Determinants Of Multidrug Resistant Tuberculosis Among Adults Undergoing Treatment For Tuberculosis In Tigray Region, Ethiopia: A Case Control Study

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Abstract

Background Multidrug-resistant tuberculosis is a type of tuberculosis that is resistant to at least the first line anti-tuberculosis drugs namely, Rifampicin and Isoniazid. Multidrug-resistant tuberculosis has continued to be a challenge for tuberculosis control globally. Globally 600,000 people were newly eligible for Multidrug-resistant tuberculosis treatment with an estimated 240,000 deaths annually. There are few numbers of multi drug resistant tuberculosis studies in different regions of Ethiopia. However, most of these studies were restricted only to a single hospital and there is no published information regarding multi drug resistant tuberculosis in Tigray region. Therefore, the aim of this study was to assess the determinants of multidrug resistant tuberculosis among adults undergoing treatment for tuberculosis in Tigray region, Ethiopia.

Methods A hospital based unmatched case control study was conducted from April to June, 2019. Simple random sampling method was used to select 85 cases and 169 controls. Primary data was collected by face-to-face interview and secondary data by reviewing patients' charts using pretested structured questionnaires. The data were entered and cleaned using Epi data manager then exported to SPSS for analysis. Binary Logistic regression model was used to test the association between independent and dependent variables. Model fitness was checked using Hosmer-Lemeshow goodness-of-fit and Variance inflation factor was used to assess multi collinearity between the independent variables. Variables at p-value less than 0.25 in bivariate analysis was entered into a multivariable analysis to identify the determinant factors of multi drug resistant tuberculosis. Finally, level of significance was declared at p-value <0.05.

Results A total of 254 participants with 85 cases and 169 controls were included in this study. Of the respondents, 62 (36.7%) among the controls and 48 (56.5%) among the cases were living in rural residence. Rural residence [AOR=2.54;95%CI=1.34,4.83], HIV[AOR=4.5;95%CI=1.4,14.2], relapse [AOR=3.86;95%CI;1.98,7.5], return after lost follow up [AOR=6.29;95% 1.64,24.2], treatment failure [AOR=5.87; CI=1.39,24.8] were among the determinants of Multi drug resistance tuberculosis.

Conclusion Rural residence, HIV, relapse, return after lost follow up and treatment failure were the identified determinant factors of Multi drug resistance tuberculosis.

Background

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis*. Mostly, it affects the lungs and other organs[1]. Multidrug-resistant tuberculosis (MDR-TB) is a type of tuberculosis that is resistant to at least the powerful first line anti-TB drugs namely, Isoniazid and Rifampicin [2]. When an individual who has no history of first-line TB treatment develops MDR-TB, it is termed primary. When insufficient treatment leads to selection of spontaneously resistant strains (i.e., drug resistance is acquired), the disease is termed secondary multidrug-resistant tuberculosis (MDR-TB) [3]. Unless the individuals infected with resistant strains of *M. tuberculosis* are treated appropriately, resistant strains

will continue to spread in the community, accelerating the epidemic [4]. Both primary and retreatment or secondary cases of MDR-TB have already been reported in Ethiopia [5].

Multidrug-resistant tuberculosis (MDR-TB) has continued to be a challenge for tuberculosis (TB) control globally [6, 7]. According to 2016 WHO report 600,000 people were newly eligible for MDR-TB treatment [8]. Although MDR-TB is a growing concern in Africa where limited resource exists, it is largely under-reported [9, 10]. According 2010 WHO report the number of MDR-TB cases was rising in Africa [2]. The prevalence varies among countries and regions while high prevalence has observed in developing countries [6]. Sub-Saharan Africa represents 14% of the global burden of new MDR-TB cases [9]. Seven countries including Ethiopia in Africa (new/retreatment % accordingly) Angola (2.6/18%), DR Congo (2.2/17%), Kenya (1.3/9.4%), Nigeria (4.3/25%), Somalia (8.7/47%) and Zimbabwe (4.6/14%) are also listed among the 30 high MDR-TB burden countries in the world [11]. World Health Organization in 2016 listed Ethiopia 8th out of 30 high MDR-TB burden countries in the world with a prevalence of 2.7% (1.5–4.0) in newly and 14.0% (3.6–25.0) in previously treated patients [12].

MDR-TB is a cause of death for more than 240,000 deaths annually [8]. Patients infected with multiple-drug resistant strains are less likely to become cured [13]. The cure rate for MDR TB is poor ranging from 6% to 59% [14]. According to the Ministry of Health statistics, tuberculosis is one of the leading causes of morbidity, the fourth cause of hospital admission, and the second cause of hospital death in Ethiopia [15].

The treatment of MDR-TB with second line drugs is long which is more than two years, complex process, and has a considerable rate of adverse effects and making MDR-TB costly and difficult to manage than drug-susceptible TB [16, 17]. The cost of drugs alone for treating the average MDR-TB patient is 50 to 200 times higher than for treating a drug-susceptible TB patient [18]. The cost per patient treated is in the range of 100–1000 US\$ for drug-susceptible TB and 2000– 20,000 US\$ for MDR-TB [8].

MDR-TB mostly affect the poor, illiterate, productive age group, and immune compromised individuals [7]. Inadequate treatment (due to shortage of drug, increasing cost of drug and physician errors), inadequate adherence (such as poor compliance, alcoholism, drug addiction, length of treatment and adverse drug reactions) and poor infection control have been also identified contributing factors for the occurrence of MDR TB [19–21]. In Ethiopia, the low socioeconomic status of the people, high prevalence of infectious diseases and limited access to well-equipped health care facilities worsens the effect of MDR-TB [2].

Globally, Prevention of new infections of Mycobacterium tuberculosis and their progression to tuberculosis (TB) disease is critical to reduce the burden of disease and death caused by TB, and to achieve the end TB Strategy targets set for 2030 and 2035. Health interventions has been tried for latent TB infection (LTBI), prevention of transmission of Mycobacterium tuberculosis through infection prevention and control, and vaccination of children with the bacilli Calmette-Guérin (BCG) vaccine [22]. Ethiopia has also designed a strategy to provide culture and drug susceptibility testing (DST) services at least to all MDR-TB suspected cases and applying directed observed therapy (DOT) for first line anti TB

medications. However, Multi-Drug Resistant Tuberculosis (MDR-TB) is becoming a major challenge of the tuberculosis (TB) control program in Ethiopia and is continuing a public burden in our country [23–25].

There are limited numbers of MDR-TB studies in different regions of Ethiopia [26–28]. Most of these studies are also restricted only to a single hospital, has inconsistent results and there is no published information regarding MDR TB in Tigray region. Thus, this study will be used as base line data/input on determinants of MDR TB among adult patients undergoing first line drug treatment in MDR TB treatment centers of Tigray hospitals. The findings would be used as in put for policy makers to improve MDR-TB treatment in Ethiopia.

Identifying determinant factors in a given region has substantial role in reduction of mortality and morbidity by collaboratively preventing the infection. Therefore, for regional health bureau this research will be used as source of information to identify the determinant factors of MDR TB and to develop a strategy on the factors and to tackle MDR. This study will be also used as base line information for further researchers who are interested to do on MDR TB. For community this study will be a good information to identify the risk factors and prevent the disease. Again, for other stakeholders (NGO) this study would be a good indicator to invest and work on MDR TB. Therefore, the main aim of this study was to identify the determinant factors MDR TB among adults undergoing first line treatment in Tigray region.

Methods

Study Area and Period

The study was conducted in Tigray public hospitals. Tigray is found in the northern part of Ethiopia. Tigray regional state has two comprehensive specialized hospitals, 15 general hospitals, 22 primary hospitals and 223 health centers. From the 15 general hospitals seven hospitals namely Kahsay Abera, Suhul, Adwa, Adigrat, Mekelle, Lemlem Karl and Alamata are giving MDR TB treatment services. There were 118 registered MDR TB patients in Tigray region. The study was conducted from April to June, 2019 in Multi drug resistant tuberculosis treatment center hospitals of Tigray.

Study Design

A hospital -based unmatched case- control study was conducted.

Study Population

The study population for cases were all MDR TB patients undergoing treatment in the selected hospitals during the data collection period. The study population for controls were all TB patients (non MDR TB) undergoing treatment for tuberculosis in the selected hospitals during the data collection period.

Sample Size Determination and Sampling Technique

Sample Size Determination

The required sample size was determined by using the Epi-Info version 7.2.2.12 from previous study conducted in Ethiopia. The estimated sample size was determined based on the following assumptions: confidence interval of 95% at power the of 80%, with the ratio of 1:2 (case to control).

Finally, by comparing the three results the first variable was used with a total sample size of 242 By adding a 5% non-response rate the total sample size was 254 (85 and 169 controls).

Sampling Techniques and Procedures

First, the sample size was allocated proportionally to the seven MDR TB treatment centers of Tigray according to the number of patients registered to take the treatment. Then a frame of MDR-TB patients enrolled to second line drug treatment at MDR treatment centers of Tigray was created using the medical registration number. Finally, a simple random sampling technique was used to select the MDR TB cases. MDR-TB patients enrolled to second line drug at MDR treatment center hospitals of Tigray taken as cases and simple random sampling technique was used to include 85 study subjects from the list of MDR TB patients register. Controls were also selected from the TB registration book in the similar hospitals. Finally, 169 controls were randomly selected by simple random sampling.

Data Collection Tools and Procedures

Primary data was collected by face-to-face interview using pretested structured questionnaires, whereas secondary data was collected by reviewing patient medical charts/ registration logs using check lists for the corresponding study participants. Seven trained BSc nurses were employed to conduct an interview to the participants and review the corresponding records. Three senior BSc nurse supervisors were assigned to supervise the whole data collection process during the data collection period. The questioner contained sociodemographic related factors, behavioral related factors and clinical related factors. During data collection, data collectors was used the N-95 respiratory mask (covers both the mouth and nose and filters more than 95% of particles) to prevent from acquiring from infection. The data collection period was from April to June 2019.

Data Quality Assurance

Data quality was ensured by giving two days of training for data collectors and supervisors and by providing supervision during the data collection period. First, the questioner was adapted from a published paper in English form [43], then translated into Tigrigna (local language) and back- translated into English to ensure its consistency. Each questionnaire was checked for completeness, missed values

then manually cleaned up on such indications before living the study area. The questionnaire was pretested on 5 % of other patients who were not participated in the study for completeness and appropriateness to the local context. Based on the findings necessary amendments have done. Every questionnaire was checked by the principal investigator on the spot.

Data Processing and Analysis

The data was coded and entered into Epi data manager version 4.4.3.1 then exported to SPSS version 20 for further statistical analysis.

Descriptive statistics such as frequencies, percentages, median, interquartile range were computed. Finally, the report was summarized and presented using, texts, tables, and figures. Binary Logistic regression model was used to test the association between independent and dependent variables. All variables at p-value <0.25 in bivariate logistic regression were entered into multi variable logistic regression to determine the association between a set of independent variables with the dependent variable. Odds ratio was estimated at 95% CI to show the strength of an association and p- value <0.05 was used to declare statistical significance. The model fitness was checked using Hosmer-Lemeshow goodness-of-fit which was fitted (0.436). Variance inflation factor was used to assess multicollinearity between the independent variables.

Study Variables

The dependent variable is MDRTB (yes or no). The Independent variables included the sociodemographic variables (age, sex, religion, socio economic status/income, education, occupation, marital status, and living residence, family size, the number of rooms in the patient's household and number of windows), clinical related variables (HIV status, history of contact with known TB patient, history of contact of with known TB patient, other underlying/chronic disease, number of TB episodes TB, outcome, history of interruption the first line anti TB, directed observed therapy, encountered side effects, category of TB, and duration of first line treatment) and behavioral related variables (prison status, alcohol consumption and cigarette smoking). Data on sociodemographic characteristics, behavioral characteristics and some the clinical characteristics were collected through face to face interviews. The remain clinical characteristics were collected by the review of the patient records and registration books.

Results

Sociodemographic characteristics

A total of 254 participants with 85 cases and 169 controls were included in this study with a 100% response rate. The median and interquartile range age of the cases was 30 ±18. The median and

interquartile range age of the controls was 35 ± 19 . Of the participants, 55 (64.7%) were males among the cases and 99(58.3%) were females among controls (Table 1).

Regarding educational status, around 34 (40%) participants among the cases and 60 (35.5%) participants among controls had no formal education,26 (30.6%) participants among cases and 55(32.5%) participants among controls had finished their primary school, 14(16.5%) participants among cases and 34(20.1%) participants among controls were secondary school,11(12.9%) participants among cases and 20 (11.8%) participants among controls were college and above.

Of the respondents,62 (36.7 %) among the controls and 48 (56.5%) among the cases were living in rural residence (Figure 1)..

Behavioral related factors

More than three fourth, 67 (78.8%) cases and 127 (75.1%) controls did not drink any alcohol. Of the cases,7 (8.2%) and 17 (10.1%) from controls were cigarette smokers (Table 2)..

Clinical related factors

Of the respondents 29 (34.1%) of cases (MDR TB patients) and 120(71%) of controls (TB patients) were new patients. Eight (9.4%) and 14 (16.5%) among cases were return after lost follow up and treatment failure respectively. From the participants,34 (40%) among cases and 31 (18.3%) among controls were relapse patients (Figure 2)..

Of the cases,56 (65.9%) were faced two and more episodes of tuberculosis and 120 (71%) among controls were faced only one episode. Seventy (82.4%),163 (96.4%) were non-reactive among cases and controls respectively. From the participants,15 (17.6%) among cases and 6 (3.6%) among controls were HIV reactive patients (Table 3)

Determinants of Multi drug resistance Tuberculosis

The bivariate logistic regression analysis showed that rural residence, TB episodes greater than or equal to two, treatment category (treatment after lost follow up, relapse and treatment failure), HIV and Hx of close contact with known TB were statistically associated with the development of MDR TB. However, after multi variable logistic regression analysis rural residence, HIV, relapse, lost follow up and treatment failure were significantly associated with MDR TB at p-value <0.05.

The odds of MDR TB among rural residence was 2.6 times as compared to urban residence [AOR = 2.58;95% CI = 1.4–4.6]. The odds of being MDR TB among HIV reactive participants was 4.4 times as compared to HIV non-reactive participants [AOR = 4.4;95% CI = 1.5–12.6]. Treatment after lost follow up participants had 5.4 times high risk for MDR TB as compared to the newly diagnosed patients [AOR =

5.4;95% CI = 1.69–17]. Relapse patients had 3.9 times high risk for the development of MDR TB as compared to new patients (AOR = 3.86;95% CI = 1.98–7.5). Participants with first line treatment failure patients were found 5 times more likely to develop MDR TB as compared to new patients [AOR = 5.1;95% CI = 2–13] (Table 4)..

Discussion

In this study living in a rural setting, return after lost follow up, relapse, treatment failure, and HIV were found to be significantly associated with the occurrence of MDR-TB.

Multi drug resistant tuberculosis was significantly associated with residence area; living in a rural area increased the occurrence of MDRTB compared with living in an urban area. This is similar to the studies conducted in east shoa, Oromia region and Amhara regional state, Ethiopia [30–32]. This might be due the large proportion of people living rural setting, differences in access to TB services, socio-economy and the level of awareness about adherence to first-line TB treatment, as rural communities have poor adherence to treatment that likely leads to MDR-TB [30]. In contrast, a study conducted in south western Ethiopia showed that rural residence was no associated with the development of MDR TB[26]. This might be due to sample size difference.

In this study HIV was significantly associated with the occurrence of MDR TB. This is supported by a study conducted in Oromia which found that HIV is a risk factor for the development of multi drug resistant tuberculosis [31]. This could be due to drug mal-absorption in HIV infected patients since the patient is taking both ART and anti TB medications,especially rifampicin and ethambutol, can lead to drug resistance and has been shown to lead to treatment failure[33]. In contrast, HIV was not associated with the development of MDR-TB in a study conducted in south western and, east shoa, Ethiopia [26, 30]. This discrepancy might be due sample size difference.

In this study MDR TB was significantly associated with return after lost follow up(defaulting). This finding is similar with the study conducted in Brazil, Thailand, Addis Ababa, Ethiopia [34–36]. This can be explained by the increased exposure with anti-tuberculosis drugs. A study conducted in eleven countries has shown that the longer the time of exposure to anti-tuberculosis drugs, the greater the chance of occurrence of resistance[37]. This might be due to poor management of the patient, unsatisfactory patient or clinician compliance, lack of supervision of treatment, and absence of infection control measures in hospitals [38, 39]. This study found that, relapse was significantly associated with the occurrence of MDR TB. This finding is supported by a study conducted in Brazil [36]. In contrast, relapse was not associated with the occurrence of multi drug resistance tuberculosis in a study conducted in Amhara regional state [32]. This difference might be due to the different selection of study participants and relatively small proportion of relapse patients in a study conducted in Amhara regional state.

Treatment failure was significantly associated with the development of multi drug resistance tuberculosis. This finding is similar with a study conducted in Jimma south west Ethiopia,Addis Ababa,Amhara regional state, Ethiopia [32, 34, 40]. The association between TB treatment failure and

MDR-TB might be related to unsatisfactory compliance by patients or clinicians, lack of supervision of treatment, improper drug regimens and inadequate or irregular drug supply that may potentiate drug resistance [27, 41].

Limitation Of The Study

This study may have recall bias, since some of the information such as interruption of anti TB, contact history with known TB and MDR TB were based on the recall of the study participants.

Conclusion

This study identified rural residence, HIV, relapse, return after lost follow up and treatment failure as determinant factors for the occurrence of MDR TB.

Abbreviations

AIDS: Acquired Immune Deficiency Syndrome; OR: Adjusted Odds Ratio; BCG: Bacille Calmette Guerin; CI: Confidence interval; COR: Crude Odds Ratio; DM: Diabetes Mellitus; DST: Drug Susceptibility Testing; HIV: Human Immune Virus; MDRTB: Multi Drug Resistant Tuberculosis; RR: Rifampicin Resistant; SPSS: Statistical Package for Social Science; TB: Tuberculosis; WHO: World Health Organization.

Declarations

Ethics approval and consent from the participant

Ethical clearance was obtained from Mekelle University College of health science institutional review board (IRB). Official supportive letters were obtained from Tigray regional health bureau and respective hospitals. Moreover, prior to conducting the study, the purpose and objective of the study was described to the study participants and informed consent was obtained. Respondents were allowed to refuse or discontinue participation at any time they want. Information was collected anonymously, confidentiality was assured and maintained throughout the study period.

Competing interests

The authors declare that they have no competing interests

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Consent for publication

Not applicable

Availability of data and materials

All data is available via this manuscript.

Author's contributions

The KZ was made substantial contributions to the conception, design of the work, methodology, analysis, data interpretation and wrote the final manuscript. TK, HT and GB, had equally contributed to the analysis and interpretation of the data. WA, AA and GM have made substantial contribution in reviewing overall the study in analysis, interpretation of data, have drafted the manuscript and substantively revised the work. All authors read and approved the final manuscript.

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Tables

Table 1: Sociodemographic characteristics of MDR-TB in Tigray region, Ethiopia, 2019 (n=254)

Variables	Cases (n=85		controls(n=169)	
	Number	Percentage	Number	Percentage
Age				
18-25	23	27.1	37	21.9
26-45	44	51.8	93	55
>45	18	21.2	39	23.1
Sex				
Male	55	64.7	99	58.6
Female	30	35.3	70	41.4
Religion				
Orthodox	76	89.4	157	92.9
Muslim	9	10.6	12	7.1
Occupation				
Farmer	26	30.6	49	29
Merchant	10	11.8	32	18.9
Government employer	7	8.2	14	8.3
Unemployed	29	34.1	40	23.7
Others**	13	15.3	34	20.1
Family size				
1-3	26	30.6	57	33.7
4-6	49	57.6	91	53.8
7-11	10	11.8	21	12.4
Marital status				
Single	32	37.6	52	30.8
Married	37	43.5	78	46.2
Divorced /widowed	16	18.8	39	23.1
monthly income				

<i>Up to 500</i>	<i>10</i>	<i>11.8</i>	<i>14</i>	<i>8.3</i>
<i>501-1500</i>	<i>48</i>	<i>56.5</i>	<i>94</i>	<i>55.6</i>
<i>1501-2000</i>	<i>13</i>	<i>15.3</i>	<i>18</i>	<i>10.7</i>
<i>>2001</i>	<i>14</i>	<i>16.5</i>	<i>43</i>	<i>25.4</i>
<i>number of rooms</i>				
<i>1</i>	<i>32</i>	<i>37.6</i>	<i>70</i>	<i>41.4</i>
<i>2-3</i>	<i>40</i>	<i>47.1</i>	<i>83</i>	<i>49.1</i>
<i>>=4</i>	<i>13</i>	<i>15.3</i>	<i>16</i>	<i>9.5</i>
<i>Presence of widows</i>				
<i>No</i>	<i>20</i>	<i>23.5</i>	<i>40</i>	<i>23.7</i>
<i>Yes</i>	<i>65</i>	<i>76.5</i>	<i>129</i>	<i>76.3</i>
<i>number of windows(n=65)</i>				
<i>1</i>	<i>30</i>	<i>46.2</i>	<i>46</i>	<i>35.7</i>
<i>2-3</i>	<i>29</i>	<i>44.6</i>	<i>67</i>	<i>51.9</i>
<i>>=4</i>	<i>6</i>	<i>9.2</i>	<i>16</i>	<i>12.4</i>
<i>open window</i>				
<i>No</i>	<i>9</i>	<i>13.8</i>	<i>19</i>	<i>14.7</i>
<i>Yes</i>	<i>56</i>	<i>86.2</i>	<i>110</i>	<i>85.3</i>

N.B: *others in occupation includes private employee, students, daily worker and pensioned*

Table 2: Behavioral factors of multidrug resistant tuberculosis among adults undergoing treatment for tuberculosis in Tigray, Ethiopia,2019 (n=254)

<i>Variables</i>	<i>Cases (n=85)</i>		<i>controls(n=169)</i>	
	<i>Number</i>	<i>percentage</i>	<i>Number</i>	<i>percentage</i>
<i>drinking alcohol</i>				
No	67	78.8	127	75.1
Yes	18	21.2	42	21.2
<i>cigarette smoking</i>				
No	78	91.8	152	89.9
Yes	7	8.2	17	10.1
<i>Lived with cigarette smoker</i>				
No	79	92.9	149	88.2
Yes	6	7.1	20	11.8
<i>Imprison status</i>				
No	72	84.7	148	87.6
Yes	13	15.3	21	12.4

Table 3: Clinical related factors of multidrug resistant tuberculosis among adults undergoing treatment for tuberculosis in Tigray, Ethiopia,2019 (n=254)

Variables	Cases (n=85)			
	controls(n=169)			
	Number	percentage	Number	
	percentage			
Number of TB episodes				
Once	29	34.1	120	71
>=2	56	65.9	49	29
Interruption first line anti TB treatment				
No	44	78.6	40	81.6
Yes	12	21.4	9	18.4
Reason of interruption				
Side effects	5	41.7	8	88.9
Forgetting	1	8.3	0	0
Feeling better	6	50	1	11.1
DOT				
No	6	10.7	5	10.1
Yes	50	89.3	44	89.9
Place of treatment				
Health center	34	60.7	21	42.9
Hospital	22	39.3	28	57.1
Contact with known TB				
No	22	25.9	62	36.7
Yes	23	27.1	43	25.4
I don't remember	40	47.0	64	37.9
Contact with known MDR-TB				
No	27	31.8	97	57.4
Yes	15	17.6	4	2.4
I don't remember	43	50.6	68	40.2

<i>outcome of first line TB Rx</i>				
<i>Cured</i>	<i>15</i>	<i>26.8</i>	<i>15</i>	<i>30.6</i>
<i>Completed</i>	<i>21</i>	<i>37.5</i>	<i>25</i>	<i>51.1</i>
<i>Lost follow up</i>	<i>10</i>	<i>17.9</i>	<i>8</i>	<i>16.3</i>
<i>Failure</i>	<i>10</i>	<i>17.9</i>	<i>1</i>	<i>2</i>
<i>Chronic disease status</i>				
<i>No</i>	<i>78</i>	<i>91.8</i>	<i>149</i>	<i>88.2</i>
<i>Yes</i>	<i>7</i>	<i>8.2</i>	<i>20</i>	<i>11.8</i>

Table 4: Determinant factors of multidrug-resistant tuberculosis among adults undergoing treatment for tuberculosis in Tigray region, Ethiopia, 2019

<i>Variables</i>	<i>Controls</i>	<i>Cases</i>	<i>COR</i>	<i>AOR</i>	<i>P-value</i>
	<i>n (%)</i>	<i>n (%)</i>			
<i>Residence</i>					
<i>Urban</i>	107(63.3)	37(43.5)	1	1	
<i>Rural</i>	62(36.7)	48(56.5)	2.24(1.3-3.8)	2.58(1.4-4.6) *	0.002
<i>patient category</i>					
<i>New</i>	120(71)	29(34.1)	1	1	
<i>Relapse</i>	31(18.3)	34(40)	4.5(2.4-8.5)	3.86(1.98-7.5) *	0.001
<i>Return after lost follow up</i>	7(4.1)	8(9.4)	4.7(1.5-14.1)	5.4(1.69-17) *	0.004
<i>Treatment failure</i>	11(6.5)	14(16.5)	5.3(2.1-12.8)	5.2(2-13) *	0.01
<i>Hx of close contact with known TB</i>					
<i>No</i>	62(36.7)	22(25.9)	1	1	
<i>Yes</i>	43(25.4)	23(27.1)	1.5(0.75-3.0)	1.67(0.76-3.6)	0.197
<i>I don't remember</i>	64(37.9)	40(47.1)	1.76(0.94-3.3)	1.57(0.78-3.2)	0.2
<i>HIV status</i>					
<i>No</i>	163(96.3)	70(82.4)	1	1	
<i>Yes</i>	6(3.6)	15(17.6)	5.8(2.2-15.6)	4.4(1.5-12.6) *	0.006

N.B * and p-value <0.05 shows independent variables associated with the outcome variable and "1" indicates reference.

Figures

Figure 1

residence of MDR TB among adults undergoing treatment for tuberculosis in Tigray, Ethiopia, 2019

Figure 2

Treatment category of MDR TB tuberculosis among adults undergoing treatment for tuberculosis in Tigray, Ethiopia, 2019