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Pulmonary Tuberculosis and Associated Factors in Dessie-referral Hospital, Dessie, Ethiopia

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Abstract

Background: Tuberculosis is one of the most important public health problems causing significant morbidity and mortality globally. Prevalence of pulmonary tuberculosis has been increased from time to time and also it is a serious problem in our country. The main objective of this study was to examine risk factors related to pulmonary tuberculosis in Dessie-referral Hospital, Ethiopia.

Methods: A retrospective cross-sectional study design was conducted by review of data from September 01, 2016 to August 31, 2017, GC in Dessie-referral hospital. A total of 126 cases were analysed using binary logistic regression.

Result: Prevalence of pulmonary tuberculosis in Dessie-referral hospital was 67.5% relative to extra pulmonary tuberculosis. The highest number of pulmonary tuberculosis patients in Dessie-referral hospital was seen on the age group of 31-45 and on sex group male. In addition to this most of pulmonary tuberculosis patients were HIV positive and lowest numbers of pulmonary TB patients were worked on health center rather than non-health Center and most of TB was new case and there was small number of relapse. Weight, work place, weight, past pulmonary tuberculosis history and HIV were significantly associated with pulmonary tuberculosis occurrence.

Conclusion: The overall prevalence of pulmonary tuberculosis in Dessie-referral hospital was high relative to extra pulmonary tuberculosis. The major risk factors associated to this prevalence rate were work place, weight, past history of TB and HIV.

Keywords: Pulmonary tuberculosis; TB-HIV co-infection; Public health; Dessie-referral hospital; Ethiopia

Introduction

Tuberculosis is one of the most important public health problems causing significant morbidity and mortality globally. It is a chronic infectious disease caused by *Mycobacterium tuberculosis*. It typically affects the lungs but it could affect other parts of the body (such as the kidneys, bones and joints) as extra pulmonary TB. Tuberculosis is next to the Human Immunodeficiency Virus (HIV) in causing death among young people and adults [1].

Ethiopia is among the 28 countries in Africa with high TB and HIV co infection, 10% of TB patients are also infected by HIV/AIDS [2]. According to Amhara Regional State Health Office (ARSHO) report the number of TB cases is high (280 per 100,000) while case detection is very low 29% (Amhara Regional State Health Office) [3].

The study conducted in India has shown clearly that the prevalence of pulmonary TB disease is significantly higher among males than females [4]. Also past history of TB was no statistically significant association between the presences of previous history of tuberculosis [5].

Globally, PTB in homeless individuals is especially problematic because it may be highly contagious and can present as advanced disease with poor outcomes, including mortality [6]. HIV infected people are more risk group of people for developing pulmonary tuberculosis. HIV infection significantly increases the risk of progression from latent to active TB disease. Patients with low immunity due to HIV are more likely to acquire tuberculosis in an area with high tuberculosis prevalence [7].

Hospital workers are at increased risk both for tuberculosis because of the nature of their work. All high-risk populations for HIV/AIDS in sub-Saharan Africa are at increased risk for tuberculosis, particularly if they live in crowded quarters. Such groups include military and police living in barracks, prisoners and their wardens, sex workers, people with multiple sex partners, immigrant workers away from their families, truck drivers, and children of HIV mothers [8].

Tuberculosis remains a global killer claiming millions of lives. Pulmonary TB is a leading cause of adult morbidly and mortality. Ethiopia is one of the countries reporting the highest number of pulmonary TB cases globally and also Amhara regional state report high TB cases. This fact initiates me to do this study on the identify risk factor affect contributing pulmonary TB in Dessie-referral hospital.

Methodology

Study area

Dessie is capital city of South Wollo-zone in Amhara Region-Ethiopia. Which is located at a latitude and longitude of 11°8′n 39°38′e respectively, with an elevation between 2,470 and 2,550 m above sea level. Also it is located 401 km from north of Addis Abeba. In Dessie town there is only one referral hospital, therefore, our study conducted in this Referral Hospital.

Sampling design and data collection method

In this study, facility based retrospective cross-sectional study

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design was conducted. The data will obtain from recorded registration of TB patients in Dessie Referral Hospital from September 01, 2016 to August 31, 2017 GC was conducted in the study. All patients admitted and managed for TB in the one year of study period only 126 patients were available.

Ethical consideration

In this study, ethical standards adhered to as stated below:

- **Access to data:** I was ensuring that clients whose data examined remains anonymous to research throughout the study as well as making sure that the data was keep in a secure location.
- **The principle of anonymity and confidentiality:** I use anonymous data from hospital registers protecting the identity of patients as their names not need for the study. Researchers access to data from the Dessie Referral Hospital after names and identification numbers of clients were removed.

Variables of the study

Variables of the study are included:

i. Dependent variables: Prevalence of TB (0=extra pulmonary TB; 1=pulmonary TB)

ii. Independent variables: Factors expected to associate TB are age of patients, Sex, Weight in kg, Work place, Past history of TB and Status of HIV. Description of explanatory variables with the respecting coding displayed in Appendix I.

Data processing and analysis

Data collection format were checked for completeness, coded and entered in to SPSS windows version 20 for further analysis. Errors related to inconsistency of data was checked and corrected during data cleaning. Descriptive statistics such as percentages, ratios, frequency distributions and appropriate graphic presentation besides measures of central tendency were used for describing the data.

Binary logistic regression Model

Binary logistic regression was used to assess association and strength of association between explanatory factors and dichotomous outcome variable. The response variable can take the value 1 with a probability of success π, or the value 0 with probability of failure 1- π. This type of variable is called a Bernoulli variable.

The explanatory or predictor variables can take any form. The relationship between the explanatory variables and the response variable is not a linear function in logistic regression, but rather a linear relationship exists between the logit of the explanatory variables and response variable. Given p explanatory variables denoted by the vector $X' = X_1, X_2, ..., X_p$ the conditional probability that the outcome is present be denoted by $P(Y = 1/X) = \pi$.

$$The\ model\ is: P(Y = 1/X) = \pi(x) = \frac{e^{\beta_0+\beta_1X_1+\beta_2X_2+---+\beta_px_p}}{1+e^{\beta_0+\beta_1X_1+\beta_2X_2+---+\beta_px_p}}$$

Where: $\beta = (\beta_0, \beta_1, \beta_2 --, \beta_p)\ are\ parameters$

β_0 = the constant of the equation and, β_i = the coefficient of the th predictor variable.

An alternative form of the logistic regression equation is:

$$Logit\,\pi(x) = \log\left[\frac{\pi}{1-\pi}\right] = \beta_0 + \beta_1X_1 + \beta_2X_2 + --- + \beta_pX_p$$

Parameter estimation

Maximum likelihood estimation, ML, is the most common method used to calculate the logit coefficients. ML methods seek to maximize the log likelihood, LL, which reflects how likely it is (the odds) that the observed values of the outcome may be predicted from the observed values of the predictors. Suppose Yi independent random observations, the probability function of Yi are:

$$\theta(x_i) = \pi(x_i)^{yi}\left(1-\pi(x_i)\right)^{1-y_i}$$

i=1.2,3…..n

Since, Y_i are assumed to be independent, the joint probability functionorlikelihood function is given by: $L(\beta) = \Pi_{i=1}^{n}\left(\theta(x_i)\right)$

The principle of maximum likelihood states that we use as our estimate of $L(\beta)$ the value which maximizes the expression $L(\beta)$. However, it is easier mathematically to work with the log of equation $L(\beta)$. This expression, the *log likelihood,* is defined as:

$$LL = lnL(\beta) = \sum\left\{y_i \ln\left[\pi(x_i)\right] + (1-y_i)\ln\left[1-\pi(x_i)\right]\right\}$$

To find the value of β that maximizes L(β) we differentiate L(β) with respect βj, and set the resulting expressions equal to zero. The solution for the maximum likelihood estimates is obtained by a method called Newton-Raphson iteration which is known as Iteratively Reweighted Least Square (IRLS) algorithm.

Goodness of fit of the model

Assessing goodness of fit involves investigating how close values predicted by the model are to the observed values. In the study Hosmer-Lemeshow test and Likelihood ratio test were used to assess the goodness of fit of the mode l [9,10].

Result

As shown in Table 1 the total of 126 tuberculosis patients, most of the respondents 85 (67.5%) exposed with pulmonary TB (Table 1).

Pulmonary tuberculosis according to influencing factors

With regard to patient's sex, 58.5% male patients were with pulmonary TB while the percentage of female with pulmonary TB was 43.5 %. Moreover, there were marked age variations in pulmonary TB. The proportion of patients that were with pulmonary TB was higher for age group 31-45 years old (37.6%) followed by 19-30 and (35.3%).

Another variable considered as influencing the pulmonary TB was work place. Table 2 showed that patients that were non-health center worker accounted for 63.5% of the TB patients in the sample. Among those, 75.3% were with pulmonary TB patients.

Similarly, the proportion of TB patients, as can be seen in Table 2, differs by weight. Accordingly, 65.9% of the pulmonary TB patients had weight 30-60 kg while 20.0% of pulmonary TB patients had weight less than 30 kg and the share for the weight category greater than 60 kg was

TB	Frequency	Percent
Extra pulmonary TB	41	32.50%
Pulmonary TB	85	67.50%
Total	126	100.00%

Table 1: The converge of tuberculosis at Dessie-referal Hospital.

14.1%.

Past history of TB was also another potential determinant of the frequency of pulmonary TB patients considered in the study. The results show that, 58.7% was new cases among those 58.8% were pulmonary TB patients. 41.2% were relapsed pulmonary TB patients. Furthermore, more than half of the TB patients (59.5%) had HIV positive of which 71.8% were exposed to pulmonary TB patients. The rest, below 30% pulmonary TB patients were HIV negative (Appendix II).

Bivariate statistical analysis

The bi-variate statistical analysis addresses the marginal effect of a predictor variable on the response without taking into account other predictors. And it shows the association between the outcome variable and other predictor variables, obtained by cross tabulation of the response variable, prevalence of TB patients, and the other predictor variables independently. In this study, bivariate chi-square analysis has been used and all of the 6 variables considered were found to be statistically significant at 5% (since, $p<0.05$) significance level. Thus, the prevalence of TB had associated with patient's age, work place, weight, past history of TB and HIV (Appendix II).

Model Analysis of Pulmonary Tuberculosis

Model fitting

Hosmer and Lemeshow test was used to assess a goodness of fit test of the null hypothesis that the model adequately fits the data, since the value of the Hosmer-Lemeshow goodness-of-fit test statistical significance value is greater than 0.05 (i.e. 0.554>0.05), we fail to reject the null hypothesis that there is no difference between observed data and model-predicted values, implying that the model fits the data at an acceptable level, this proves that the predicted data are not significantly different from the observed data.

Consider the model which includes all predictors. Omnibus Tests of Model Coefficients had given Chi-Square value of 62.985 which is significant at 5% level of significant (i.e. 0.00<0.05). Since our omnibus test is significant we can conclude that adding the predictors to the model has significantly increased our ability to predict maternal outcome of uterine rupture (Table 2).

Validation of predicted probability of binary logistic regression model

The classification Table 3 shows that with the cut-off set at 0.5, 84.7% of patients who live with pulmonary TB were correctly classified whereas 68.3% of patients who live with extra pulmonary TB were correctly classified. About 79.4 % correct predictions of overall patients of TB were modelled by using binary logistic regression model (Table 3).

Risk factors associated with pulmonary tuberculosis

Binary logistic regression was employed to predict the probability of prevalence of pulmonary TB. The results of the binary logistic regression are given in Table 4, which displays the estimated coefficients, odds ratio, and p-value of Wald statistic. The result revealed that work

Hosmer and Lemeshow Test				
Step		Chi-square	df	Sig.
1		0	0	.
2		6.836	8	0.554
Omnibus Tests of Model Coefficients				
1	Step	62.985	10	0
	Block	62.985	10	0
	Model	62.985	10	0

Table 2: Hosmer and Lemeshow test and Omnibus tests of Model coefficients.

	Observed	Predicted		
		Extra pulmonary TB	Pulmonary TB	Percentage Correct
Step 1	Extra pulmonary TB	28	13	68.3
	Pulmonary TB	13	72	84.7
	Overall Percentage			79.4
*The cut value is 0.500				

Table 3: Validation of predicted probability of Binary Logistic regression model.

place, weight, past history of TB and HIV were found to be significant at 5% level of significant.

The odds of patients who worked in health center were 0.200 times (OR: 0.200, CI: (0.070, 0.573)) less likely exposed to pulmonary TB from patients who worked in non-heath center controlling for all the other variables in the model.

Patients who had weight less than 30 kg were 7.580 (OR: 7.580, CI: (1.446, 39.733)) times more likely to have pulmonary TB as compared to those patients who had greater than 60 kg, similarly patients who had a weight lie between 30 kg to 60 kg were 8.075 times (OR: 8.075, CI: (2.328, 28.008)) times more likely to have pulmonary TB as compared to those patients who had greater than 60 kg controlling for all the other variables in the model.

New cases were 0.178 times (OR: 0.178, CI: (0.055, 0.572)) less likely to had pulmonary TB compared to relapse controlling for all the other variables in the model. HIV infected individuals were 4.425 (OR: 4.425, CI: (1.571, 12.466)) times more likely to had pulmonary TB than those who were HIV uninfected individuals controlling for all the other variables in the model (Table 4).

Discussion

In this study, the pulmonary tuberculosis patients were high relative to extra pulmonary tuberculosis. The highest prevalence rate was observed in age group within 19-30 and 31-45, but the prevalence rate was very low in the age groups of 0-18 and above 64 which is consistent finding in the study on prevalence of pulmonary TB and the disease affecting mostly young adults in their productive age 15-45 years with most deaths occurring in the developing countries [2]. However, among pulmonary tuberculosis patients more than half were males which indicate higher proportion of pulmonary tuberculosis infection among male tuberculosis patients than females. A sit was documented in this study, high prevalence rate of pulmonary TB cases was observed among males compared to females. Similarly, the study conducted in India has shown clearly that the prevalence of pulmonary TB disease is significantly higher among males than females [4]. Thus, our finding was consistent with this finding.

Study done previously show that Hospital workers are at increased risk for tuberculosis because of the nature of their work [8]. But it is

Variables in the Equation									
Variable	Category	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for Exp (B)	
								Lower	Upper
Sex	Female	0.505	0.535	0.889	1	0.346	1.656	0.58	4.73
Age	Age			6.567	4	0.161			
	0-18	20.804	1075.428	0.000	1	0.998	10439.21	0.000	-
	19-30	-1.705	1.201	2.017	1	0.156	0.182	0.017	1.912
	31-45	-1.113	1.232	0.816	1	0.366	0.329	0.029	3.676
	46-64	1.601	1.779	0.809	1	0.368	4.956	0.152	162.059
Work place	Health center	-1.61	0.537	8.972	1	0.003	0.2	0.07	0.573
Weight	Weight			11.529	2	0.003			
	0-30 kg	2.026	0.845	5.742	1	0.017	7.58	1.446	39.733
	30-60 kg	2.089	0.635	10.835	1	0.001	8.075	2.328	28.008
Past history of TB	New case	-1.727	0.596	8.398	1	0.004	0.178	0.055	0.572
HIV	Positive	1.487	0.528	7.921	1	0.005	4.425	1.571	12.466
	Constant	1.238	1.387	0.797	1	0.372	3.45		

Table 4: Fitted model of pulmonary tuberculosis at Dessie-referal Hospital.

significantly different to our study. In addition, this study showed that patient who had weight less than 30 kg were more likely to have pulmonary TB as compared to those who had weight greater than 60 kg. This finding also supported by studies conducted in Seoul, South Korea [6].

In this study, past history of TB disease was significantly associated with pulmonary TB. But in other study the result also showed that there was no statistically significant association between the presences of previous history of tuberculosis [5].

Our result also showed that there was higher prevalence of HIV among pulmonary TB patients and it was found out that the result done before HIV infected people are more risk group of people for developing pulmonary tuberculosis. HIV infection significantly increases the risk of progression from latent to active TB disease. Patients with low immunity due to HIV are more likely to acquire tuberculosis in an area with high tuberculosis prevalence [7].

Conclusion

The main objective of the study was to assess the prevalence of pulmonary TB. The results of this study show that the overall prevalence of pulmonary tuberculosis in Dessie referral hospital was high relative to extra pulmonary tuberculosis. The major risk factors associated to this prevalence rate were work place, weight, past history of TB and HIV. The highest number of pulmonary TB patients in Dessie referral hospital was seen on the age group of 31-45 whereas the lowest seen on the age group of above 64. In addition to this most of pulmonary TB patients were HIV positive and lowest numbers of pulmonary TB patients were worked on health center rather than non-health center, in Dessie referral hospital most of pulmonary TB was new case and there is small number of relapse.

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