Original article

The epidemiology of smear positive pulmonary tuberculosis at Felege Hiwot Referral Hospital, Northwest Ethiopia: A five year retrospective study

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Abstract

Background: Globally**,** tuberculosis (TB) continues to cause considerable morbidity and mortality. Ethiopia is among the 22 high TB burden countries reported. Currently, data regarding the magnitude of TB and associated factors have been released at different health facilities as part of service auditing. However, such data are not universally available that this study was carried out to determine the prevalence of smear positive tuberculosis and its associated risk factors at FelegeHiwot Referral Hospital (FHRH) over a period of five years.

Methods: We analyzed all the records of 12,442 presumptive TB patients registered at FHRH from 2011 to 2015. Data on patient's sex, age, residential address and sputum smear microscopy results were extracted from laboratory registration logbook. All data were entered, cleaned and analyzed using SPSS version 22 for windows. The proportion and trend of smear positive TB over the five years period was calculated and the overall prevalence of TB in these years was determined. Logistic regression model was used to analyze the association between TB positivity and potential associated variables; $p < 0.05$ was considered to be significant.

Results: TB suspected patients were found to be characterized as male 7052 (56.7%), within the age group of 15-29 years of age 4105 (33.0%) and were from rural settings7841 (63.0). The number of presumptive TB patients visiting FHRH over the five years period was quite variable. However, the prevalence of smear positive TB in each year was almost consistent, ranging from 4.2% to 6.5%. The prevalence of smear positive TB among new and follow up patients was at 5.2% and 4.5%, respectively. The proportion of overall burden of smear positive pulmonary TB was estimated at 5.2% and was found significantly associated with age group between 15-29 (AOR: 0.45, 95% CI, 0.23-0.77), 30-44 (AOR:0.22, 95% CI, 0.15-0.32) and 45-59 (AOR:0.38, 95% CI, 0.26-0.56).

Conclusions: In the studied area high prevalence of smear positive TB was documented over the five years period; which implies inconsistent measures being taken to reduce the burden of the disease. Hence, interventions to decrease prevalence of TB and thereby its impacts need to be evaluated and strengthened. [*Ethiop. J. Health Dev.* 2017;31(3):155-160]

Key words: TB, Trend**,** Felege Hiwot Referral Hospital

Introduction

Tuberculosis (TB) as a leading cause of death in the world continues to cause considerable morbidity and mortality across the world and remains one of the world's biggest public health threats [1-3]. Globally around 9.6 million people develop TB and 1.5 million people die every year due to TB, of which 0.35 million deaths are associated with HIV-TB co-infection [1].

The burden of mortality and morbidity caused by TB is highly concentrated particularly in low-income countries. Sub-Saharan Africa, including Ethiopia, is the area of highest prevalence of TB and in 2015; a WHO report showed that Ethiopia ranks seventh among the world's 22 high TB load countries [1].TB has been recognized as a major public health problem in Ethiopia for more than half a century now [2].

The estimated epidemiological profile of TB in the country in 2014 shows that incidence, prevalence and mortality are estimated at 200, 190 and 32 per 100,000 population [1]. According to a report from the Ethiopian Federal Ministry of Health, TB remains the leading cause of morbidity, the third cause of hospital admission (after deliveries and malaria), and the second cause of death (after malaria) in the country [3].

Currently, the country is enormously involved in early case detection, provision of enough treatment and prevention of transmission of TB in the community. In spite of such hard work, the transmission of TB and event of drug resistance TB strain is continuing challenges for TB control and prevention programs [3-5].

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As primarily an airborne disease [6], patients with sputum smear-positive spread tiny airborne droplets into the surrounding air during coughing, sneezing, speaking and laughing [7]. This is why sputum smear microscopy is the recommended diagnostic tool in TB control, whose objective is to interrupt the transmission of the disease. This bacteriological examination is remarkable by its rapidity, its specificity and its low cost. In a resource poor and high TB burden countries like Ethiopia, it is by far the most commonly performed test for diagnosis and follow-up of TB patients [8, 9].

Directly observed treatment, short-course (DOTs) chemotherapy is the global standard of care for treating TB patients [10-11].

At present, data regarding the magnitude of TB and associated factors have been released at different health facilities as part of service auditing. However, such data are missing from Felege Hiwot Referral Hospital in Bahir Dar. Moreover, there are no clear trends over time on the burden of smear positive TB in different parts of the country (expertise observation).Thus, the aim of this study was to determine the prevalence and trend of smear positive TB (morbidity) and its associated factors at Felege Hiwot Referral Hospital (FHRH) over the five years period. This study indeed will add knowledge on the existing literatures.

Methods

Study setting: The study was conducted at Felege Hiwot Referral Hospital in Bahir Dar, which is the capital city of Amhara National Regional State, 565 km away from Addis Ababa. The hospital is a tertiary health care level facility serving the population of Bahir Dar town, the surrounding and remote areas of Northwest Ethiopia. The total population served by the hospital is about 12 million where patients come from different health centers or directly by themselves in anticipation of better services. In the hospital, DOTs clinic operates under the National TB and Leprosy Program (NTLCP) of Ethiopia, under which patients were diagnosed for TB, by examination of spot-morning-spot sputum smears and now spot-spot strategy by Zeihel–Nieelsen staining for the presence of acid fast bacilli (AFB).

We considered patients smear positive when any definite red bacilli were seen per 100 fields. When sputum smear is negative, doctors establish the diagnosis of TB primarily based on clinical grounds such as by using chest X-ray.

Study design and data collection: A five-year secondary data were collected retrospectively and analyzed to assess the prevalence of smear positive TB of 12,442 presumptive TB patients registered from January 2011to February 2015 at FHRH. All presumptive patient records were collected using data extraction sheet. Socio-demographic data such as patient's age, sex, address as well as patients sputum smear microscopy result were extracted from the laboratory registration log book.

In accordance with the NTLCP guidelines [11] the following TB case classifications were applied:

a. **Smear-positive pulmonary TB (PTB+) –**A patient with at least two initial sputum smear examinations positive for AFB by direct microscopy, or a patient with one initial smear examination positive for AFB by direct microscopy, or a patient with one initial smear examination positive for AFB by direct microscope and radiographic abnormalities consistent with active PTB.18705245
b. **Smear-negative pulmonary TB (PTB-) –**A patient having symptoms suggestive of TB with at least 3 initial smear examinations that were negative for AFB by direct microscopy, no response to a course of broad spectrum antibiotics, followed by an additional three negative smear examinations by direct microscopy and radiological abnormalities consistent with pulmonary tuberculosis or a patient whose diagnosis is based on a culture-positive result for *M. tuberculosis,* but has three negative initial smear examinations by direct microscopy.

Statistical analysis: All the data were entered, cleared, and analyzed using the SPSS statistical software package, Version 22.0(IBM Corp. Released 2011. IBM SPSS Statistics for Windows. Armonk, NY: IBM Corp.).

Descriptive data analysis such as proportion, median and range were used to visualize differences within data. To calculate the prevalence of smear positive TB, the denominator we employed was the total number of presumptive patients (smear positive and smear negative once).

Moreover, stepwise logistic regression model was done to assess factors associated with TB positivity using smear microscopy in terms of the odds ratio and its 95% confidence interval (CI). Variables such as patients' sex, age category, address and the year when they visited the hospital were included in the analysis. *P* value was set at 0.05 to indicate statistical significance difference.

Ethical clearance: Permission was granted from FHRH to utilize the laboratory registered data for research purpose. As the date used was collected retrospectively from record, written informed consent was not required and no patient details that may link to the patient identity like names was used and the confidentially was maintained.

Results

Demographic characteristics of the study subjects: We have assessed AFB smear microscopy results of 12,442 suspected and follow up patients from laboratory reporting logbook processed over a 5 years period in FHRH; a high TB and HIV setting. Of the total TB patients registered, 7052 (56.7%) were males and 5390 (43.3%) of them were females with a male to female ratio of 1.3. The median age of the patients was 35 years, ranging from 1-95 years. The majority, 7841

(63.0%) of the subset were from urban settings. Four thousand and one hundred five (33%) of the patients were in the age group 15-29 years (Table 1).

Table 1: **Distribution of TB suspected cases (n = 12,442) by sex, age category, patients residence and TB type in Felege Hiwot Referral Hospital, Bahir Dar, North west Ethiopia, 2011-2015.**

Variables	Frequency	%
Sex		
Male	7052	56.7
Female	5390	43.3
Patient residence		
Urban	4601	37.0
Rural	7841	63.0
Age group		
0-14	541	4.3
15-29	4105	33.0
30-44	3870	31.1
45-59	2373	19.1
≥60	1553	12.5
New *AFB result		
Positive	628	5.2
Negative	11353	94.8
Follow up AFB result		
Positive	21	4.5
Negative	442	95.5
All AFB result		
Positive	649	5.2
Negative	11793	94.8
Total	12442	100

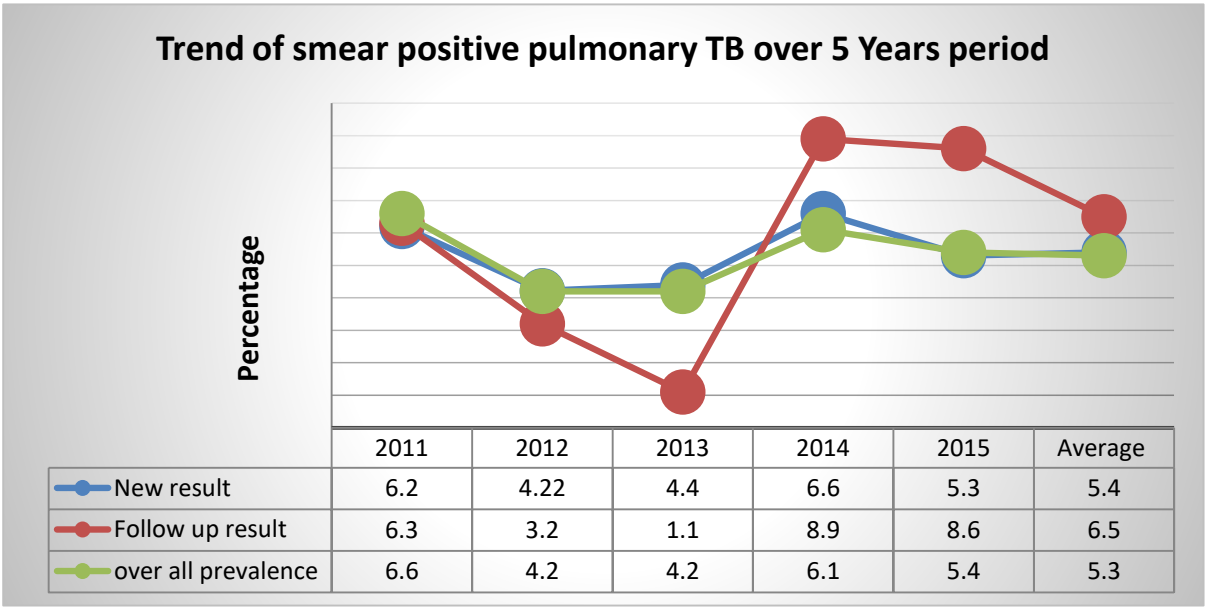
*AFB= Acid Fast Bacilli

Prevalence of smear positive pulmonary TB: The prevalence of smear positive TB among newly infected and follow up cases was at 628 (5.2%) and 21 (4.5%), respectively. Overall the prevalence of smear positive pulmonary TB among TB suspected and follow-up patients was at 649/12442 (5.2%) (Table1).There was a significant variation ($p<0.05$) on the number of patients who came to the hospital seeking TB diagnosis and treatment in each year in the five years period by their sex, residence and age group (Table 2).

Table 2: **Distribution of suspected TB cases (n = 12,442) by year in Felege Hiwot Referral Hospital, Bahir Dar, North west Ethiopia, 2011-2015.**

Variable	Total	Year					
		2011	2012	2013	2104	2015	*P value*
Sex							
Male	7052	1297	1142	1772	868	1973	
Female	5390	1053	797	1436	679	1425	0.021
Residence							
Urban	4601	961	729	1306	583	1022	
Rural	7811	1389	1210	1902	964	2376	0.000
Age							
0-14	541	111	85	155	80	110	
15-29	4105	867	695	1062	493	988	
30-44	3870	748	603	988	444	1087	
45-59	2373	392	332	618	293	738	
>60	1553	232	224	385	237	475	0.000

Trends of smear positive pulmonary TB over a five year period: It was found that the number of TB suspected patients visiting FHRH over the five years period was quite different. We have noticed uneven number of TB suspected cases across the stated years. The highest prevalence rate at 6.6% was recorded in 2011. However, after falling from 6.6% to 4.2%in 2012 and 2013, it rose up to 6.1% in 2014 and falling from 6.1% to 5.4% in 2015.The highest number of new and follow up smear positive pulmonary patients at 6.2% and 6.3%, respectively, were recorded in 2011.The trend over the stated periods does not show steady declining or increasing trend – rather erratic. However, the prevalence of smear positive pulmonary TB across the year was almost comparable. The average prevalence of TB among new and follow up cases in the five years period was 5.4% and 6.5%, respectively (Figure 1).



	2011	2012	2013	2014	2015	Average
New result	6.2	4.22	4.4	6.6	5.3	5.4
Follow up result	6.3	3.2	1.1	8.9	8.6	6.5
over all prevalence	6.6	4.2	4.2	6.1	5.4	5.3

Figure 1: ***Prevalence of smear positive pulmonary TB among study participants over a five years period at FHRH, 2011-2015.**
*Prevalence was calculated in such a way that we used the numerator smear positive cases and the total numbers of presumptive patients as a denominator.

Factors associated with smear positive TB: In the logistic regression model, sex and patient residence was not found associated with smear positive TB positivity. Patient age group 15-29 [Adjusted OR: 0.45, 95%CI (0.23-0.77), age group 30-44 [AOR: 0.22, 95%CI (0.15-0.32)] and 45-59 [AOR: 0.38, 95%CI (0.26-0.56)] were less likely to be smear positive TB. In contrast, the odds of having sear positive TB was higher among patients diagnosed in the year 2013 and 2014[AOR: 1.40, 95%CI; (1.07-1.83)] and [AOR: 1.34 95%CI, (1.06-1.68)], respectively (Table 3).

Table 3: **Aanalysis of associated factors for sputum smear positivity among TB suspected patients in FHRH, 2011-2015.**

Variable	Total (%)	Smear positive (%)	Smear negative (%)	COR (95%CI)	AOR (95%CI)
Sex					
Male	7052 (56.7)	370 (5.2)	6688 (94.8)	1	1
Female	5390 (43.3)	279 (5.2)	5111 (94..8)	0.97 (0.84-1.16)	1.13 (0.95-1.33)
Address					
Urban	4601 (37)	245 (5.3)	4356 (94.7)	1	1
Rural	7841 (63)	404 (5.2)	7437 (94.8)	0.97 (0.82-1.14)	0.98 (0.84-1.16)
Age					
0-14	541 (4.3)	23 (4.3)	518 (95.7)	1	1
15-29	4105 (33.0)	334 (8.1)	3771 (91.9)	0.46 (0.27-0.79)	0.45 (0.23-0.77)*
30-44	3870 (31.1)	192 (5.0)	3678 (95.0)	0.23 (0.16-0.33)	0.22 (0.15-0.32)*
45-59	2373 (19.1)	69 (2.9)	2304 (97.1)	0.39 (0.27-0.57)	0.38 (0.26-0.56)*
≥60	1553 (12.5)	31 (2.0)	1522 (98.0)	0.68 (0.44-1.04)	0.67 (0.44-1.03)
Year					
2011	2350 (18.9)	156 (6.6)	2194 (93.4)	1	1
2012	1939 (15.6)	81(4.2)	1858 (95.8)	0.80 (0.64-0.99)	0.87 (0.69-1.08)
2013	3208 (25.8)	135 (4.2)	3073 (95.8)	1.30 (0.99-1.70)	1.40 (1.07-1.83)*
2014	1547 (12.4)	95 (6.1)	1452 (93.9)	1.23 (1.03-1.62)	1.34 (1.06-1.68)*
2015	3398 (27.3)	182 (5.4)	3216 (94.6)	0.87 (0.67-1.12)	0.87 (0.68-1.13)

Table 4: **Estimated epidemiological burden of TB per 100,000; [1, 4, 20-23].**

	2010	2011	2012	2013	2014	2015	Average prevalence
Global	178	170	169	159	174	142	0.17%
High burden countries	231	222	216	208	227	195	0.22%
Ethiopia	394	237	224	211	200	192	0.25%
Our study finding	-	6600	4200	4200	6100	5400	5.2%

Discussion

In Ethiopia, the limited diagnostic capacity for TB in the community remains a challenge to improving case detection rates. In the study region, laboratory diagnosis of TB remains mainly in a stage of Ziehl-Nielseen (ZN) smear microscopyeven in cases with suspected infection by drug resistant strains. Authors tried to offer the first insight to show the trend of smear-positive pulmonary TB in FHRH, Northwest Ethiopia, over five years period and have important indications for the strategic control of TB in community as TB is still a serious public health challenge in the study area in particular and Ethiopia in general.

In this study, the average prevalence of the overall five years smear positive pulmonary TB in FHRH was 5.2% (649/12442)which is found to be equivalent to 5200 cases per 100, 000 population. The results of this study are consistent with those reported by othersin Ethiopia [12-13]. On the other hand, it is lower compared to other studies in Ethiopia and elsewhere in the world [14-19]. The possible explanation for this difference might be due to the fact that this study was conducted at the site where TB patients could more likely served better medical attention and the sample size we employed was quite larger than the previous reports. In contrary, according to global TB report of the year 2011-2015, the average estimated epidemiological burden of TB in Ethiopia was 250/100000= 0.25% [1, 4, 20-22] which is much lower than compared to our report in the same years (5.2%). This partly could be explained by the fact that in the present study the subjects were those individuals who were clinically suspected for pulmonary TB at the tertiary hospital health care level while the WHO estimate was based on the community based survey. At the same time, our finding is one site report while the WHO data was country wide in which disparity is likely to happen.

The trend of smear positive pulmonary TB over a five years period showed after falling from 6.6% to 4.2% in 2011 and 2012 , it rose up to 6.1% in 2014 and falling from 6.1% to 5.4% in 2014, which might indicatesinconsistent intervention measures taken to reduce the burden of the disease with time in the studied area. However, at the national level the trend of TB over the five years period (2011-2015) indicated a declined trend (Table 4) [1, 4, 20-23]. Similarly, according to WHO report, the global TB incidence has fallen by an average of 1.5% per year since 2000 and is now 18% lower than the level of 2000 [1]. Moreover, a study in China showed a declining trend in the incidence of sputum smears positive TB from 2005 to 2013 [24].

Unfortunately our finding in general does not show declining trend – rather erratic. This could partly be explained by inconsistent interventions that the local government and other stakeholders might undertake to decrease the burden of TB in the studied area. Marking 2015 as the end of the Millennium Development Goal (MDG) era and its replacement with a set of Sustainable Development Goals (SDGs) for 2016-2030, as well the End TB Strategy 2016-2035, our finding calls stakeholders to evaluate and strengthen their strategies to align their TB prevention and control measures with these bold targets.

Risk factors such as age and sex may play an important role in the progression of TB infection [25]. However, in this study, the disease risk was low for age groups of 15-29, 30-44 and 45-59 years compared to children (0-14).There was no significant difference between the patient residence, males and females.Furthermore, TB infection was high in the year 2013 and 2014.

The main limitations of this study were the lack of culture (as no culture facility), chest X- rays and clinical findings.Another drawback of our study is the lack of the status of TB treatment outcome and HIV, which might all have determinant factor to show the complete picture of the study subjects in the studied area. However, our study report, which generated from relatively larger sample size, will be an important source that will provides information concerning the implementation of TB prevention measures in the study area where there is high burden of TB and HIV.

***Conclusions*:**

In the studied area, there is high prevalence of TB and is continuing as a major public health challenge. Thus, the intervention strategies to decrease the impact of TB have to be evaluated and strengthened.

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Competing interests: The authors declare that there is no conflict of interest regarding the publication of this article.

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