



Smear Positivity and Associated Risk Factors among Pulmonary Tuberculosis Suspects at Nigist Eleni Mohammed Memorial Hospital, Hossana, South Ethiopia

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Abstract

Background: Tuberculosis remains to be a major public health problem among the under developed world due to delay in detection and treatment of patients with active TB. In Ethiopia, case detection rate remains low compared with WHO target. Prolonged delay of tuberculosis case detection may lead to disease that is more advanced, high mortality, and continual transmission in the community. Therefore, we aimed to assess the prevalence of smear positive pulmonary tuberculosis and its associated factors among pulmonary tuberculosis suspects at Nigist Eleni Mohammed memorial Hospital, Hossana, South Ethiopia. **Method and Materials:** A hospital based cross sectional study was conducted at Nigist Eleni Mohammed Memorial Hospital, South Ethiopia from May to June 2013. 186 consecutive pulmonary tuberculosis suspects were included in the study from the hospital outpatient department. Data on demographic and other risk factors were collected using semi-structured questionnaire. Three sputum specimen samples were collected and processed using the standard microbiological method to make sure participants were smear positive. The data were entered into and analyzed using SPSS Version-16 software. Bivariate and multivariate logistic regression analysis was used to identify factors associated with smear positive pulmonary tuberculosis. **Result:** Of the 186 suspected pulmonary tuberculosis participants, smear positive acid fast bacilli were detected in 18 (9.7%) and 20 (10.8%) by direct and bleach concentrated Zeihl Neelson staining technique respectively. Compared to age group of 15 - 30 there was lower risk of pulmonary tuberculosis for those who were in age group of ≥ 45 years, [AOR = 0.04, 95% CI: (0.01, 0.36)]. Being male [AOR = 6.56, 95% CI: (1.84, 23.34)], cough duration ≥ 2

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weeks [AOR = 10.20, 95% CI: (1.16, 89.48)] and contact with known TB patient at home, [AOR = 5.81 (1.57, 22.31)] were found to have strong association with smear positive pulmonary tuberculosis. **Conclusion and recommendation:** Higher proportion of smear positivity was found by bleach concentrated technique than direct Zeihl Neelson staining technique. However, case detection rate remains low. Prevention and control of tuberculosis should focus on young age groups between 15 - 30 years. Sustainable health education using various Information Education Communication (IEC) methods including local mass media, early case finding and treatment are recommended to reduce the spread of the disease.

Keywords

Smear Positivity, PTB (Pulmonary Tuberculosis), Risk Factors, Suspects

Subject Areas: Epidemiology, Public Health

1. Introduction

Tuberculosis remains to be a major public health problem worldwide, especially in developing countries where delay in detection and treatment of patients with active TB let the infection to spread. According to a report by the World Health Organization (WHO) in 2011, 8.8 million new cases of TB were registered around the world, which East Asia (35%) and Africa (30%) took the largest disease burden. In the same year, an estimated 1.1 million deaths were reported globally; of which, a respective 59% and 26% were from Asia (59%) and Africa [1].

TB is one of the major causes of morbidity and mortality in the horn of Africa, and Ethiopia ranks 7th with highest TB burden in the world [2]. According to the Ethiopian Federal Ministry of Health (MOH) data, tuberculosis is the 3rd cause of hospital admission and the 2nd cause of death after malaria [3]. In 2007, Ethiopia reported 141,909 all types of TB cases; this being one of the largest reported caseloads in the world after China, India, Nigeria and South Africa [4]. According to WHO report of 2011, the incidence and prevalence of all forms of TB were 261/100,000, 394/100,000 population per year, respectively [1].

Although TB has the potential to affect all people regardless of sex and age, those in the age range 15 - 54 years and with poor socio-economic status were found to be at higher risk [5] [6].

Various factors including poverty, malnutrition, overcrowded living condition, multidrug resistant (MDR) TB and HIV/AIDS have been known to increase the risk of developing the disease and for the continued threat of TB in the world [3] [7]. One of the most important problems in TB prevention and control program is delay in detection and treatment of patients with active TB. If tuberculosis suspects are not recognized, a considerable proportion of patients with smear-positive pulmonary tuberculosis will not be found [8]. Prolonged delay of such patients may lead the disease to become more advanced, highly mortal, and continually transmitted in the community [9].

Thus, the expanded scope of the new strategy for TB control comprises of interventions, intensified case finding, cure and preventive treatment. However, the case detection rate remained low: 30% in 2006 and 34% in 2009 [10] compared to the WHO target of 70% detection.

In Ethiopia, data on smear positivity on suspected pulmonary tuberculosis are limited in different localities to plan effective intervention. It would be crucial to describe epidemiology of the pathogen in different localities to decide on appropriate treatment regimen. Hence, the current study aimed at assessing the prevalence of smear positivity and other associated risk factors among suspected pulmonary tuberculosis patients at Nigist Eleni Mohammed Memorial Hospital, southern Ethiopia.

2. Materials and Methods

2.1. Setting and Participants

A hospital based cross sectional study was conducted from May to June, 2013 at Nigist Eleni Mohamed Memorial Hospital; which is located in Hossana Town, Hadiya Zone, South Nations and Nationalities People Region

(SNNPR), Ethiopia. The town is located 232 km south of the capital city Addis Ababa and 194 km far from the regional capital, Hawassa. The hospital provides services in various outpatient and inpatient departments for about 1,506,733 million populations.

2.2. Selection of the Study Participants

The study population consisted of all patients who were suspected with pulmonary tuberculosis (PTB) at the outpatient department of the hospital. Using convenience sampling technique, consecutive patients with suspected pulmonary tuberculosis (PTB) above the age of 15 years attending the hospital during the study period were included in the study. The sample size was computed using single population proportion formula with the assumption of estimated proportion of smear positive tuberculosis ($p = 14.2\%$) [11], 95% level of confidence ($z = 1.96$), and margin of error ($d = 5\%$). Therefore, the sample size was calculated to be 186. Those patients taking anti-TB treatment but who gave sputum for follow-up examination during the study period were excluded.

2.3. Data Collection

Trained data collectors interviewed the study participants on demography, history of ever having TB disease, and other pulmonary tuberculosis related risk factors were collected using structured questionnaire.

Moreover, three morning consecutive sputum specimens samples were collected from patients all participants with according to the standard sputum collection mechanism procedure on sterile sputum cups. Sputum containing cups were transferred to the microbiology laboratory within 30 minutes after of collection, and examined, initially, for physical appearance. Following reception in the laboratory, the specimens were processed directly with Ziehl-Neelsen staining technique and also after concentration with bleach technique. Registered and macroscopically examined for their physical appearances. In this technique, air-dried sputum smears were fixed with heat, stained by carbol fuchsin for 5 minutes, decolorized with 3% acid alcohol for 3 minutes, and counter stained with methylene blue for 1 minute. Stained smears were air-dried and examined microscopically (using 100× objective) for acid-fast bacilli. All sputum specimens were smeared on slides, air-dried, fixed with heat, and stained using Ziehl-Neelsen staining technique [12]. The Ziehl-Neelsen staining technique helps to classify bacteria as acid-fast bacilli or non-acid fast bacilli on the bases of their acid fastness. AFB positive results by either method and concordant AFB negative results by both methods define the smear positivity and negativity, respectively.

2.4. Data Analysis

Data entry and analysis was performed using SPSS Version 16. Frequency tables, graphs and descriptive summaries were used to describe the study variables. Chi-square test was done to assess the association between independent variables and pulmonary tuberculosis. Multivariate logistic regression analysis was performed on variables found statistically significant in bivariate analysis. Results were reported statistically significant whenever p-value is less than 5%.

2.5. Ethical Consideration

The study was ethically approved by the Ethical and Research Approval (ERA) Committee of Hossana College of Health Science. Participation was entirely voluntary, and written consent was obtained from the study participants. Any information obtained during the study was kept with utmost confidentiality. All laboratory analysis was performed free of charge, and results were provided to the clinicians for possible management.

3. Result

A total of 186 individuals participated in the study. Socio-demographic characteristics of the study participants are summarized in **Table 1**. The mean age of the participants was 36.9 years and (+SD) of (+15.10) years and the male to female ratio was 1:1.3. Majority of the participants were rural residents 135 (72.6%) and married 117 (62.9%). Participants 117 (62.9%) who were illiterate and farmers accounts 47.8% and 39.2%, respectively.

More than half of the participants (52.7%) responded that they are aware of the availability of TB treatment free of charge. Also, those who responded TB is a curable disease accounted 78.0% and who reported TB is a

Table 1. Bivariate logistic regression result of smear positive pulmonary tuberculosis by background variables, Nigist Eleni Mohammed memorial hospital, Hossana, South Ethiopia, 2013.

Variables	Sputum examination		Crude OR (95% CI)	P-Value
	Positive (%)	Negative (%)		
Sex				
Female	4 (5.0)	76 (95.0)	1	
Male	16 (15.1)	90 (84.9)	3.38 (1.08, 10.53)	0.036 [†]
Age				
15 - 30	14 (17.3)	67 (82.7)	1	
31 - 44	5 (8.5)	54 (91.5)	0.44 (0.15, 1.31)	0.140
≥45	1 (2.2)	45 (97.8)	0.11 (0.01, 0.84)	0.033 [†]
Marital status				
Single	9 (15.3)	50 (84.7)	1	
Married	9 (7.7)	108 (92.3)	0.46 (0.17, 1.24)	0.125
Others*	2 (20)	8 (80.0)	1.39 (0.25, 7.64)	0.706
Education				
Illiterate	3 (3.4)	86 (96.6)	1	
Primary	8 (11.9)	59 (88.1)	3.89 (0.99, 15.26)	0.052
Secondary +**	9 (30.0)	21 (70.0)	12.29 (3.06, 49.38)	0.010 [†]
Occupation				
Employed	11 (11.0)	89 (89.0)	1	
Unemployed	9 (10.5)	77 (89.5)	0.95 (0.37, 2.40)	0.907
Residence place				
Rural	13 (9.6)	122 (90.4)	1	
Urban	7 (13.7)	44 (86.3)	1.49 (0.56, 3.98)	0.423

*Divorced, separated and widowed; **9 - 12, diploma and degree; [†]P-value < 0.05.

dangerous disease if not treated were 73.1%.

All of the study participants 100% had cough; of which, 48.4% experienced difficulty of breathing and 39.7% had fever. Moreover, a respective, 11.3%, 24.7% and 31.7% of the participants had weight loss, night sweating and loss of appetite (**Figure 1**).

Among the participants, 67.2% visited health institution for the current symptoms. Thirty nine patients (21%) reported ever been diagnosed for tuberculosis; of which, 37 (94.9%) started anti-TB treatment but 6 patients did not take the full course of the treatment. Of the total participants, 20.4% had history of diabetes/hypertension and 12.9% had history of contact with known TB patient (**Table 2**).

Acid fast bacilli were detected in 18 and 20 individuals by direct sputum examination and concentration technique, respectively. Accordingly the prevalence of smear positive pulmonary tuberculosis was 9.7% by direct sputum examination and 10.8% by concentration technique.

In bivariate analysis the rate of smear positive TB was significantly higher in males compared to females (15.1% versus 5%; $p = 0.036$) in the age group 15 - 30 years compared to >45 (17.3% versus 2.2% $p = 0.033$) and in those having secondary level education compared to illiterate (30% versus 3.4%; $p = 0.01$) (**Table 1**).

A significantly higher rate of TB was also detected in higher rate in participants who had cough for over 2 weeks period (14.8%), with diabetes or hypertension (21.1%) and had contacts with TB patients (25%) compared to those with no such conditions (**Table 2**).

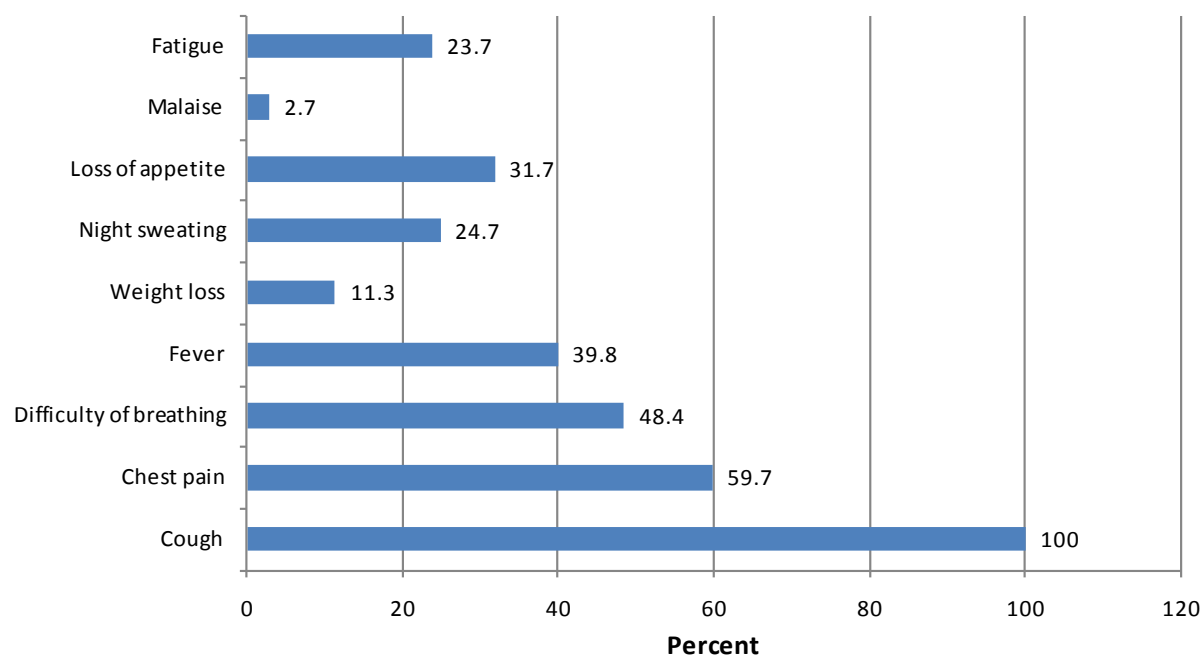


Figure 1. Symptoms of tuberculosis among Tb suspected patients attending outpatient department of Nigist Eleni Mohammed Memorial Hospital, South Ethiopia, 2013.

Table 2. Bivariate logistic regression result of smear positive pulmonary tuberculosis by selected explanatory variable Nigist Eleni Mohammed Memorial Hospital, Hossana, South Ethiopia, 2013.

Variables	Sputum examination		Crude OR (95% CI)	P-Value
	Positive (%)	Negative (%)		
Smoking				
No	18 (10.3)	156 (89.7)	1	
Yes	2 (16.7)	10 (83.3)	1.73 (0.35, 8.54)	0.499
Cough duration/week				
<2	1 (1.7)	57 (98.3)	1	
≥2	19 (14.8)	109 (85.2)	9.94 (1.30, 76.13)	0.027*
Patients with DM or Hypertension				
No	12 (8.1)	136 (91.9)	1	
Yes	8 (21.1)	30 (78.9)	3.02 (1.14, 8.04)	0.027*
History of Contact				
No	14 (18.6)	148 (91.4)	1	
Yes	6 (25.0)	18 (75.0)	3.52 (1.20, 10.32)	0.022*
Previously diagnosed With TB				
No	17 (11.6)	129 (88.4)	1	
Yes	3 (7.7)	36 (92.3)	0.632 (0.18, 2.28)	0.483
History of hospitalization				
No	17 (10.9)	139 (89.1)	1	
Yes	1 (7.7)	12(92.3)	0.68 (0.83, 5.57)	0.720

*P-value < 0.05.

After adjustment for significantly associated variables using backward multiple logistic regression analysis, male participants were found to have about six-fold higher rate of TB smear positivity than females [AOR = 6.56, 95% CI: (1.84, 23.34)]. Moreover, participants in the age range 15 - 30 years had higher rate of smear positivity compared with those older than ≥ 45 years of age [AOR = 0.04, 95% CI: (0.01, 0.36)]. Patients with cough for ≥ 2 weeks period were ten times more likely had smear positivity compared with those < 2 weeks cough duration [AOR = 10.20, 95% CI: (1.16, 89.48)]. A history of having contact with known TB patients raised the odds of smear positivity compared with no history of contact [AOR = 5.81, 95% CI: (1.57, 22.31)] (Table 3).

4. Discussions

In this study, the overall prevalence of sputum smear positive pulmonary tuberculosis was 10.8%, which is similar with a study conducted in Agaro, southwest Ethiopia [13], and Metehara Sugar Factory, central Ethiopia (14.2%) [11]. However, Our finding was lower compared to a result from South Africa, which reported a 4% sputum smear positivity rate [14].

The higher prevalence of smear positivity in male study participants in this study was in agreement with results from Mexico [15] and Pakistan [16], This may be due to men involved in activities facilitating social interaction outside home; thus, increasing exposure to TB infection Behavioral differences between men and women like smoking, alcoholism, migration and in some cases, and imprisonment may contribute to higher risk for infection and progression from infection to active TB among men [17]. A contrasting higher vulnerability of contracting TB infection as well as developing disease among women compared to men in Bangladesh and India [18] [19] may further emphasize the difference in distribution of TB by gender in various geographical and socio-cultural contexts.

Table 3. Multivariate logistic regression result of smear positive pulmonary tuberculosis by explanatory variables, Nigist Eleni Mohammed Memorial Hospital, Hossana, South Ethiopia, 2013.

Predictors	Sputum examination		AOR 95% CI
	Positive	Negative	
Sex			
Female	4 (5.0)	76 (95.0)	1
Male	16 (15.1)	90 (84.9)	6.56 (1.84, 23.34) [‡]
Age			
15 - 30	14 (17.3)	67 (82.7)	1
31 - 44	5 (8.5)	54 (91.5)	0.29 (0.08, 0.10)
≥ 45	1 (2.2)	45 (97.8)	0.04 (0.01, 0.36) [‡]
Cough duration/week			
< 2	1 (1.7)	57 (98.3)	1
≥ 2	19 (14.8)	109 (85.2)	10.20 (1.16, 89.48) [‡]
Patients with DM/Hypertension			
No	12 (8.1)	136 (91.9)	1
Yes	8 (21.1)	30 (78.9)	2.81 (0.90, 8.87)
History of Contact			
No	14 (18.6)	148 (91.4)	1
Yes	6 (25.0)	18 (75.0)	5.81 (1.57, 22.31) [‡]

[†]P-value < 0.05 ; [‡]P-value < 0.01 .

In contrast, a study in Bangladesh reported that women had a higher risk of progressing from infection to clinical disease than men in the same age group [18]. In line with this evidence from India showed that women are more vulnerable to tuberculosis infection and disease [19]. Lower smear positive pulmonary tuberculosis cases among women in this study may be due to fewer women in the population with active TB, or it could be a consequence of fewer women with tuberculosis presented for treatment. Lower risk of PTB among women may also be associated with local socio-cultural contexts. In Pakistani communities, women in particular are fearful of contracting TB because it decreases a single woman's marriage prospects and increases the married women's vulnerability to divorce [20]. Such stressors discourage women from acknowledging symptoms and seeking appropriate care.

The higher smear positivity rate among participants in the age range 15 - 30 years may similarly be due to their active interaction with various segments of the population while shouldering social responsibilities or engaging in risky behaviors that expose them to TB infection. In agreement, evidences showed TB is related to HIV/AIDS in that it has been affecting people in their 20's and 30's; the primary age group who are dying of AIDS [21] [22]. Thus, TB either backed by HIV.

As part of effort to enhance active TB detection, intervention strategies targeting patients with cough over two weeks period has been emphasized [23]. In agreement, the current study showed participants who had cough for more than 2 weeks period were at higher risk of having TB, which re-affirm the view that cough over 2 weeks period is a known symptom of pulmonary tuberculosis. Thus, informing the general public regarding the importance of enhancing the health seeking behavior of patients with such clinical feature would be most useful in the effort to fight tuberculosis, which is claiming the lives of many people and cutting the life expectancy of the country.

The evidence that TB was detected most frequently among participants who had a history of contact with known TB patient at home was in line with others results from Ethiopia, India, and Switzerland [11] [24]-[26]. This emphasizes the need to strengthen intervention measures targeting households with TB diseased member so as to effectively halt transmission.

Failure to use culture method in order to diagnose pulmonary tuberculosis was the major limitation of this study. As a result, there might be under diagnosis of tuberculosis cases.

5. Conclusions

The overall prevalence of smear positive pulmonary tuberculosis was 10.8%. Higher proportion of smear positive pulmonary was found by bleach concentrated technique than direct Zein Nelson staining technique. Male participants, those in the age range 15 - 30 years, having cough over 2 weeks period, and experiencing contact with known TB patient, increased the risk of having smear positive pulmonary tuberculosis.

Laboratory diagnosis of smear positive tuberculosis should be made by bleach concentration smear than the routine direct Zein Nelson staining technique in order to increase case detection rate. Prevention and control of tuberculosis should focus on young age groups between 15 - 30 years. Continuous health information should be provided to the community through various Information, Education and Communication (IEC) methods and using local mass media about risk factors of pulmonary tuberculosis with special emphasis to reduce contact with chronic cougher. Early case finding activities should focuses on screening patients with ≥ 2 week's duration of cough. Further community based research to compare male and female rates of tuberculosis in order to elucidate the magnitude of differences in relation to both biological and socio cultural determinants.

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