022). Effect of Gender on Clinical Presentation of Tuberculosis (TB) and Age-Specific Risk of TB, and TB-Human Immunodeficiency Virus Coinfection. *Open Forum Infectious Diseases, 9*(10), 1–9. https://doi.org/10.1093/ofid/ofac512

Iddrisu, A., Amikiya, E. A., & Bukari, F. K. (2024). Spatio-temporal characteristics of Tuberculosis in Ghana. *PUBMED Central, 111,* 1–30. https://doi.org/10.12688%2Ff1000research.109053.4

Japan Anti-Tuberculosis Association. (2021). 52nd World Conference on Lung Health of the International Union Against Tuberculosis and Lung Disease. *The International Journal of Tuberculosis and Lung Disease, 25*(10), 1–477. https://jata.or.jp/english/

Jenkins, H. E., Ayuk, S., Puma, D., Brooks, M. B., Millones, A. K., Jimenez, J., Lecca, L., Galea, J. T., Becerra, M., Keshavjee, S., & Yuen, C. M. (2022). Geographic accessibility to health facilities predicts uptake of community-based tuberculosis screening in an urban setting. *International Journal of Infectious Diseases, 120,* 125–131. https://doi.org/10.1016/j.ijid.2022.04.031

Kazibwe, A., Twinomugisha, F., Musaazi, J., Nakaggwa, F., Lukanga, D., Aleu, P., Kiyemba, T., Nkolo, A., Kirirabwa, N. S., Freitas Lopez, D. B., Birabwa, E., Dejene, S., & Zawedde-Muyanja, S. (2021). Comparative yield of different active tb case finding interventions in a large urban tb project in central uganda: A descriptive study. *African Health Sciences, 21*(3), 975–984. https://doi.org/10.4314/ahs.v21i3.3

Kigozi, N. G., Heunis, J. C., Engelbrecht, M. C., Janse Van Rensburg, A. P., & Van Rensburg, H. C. J. D. (2017). Tuberculosis knowledge, attitudes and practices of patients at primary health care facilities in a South African metropolitan: Research towards improved health education. *BMC Public Health, 17*(1), 1–8. https://doi.org/10.1186/s12889-017-4825-3

Laghari, M., Azhar, S., Sulaiman, S., Khan, A. H., Talpur, B. A., & Bhatti, Z. (2019). Contact screening and risk factors for TB among the household contact of children with active TB : a way to find source case and new TB cases. *BMC Public Health, 19*(1274), 1–10. doi.org/10.1186/s12889-019-7597-0

Law, I., Floyd, K., Abukaraig, E. A. B., Addo, K. K., Adetifa, I., Alebachew, Z., Banda, R., Bashorun, A., Bloss, E., Bonsu, F. A., Chanda-Kapata, P., Demba, E., Elegail, A. M. A. S., Eltigany, M., Ershova, J., Gasana, M., Girma, B., Glaziou, P., Kalisvaart, N., … Yamada, N. (2020). National tuberculosis prevalence surveys in Africa, 2008–2016: an overview of results and lessons learned. *Tropical Medicine and International Health, 25*(11), 1308–1327. https://doi.org/10.1111/tmi.13485

Litvinjenko, S., Magwood, O., Wu, S., & Wei, X. (2023). Burden of tuberculosis among vulnerable populations worldwide: an overview of systematic reviews. *The Lancet Infectious Diseases, 23*(12), 1395–1407. https://doi.org/10.1016/S1473-3099(23)00372-9

MacNeil, A., Glaziou, P., Sismanidis, C., Date, A., Maloney, S., & Floyd, K. (2020). Global Epidemiology

of Tuberculosis and Progress Toward Meeting Global Targets Worldwide, 2018. MMWR. *Morbidity and Mortality Weekly Report, 69*(11), 281–285. https://doi.org/10.15585/mmwr.mm6911a2

Martinez, L., Cords, O., Liu, Q., Acuna-Villaorduna, C., Bonnet, M., Fox, G. J., Carvalho, A. C. C., Chan, P. C., Croda, J., Hill, P. C., Lopez-Varela, E., Donkor, S., Fielding, K., Graham, S. M., Espinal, M. A., Kampmann, B., Reingold, A., Huerga, H., Villalba, J. A., … Andrews, J. R. (2022). Infant BCG vaccination and risk of pulmonary and extrapulmonary tuberculosis throughout the life course: a systematic review and individual participant data meta-analysis. *The Lancet Global Health, 10*(9), e1307–e1316. https://doi.org/10.1016/S2214-109X(22)00283-2

Miller, P. B., Zalwango, S., Galiwango, R., Kakaire, R., Sekandi, J., Steinbaum, L., Drake, J. M., Whalen, C. C., & Kiwanuka, N. (2021). Association between tuberculosis in men and social network structure in Kampala, Uganda. *BMC Infectious Diseases, 21*(1), 1–9. https://doi.org/10.1186/s12879-021-06475-z

Ncayiyana, J. R., Bassett, J., West, N., Westreich, D., Musenge, E., Emch, M., Pettifor, A., Hanrahan, C. F., Schwartz, S. R., Sanne, I., & van Rie, A. (2016). Prevalence of latent tuberculosis infection and predictive factors in an urban informal settlement in Johannesburg, South Africa: A cross-sectional study. *BMC Infectious Diseases, 16*(1), 1–10. https://doi.org/10.1186/s12879-016-1989-x

Ohene, S. A., Bonsu, F., Hanson-Nortey, N. N., Sackey, A., Danso, S., Afutu, F., Klatser, P., & Bakker, M. (2018). Yield of tuberculosis among household contacts of tuberculosis patients in Accra, Ghana. *Infectious Diseases of Poverty, 7*(1), 1–8. https://doi.org/10.1186/s40249-018-0396-5

Okoro, L. C., Odukoya, O., Ikwuka, A. O., & Udeh, F. C. (2024). Prevalence , Patterns and Peculiarities of Depression among Tuberculosis Patients Attending Directly Observed Treatment Short-course (DOTS) Centers in Lagos State Nigeria. *American Journal of Medical Science and Innovation, 3*(1), 62–72. https://doi.org/https://doi.org/10.54536/ajmsi.v3i1.2653

Olmo-Fontánez, A. M., & Turner, J. (2022). Tuberculosis in an Aging World. *Pathogens, 11*(10), 1–13. https://doi.org/10.3390/pathogens11101101

Onyango, V. C., Mutiso, B., Mutuma, N. M., Malalu, C. P., Auma, N., & Fryda, W. C. (2024). Miliary Tuberculosis Causing Presumed Primary Adrenal Insufficiency and Addisonian Crisis : A Case Report from Rural Kenya. *American Journal of Medical Science and Innovation, 3*(1), 91–95. https://doi.org/https://doi.org/10.54536/ajmsi.v3i1.2773

Quarcoopome, L., & Tornu, E. (2022). Health-related quality of life of persons living with tuberculosis: A cross-sectional study. *Journal of Clinical Tuberculosis and Other Mycobacterial Diseases, 28*(June), 100324. https://doi.org/10.1016/j.jctube.2022.100324

Reichler, M. R., Khan, A., Yuan, Y., Chen, B., McAuley, J., Mangura, B., & Sterling, T. R. (2020). Duration of exposure among close contacts of patients with infectious tuberculosis and risk of latent tuberculosis infection. *Clinical Infectious Diseases, 71*(7), 1627–1634. https://doi.org/10.1093/cid/ciz1044

Ross, J. M., Xie, Y., Wang, Y., Collins, J. K., Horst, C., Doody, J. B., Lindstedt, P., Ledesma, J. R., Shapiro, A. E., Hay, P. S. I., Kyu, H. H., & Flaxman, A. D. (2021). Estimating the population at high risk for tuberculosis through household exposure in high-incidence countries: a model-based analysis. *EClinicalMedicine, 42,* 1–7. https://doi.org/10.1016/j.eclinm.2021.101206

Ternaa, A., Elizabeth, A. U., & Sarc, T. (2022). Role of HIV Infection in Multi-Drug Resistant Tuberculosis in Parts of Benue State, Nigeria. *American Journal of Medical Science and Innovation, 1*(1), 1–9. *https://doi.org/* https://doi.org/10.54536/ajmsi.v1i1.505

Turusbekova, N., Celan, C., Caraulan, L., Rucsineanu, O., Jibuti, M., Ibragimova, O., & Saidova, N. (2022). Gender-related factors associated with delayed diagnosis of tuberculosis in Eastern Europe and Central Asia. *BMC Public Health, 22*(1), 1–9. https://doi.org/10.1186/s12889-022-14419-8

USAID. (2023). *USAID's global tuberculosis (TB) strategy 2023–2030*. USAID. https://www.usaid.gov/global-health/health-areas/tuberculosis/resources/publications/usaid-global-tuberculosis-strategy-2023-2030

Vyambwera, S. M., & Witbooi, P. (2021). A Two-Group Model of TB in a Crowded Environment. *Applied Mathematics and Information Sciences, 15*(4), 523–532. https://doi.org/10.18576/amis/150415

World Health Organization. (2022). *Global tuberculosis report 2022*. https://iris.who.int/bitstream/handle/10665/363752/9789240061729-eng.pdf?sequence=1

World Health Organization. (2023). *Tuberculosis*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/tuberculosis#:~:text=Worldwide%2C%20TB%20is%20the%20second,women%20and%201.3%20million%20children

Yayan, J., Franke, K. J., Berger, M., Windisch, W., & Rasche, K. (2024). Early detection of tuberculosis: a systematic review. *Pneumonia, 16*(1), 1–15. https://doi.org/10.1186/s41479-024-00133-z

Yousif, K., Ei Maki, M., Babikir, R. K., & Abuaisha, H. (2021). The effect of an educational intervention on awareness of various aspects of pulmonary tuberculosis in patients with the disease. *Eastern Mediterranean Health Journal, 27*(3), 287–292. https://doi.org/10.26719/emhj.20.102

Zhu, M., Han, G., Takiff, H. E., Wang, J., Ma, J., Zhang, M., & Liu, S. (2018). Times series analysis of age-specific tuberculosis at a rapid developing region in. *Scientific Reports, 8*(1), 2011–2016. https://doi.org/10.1038/s41598-018-27024-w