Tuberculosis Treatment Outcomes Among Prisoners And Non-prisoners In Zomba, Malawi

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Abstract

Background TB remains a major global health problem. It is particularly prevalent in prisons in sub-Saharan Africa due to overcrowding, malnutrition, high HIV prevalence and insufficient medical services. Prisoners have experienced worse treatment outcomes than the general population. We investigated the TB treatment outcomes and predictors of unsuccessful treatment outcomes among prisoners and non – prisoners. Methods We retrospectively reviewed TB registers of prisoners and non - prisoners diagnosed with TB from January 2011 to December 2016 at Zomba Maximum Central Prison and Zomba Central Hospital, Malawi. The study used routinely collected data extracted from national, standardized TB treatment monitoring tools. Successful treatment outcome was classified as the total for cured and completed treatment while unsuccessful treatment outcome was classified as the total of deaths and treatment failures. We used descriptive statistics to compare the demographics and TB treatment parameters among prisoners and non – prisoners and computed multivariate analysis to predict the independent factors of unsuccessful treatment outcomes. Results Of 1652 registered cases, 27% were prisoners (all males) and 72% were non-prisoners (58% males). The median age was 35 years (IQR: 29 - 42); 76% were Pulmonary TB cases (78% among prisoners vs 75% among non-prisoners); 83% were new TB cases (77% among prisoners vs 86% among non-prisoners); and 65% were HIV positive (50% among prisoners vs 71% among non – prisoners). Regarding treatment outcome, 1472 (89%) were cured and/or completed treatment (93% among prisoners vs 88% among non – prisoners), 2(0.2%) were treatment failures, 122 (8%) died (5% among prisoners vs 8% among non – prisoners) and 55 (3%) were not evaluated (1% among prisoners vs 4% among non – prisoners). Independent factors of unsuccessful TB treatment outcomes were noted in those with age greater than 35 years (aOR = 0.68: 95% C.I: 0.58 – 0.80), Extra-Pulmonary TB (aOR=1.69: 95% C.I: 1.08 – 2.63), HIV positive status (aOR = 0.63: 95% C.I: 0.42 – 0.94). Conclusion Good TB treatment outcomes which are comparable to the general population can be achieved among Malawian prisoners despite the challenging prison conditions.

Background

Tuberculosis (TB) remains a major global health problem. Globally in 2016, there were an estimated 10.4 million new TB cases of which 10 % were among People living with HIV[1]. There were an estimated 1.7 million TB deaths worldwide with 23 % (0.4 million deaths) resulting from TB disease among people living with HIV [1]. TB is the most common severe opportunistic infection associated with HIV in many resource-limited countries [2,3] with about 70 % of incident TB cases reported in the World Health Organization (WHO) South East Asia and African Regions. TB is more common in prison populations than in the general populations [2,10,11] and HIV epidemic, poor living conditions, low socioeconomic status and poor general health, appears to have contributed directly to higher rates of TB within prisons [2]. (1, 14) Prisons therefore serve as reservoirs for TB infection, not only for inmates and staff but also for the general population as visitors come and go and released prisoners return to society [2].

In 2015, Malawi reported an estimated 17,000 TB case notifications (193 cases per 100,000 population) with a 53% HIV/TB co-infection rate (95% on ART{anti-retroviral therapy}) and 85% treatment success rate

[4]. Malawi is one of the focus countries in the *End TB Strategy* era (2016-2035), as it is in the top 20 countries of high TB incidence among people living with HIV[1].

Data from the WHO epidemiological surveillance for TB treatment outcomes of 2015 cohort showed a range of 47% to 90 % treatment success in the Central and South America countries; 60 % to 94 % treatment success in the South East Asia; and 43 % to 88 % in sub – Saharan Africa [5]. In contrast, Prison settings have shown sub-optimal TB treatment success rates than the recommended 90 % set by the *End TB Strategy*. In Brazil, a retrospective study from 2007 - 2011 showed that prisoners accounted for 5.7% (24,585) of the national TB registered cases with a 50% cure rate, 8% default rate, 1% death rate, 8% transfer out rate and in 30% the 'treatment outcome' field was not completed [17]. In South Africa, a retrospective study of 202 prisoners diagnosed with TB from 2007 – 2009 showed a 45 % cure rate, 1% relapse rate, 0.5 % treatment failure rate, 1.8 death rate and 51% transfer out rate [18], while in Nigeria, a retrospective study of 48 prisoners diagnosed with TB from 2004 to 2008 showed a 67% treatment completion rate, 29 % transfer out rate and 4.2 % death rate [19]. In Uganda, a retrospective study of 469 prisoners diagnosed with TB from 2011 to 2012 showed a 48% treatment completion rate, 43% defaulter rate, 5% death rate and 4% still on treatment. During treatment, 12% of prisoners remaining in the same prison defaulted, 53% of transfers defaulted and 81% of those released were lost to follow-up [20]. Standard TB treatment outcomes are known to be influenced by a number of factors including HIV co-infection, but the evidence on which factors are most influential appears inconclusive [5]. While some studies found lower TB treatment success rates among TB/HIV patients[5–8], other reported comparable rates to those infected only with TB[9]. The low TB treatment outcomes in prisons compromise TB control interventions which might contribute to the development of Multi Drug Resistant Tuberculosis (MDR-TB).

Since 2009 Dignitas International (DI) in conjunction with the Ministry of Health has been providing HIV/TB testing and treatment services to Zomba Central Hospital and Zomba Central Prison in Zomba, Malawi. Therefore, we investigated the TB treatment outcomes and predictors of unsuccessful treatment outcomes among prisoners and non – prisoners in order to audit the effectiveness of TB control since TB treatment outcome results serve as a proxy for the quality of TB treatment provided by a health care system.

Methods

Study design and setting

A retrospective cross-sectional study was conducted at the Zomba Central Prison (ZCP) and Zomba Central Hospital (ZCH), Malawi. Zomba Central Prison is the maximum security prison with the highest prison population in Malawi. On average, it approximately houses 2500 prisoners in a facility meant for 800 prisoners. Zomba Central Hospital is a tertiary semi - urban referral hospital (catchment area 3.1 million) for the South East Health Zone in Zomba, Malawi. The data source was the National TB register where relevant patient level and clinical information for all patients diagnosed with active TB disease are put on anti-TB treatment regimens and monitored throughout the course of their treatment.

Operational definitions

According to the standard definitions of anti-tuberculosis treatment outcomes used in Malawi adopted from WHO, the following clinical case and treatment outcome operational terms were used:

Cured: A pulmonary TB patient with bacteriologically confirmed TB at the beginning of treatment who was smear- or culture-negative in the last month of treatment and on at least one previous occasion.

Treatment completed: A TB patient who completed treatment without evidence of failure but with no record to show that sputum smear or culture results in the last month of treatment and on at least one previous occasion were negative, because tests were not done or because results are unavailable.

Treatment failed: TB patient whose sputum smear or culture is positive at month 5 or later during treatment.

Died: TB patient who dies for any reason before starting or during the course of treatment.

Lost to follow-up: TB patient who did not start treatment or whose treatment was interrupted for 2 consecutive months or more.

Not evaluated: TB patient for whom no treatment outcome is assigned. This includes cases “transferred out” to another treatment unit as well as cases for whom the treatment outcome is unknown to the reporting unit.

Treatment success: sum of cured and treatment completed.

WHO defines treatment success as the sum of patients who are cured and those who have completed treatment therefore, treatment outcomes were categorized into the following:

- Successful outcome- if TB patients were cured or completed treatment with resolution of symptoms.
- Unsuccessful outcome – if there is TB treatment failure, default, or death.

However, patients who transferred out and not evaluated were excluded from the treatment outcome evaluation as information on their treatment outcome was unavailable.

Study Participants

All prisoners and non- prisoners aged 15 years and above who were diagnosed and put on TB treatment at the Zomba Central Prison and Zomba Central Hospital from January 2011 to December 2016 were included(Figure 1).

Ethical consideration

Ethical approval was obtained from the College of Medicine Research Ethics Committee (COMREC Reference No: P.05/18/2394). Individual informed consent was not sought since the study used fully

anonymized retrospective data. Prior written authorization was obtained from Zomba Central Hospital, Zomba District Health Office and Malawi Prison Services.

Data collection, management and analysis

We used routinely collected data extracted anonymously from the national standardized monitoring tools in ZCP and ZCH: TB register (age, sex, occupation, site of disease, history of previous treatment, type of diagnosis, treatment outcome, HIV test status, Anti – Retroviral Therapy {ART} and Cotrimoxazole Prophylactic Treatment {CPT} status). The data was collected in an anonymized way, entered into a data extraction sheet and then into the Access database then analyzed by STATA 13. Descriptive analysis was used to determine the patient characteristics and treatment outcomes. Chi squared tests was used to compare the characteristics between the subgroups. Bivariate logistic regression was used to assess associations between patient characteristics and poor treatment outcomes. The risk factors for poor TB treatment outcomes were analyzed using multivariate analyses adjusted for potential confounders. Odd ratios were provided with 95% confidence intervals and p-values (using a statistical significance level of <0.05).

Results

Socio-demographic and clinical characteristics of the patients

Table 1 shows the baseline characteristics of the 1652 registered adult TB patients .Twenty seven percent (27%) were prisoners (all males) and 72% were non-prisoners (58 % males). The median age was 35 years (IQR: 29 - 42); 76 % were Pulmonary TB cases (78 % among prisoners vs 75% among non-prisoners); of the 83 % were new TB cases (77% among prisoners vs 86% among non-prisoners); and 65 % were HIV positive (50 % among prisoners vs 71% among non – prisoners). Regarding treatment outcome, 1472 (89%) were cured and/or completed treatment (93% among prisoners vs 88 % among non – prisoners), 2(0.2%) were treatment failures, 122 (8%) died (5 % among prisoners vs 8 % among non – prisoners) and 55 (3%) were not evaluated (1% among prisoners vs 4% among non – prisoners). Age greater than 35 years (aOR = 0.68: 95% C.I: 0.58 – 0.80), Extra-Pulmonary TB (aOR=1.69: 95% C.I: 1.08 – 2.63), HIV positive status (aOR = 0.63: 95 % C.I: 0.42 – 0.94) were independent factors of unsuccessful TB treatment outcomes (Table 2).

Trend of the TB cases at the two facilities

The 5-year trend of the TB registration is shown in Table 1. The TB cases showed a remarkable increase at the Zomba Central Prison in 2016 while at the Zomba Central Hospital the number of TB registrations decreased steadily in the recent years.

Discussion

In this 5 year retrospective study, there was an overall 89% TB treatment success rate (cured plus completed treatment). Age greater than 35 years, HIV positive status and extra – Pulmonary TB were independently associated with unsuccessful TB treatment outcomes (death and treatment failure). In addition, it was found out that the prison only registered male TB patients over the course of the 5 years. There was a remarkable increase in the TB cases at the Zomba Central Prison in 2016 while at the Zomba Central Hospital, the TB cases had a steady decline over the 5 year study period.

The 89 % overall TB treatment Success Rate (TSR) is comparable to other studies done in resource limited settings and it is within reach of the End TB Strategy target of => 90 %. Similar studies conducted in the general population (from 2008 – 2010) at a Large District Hospital[10] and a Central Hospital[11] in Malawi showed an 86 % TSR and in Ethiopia[12]. This is also higher than the results from a study done in 2007 in 27 prisons in Malawi which showed a 73 % TSR[13] but it is comparable to recent studies done in prisons in Ethiopia[14] (89%, 90 %), but it is higher than TSR (66%) reported in Zambia[15] in 2010 – 2011 and TSR (48 %) Uganda[16] in 2011 to 2012, But slightly lower than the study done in South Africa[17] (92 %) and Ethiopia[14] (94 %). The higher TSR in prison than the general population might be attributed to the maximum security prisons where the prisoners are incarcerated for a longer sentences time are bound to be within the prison and within reach of the wardens for the DOTS(Direct Observed Treatment Strategy) [15]. The varied intra prison differences are because of the high turnover of prisoners, remandees as these prisoners are not yet sentenced and can be transferred out to another facility or released into the general public[15]. There is also poor linkage within prison facilities and with the communities as once prisoners are released into the community they are not adequately actively followed up for continuity of treatment[18,19].

This study showed an overall 2.6 % loss to follow-up which was lower than in other studies reported in similar limited resource setting in prisons in Uganda (43.0%) [16], and Brazil (13.0%) [20]. The lower rate of loss to follow up is attributed to the nature of prisoners incarcerated at the maximum security of the Zomba Central Prison therefore forming a stable prison population that is serving long term sentences hence not easily transferred or released anyhow[15].

The 5.5 % death rate is comparable to the death rate observed in Uganda prison[16] but higher than the 1.4 % death rate recorded in Ethiopia[14], 1.8 % death rate recorded in South Africa[17] and 2 % death rate recorded in Brazil[20]. This high death rate could attributed to the poor prison living conditions - overcrowding[18], poor nutrition[19] and possibly to the high burden of HIV co-infection without use of antiviral therapy (due to the lower coverage of antiretroviral therapy use during this time period), which has been shown to be associated with unsuccessful treatment outcome [10,21,22]. This study also showed that unsuccessful TB treatment outcome was associated with older age greater than 35 years old. Similar studies in Botswana and Nigeria have shown that older age may be confounded by the behavioral changes .e.g. alcohol and drug use which are rampant in prison settings and general population especially among men. This leads to poor adherence which result to poor treatment outcomes.

A traditional risk factor for unsuccessful TB treatment outcome, Extra Pulmonary TB was also found in this study due to the severe nature of the EPTB. The higher proportion of the EPTB at the Zomba Central Hospital than the Zomba Central Prison might explain the challenges in making the EPTB at the prison facilities due to the limited diagnostic capacity in the prison. However, our study demonstrated a remarkable increase in the number of TB cases in 2016 due to the TB mass screening which used a mobile X-ray unit in addition to the sputum smear microscopy and Expert MTB/Rif which ended up with a higher yield of TB cases showing that increased diagnostic capacity can yield more EPTB cases especially TB pleural effusions.

In this study, gender comparisons were not possible among prisoners and non-prisoners because the prison registered male TB patients only in the whole study period. Similar studies globally have shown unevenly distributed high proportions of male prisoners than female prisoners([19,23,24]). Globally, there has been no universally accepted explanation to this disparity and most criminology studies point to the socialized gender roles and different expectations of male and female behaviours[25]. In the sub-Saharan region, the high numbers of male prisoners might be contributing to the overcrowding in the male prison cells which is a predisposing factor for the spread of TB.

The general findings from this study support the need for prison reforms in order to improve the general prison health and TB outcomes[26]. Several strategies can be combined to yield successful efforts in the fight against TB in the prison setting. Mobile X-ray can be used in addition to the routine sputum tests to increase TB screening and case detection [24]. Since the TB treatment outcomes are worsened by HIV positive status without use of antiretroviral therapy[17,21,27] scaling up of the 3 phase integrated screening and treatment for HIV, TB and nutrition during entry, stay and exit of prison could increase access to HIV, TB and Nutritional screening and subsequent linkage to appropriate treatment services. Interventions involving the criminal justice system reforms aiming at reducing unnecessary arrests, community sentencing and improving efficiencies could help reduce the prison overpopulation which puts pressure on the already dwindling prison resources.

The strengths of this study include the following that we used routine program based data that is collected from the facility national TB registers which are used for TB patient registration, monitoring and evaluation from within a national public system. The data source was complete and all the outcomes were accounted for. We studied a large number of TB patients and the results are representative of the national situation. The study adhered to STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for the reporting of observational data.

Some noted limitations include the use of retrospective data in which other important risk factors for unsuccessful TB treatment outcomes were not assessed (smoking status, alcohol status, body mass index and TB drug side effects).

Conclusions

Good TB treatment outcomes which are comparable to the general population can be achieved among Malawian prisoners despite the challenging prison conditions due to the stable nature of the long serving prisoners in a maximum security prison. This calls for the increased efforts of TB case identification and treatment among the prisoners.

Abbreviations

ART: Antiretroviral Therapy

COMREC: College of Medicine Research Ethics Committee

CPT: Cotrimoxale Prevention Therapy

DI: Dignitas International

DOTS: Direct Observed Treatment Strategy

EPTB: Extra Pulmonary Tuberculosis

MDR-TB: Multi-Drug Resistant Tuberculosis

TSR: Treatment Success Rate

TB: Tuberculosis

WHO: World Health Organization

ZCH: Zomba Central Hospital

ZCP: Zomba Central Prison

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from The College of Medicine Research Ethics Committee (COMREC Reference No: P.05/18/2394). Individual informed consent was not sought since the study used fully anonymized retrospective data.

Consent for publication

Not applicable

Availability of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no conflict of interest.

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Authors' contributions

VS and EK designed the study and analyzed the data. VS and EK wrote the first draft of the manuscript. LC and WC contributed to subsequent drafts and have reviewed and agreed with the content of the final manuscript.

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Tables

Table 1: Socio-demographic and clinical characteristics of the patients

Characteristic	Total n (%)	Zomba Central Hospital, n (%)	Zomba Central Prison, n (%)	P-value(<i>Chi squared test</i>)
Total participants	1652	1200 (72.6)	452 (27.4)	
<i>Sex (N =1651)</i>				0.00
Male	1,148 (69.5)	697 (58.0)	451 (100..0)	
Female	503 (30.5)	503 (42.0)	0(0)	
<i>Age(N =1648)</i>				
Median(IQR)	35 (29.4)			0.00
15-24	196 (11.9)	138 (11.5)	58 (12.8)	
25-34	626 (38.0)	424 (35.3)	202 (44.7)	
35-44	488 (29.6)	350 (29.2.7)	138 (30.5)	
45-54	176 (10.7)	141 (12.0)	35 (8..0)	
=>55	162 (9.8)	145 (12.1)	17 (4.0)	
<i>TB Registration Year(N=1652)</i>				0.00
2011	286 (17.1)	212 (17.7)	74 (16.3)	
2012	302 (18.3)	246 (20.5)	56 (12.4)	
2013	250 (15.1)	201 (16.8)	49 (10.8)	
2014	270 (16.3)	193 (16.1)	77 (17.4)	
2015	255 (15.4)	178 (14.8)	77 (17.4)	
2016	289 (17.5)	170 (14.1)	119 (26.3)	
<i>TB Form(N=1652)</i>				0.00
Pulmonary TB(bacteriologically, clinically)	1257 (76.1)	904 (75.3)	353 (78.1)	
Extra-Pulmonary TB	395 (23.9)	296 (24.7)	99 (21.9)	
<i>TB Category(N=1652)</i>				0.00
New	1376 (83.3)	1027 (85.5)	349 (77.2)	
Relapse	79 (4.8)	46 (3.8)	33 (7.3)	
Return After Loss To Follow Up	4 (0.2)	4 (0.3)	0 (0)	
Failed	1 (0.1)	1 (0.1)	0 (0)	
Other	191 (11.6)	122 (10.2)	70 (15.5)	
<i>HIV Status(N=1652)</i>				0.00

Positive	1080 (65.4)	853 (71.1.0)	227 (50.2)	
Negative	530 (32.1)	319 (26.6)	211 (46.7)	
Unknown	42 (2.5)	28 (2.3)	14 (3.1)	
<i>TB treatment outcomes(N=1652)</i>				0.00
Cured	479 (29.0)	308 (25.6)	171 (37.8)	
Treatment Completed	993 (60.1)	743 (61.9)	250 (55.3)	
Treatment Failed	2 (0.2)	2 (0.2)	0 (0)	
Died	122 (8.1)	97 (8.0)	25 (5.5)	
Transferred Out	12 (0.7)	12 (1.0)	0 (0)	
Not Evaluated	43 (2.6)	37 (3.1)	6 (1.3)	

Table 2: Factors associated with unsuccessful treatment outcomes (death and treatment failure), n = 1597

le	Total (%)	Treatment Success	Unsuccessful Treatment	Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
3	486 (30.5)	444 (91.4)	42 (8.6)	1			
	1110 (69.5)	1027 (92.5)	83 (7.5)	1.17 (0.79 - 1.72)	0.43		
						0.68 (0.58 - 0.80)	0.00
	186 (11.7)	180 (96.8)	6 (3.2)	1			
	606 (38.0)	566 (93.4)	40 (6.6)	0.47 (0.20 - 1.13)	0.09		
	472 (29.6)	436 (92.4)	36 (7.6)	0.40 (0.17 - 0.97)	0.04		
	172 (10.8)	156 (90.7)	16 (9.3)	0.32 (0.12 - 0.85)	0.02		
	157 (9.9)	130 (82.8)	27 (17.2)	0.16 (0.06- 0.40)	0.00		
7						1.06 (0.62 - 1.79)	0.82
Central Prison	446 (27.9)	421 (94.4)	25 (5.6)	1			
Central Hospital	1151 (72.1)	1051 (91.3)	100 (8.7)	1.60 (1.01 - 2.51)	0.04		
Registration Year						0.92 (0.52 - 1.38)	0.98
	279 (17.5)	263 (94.3)	16 (5.7)	1			
	276 (17.3)	247 (89.5)	29 (10.5)	0.53 (0.27 - 1.03)	0.06		

	241 (15.1)	217 (90.0)	24 (10.0)	0.51 (0.26 - 1.00)	0.05		
	269 (16.8)	247 (90.2)	22 (8.2)	0.66 (0.33 - 1.30)	0.23		
	249 (15.6)	232 (93.2)	17(6.8)	0.90 (0.43 - 1.88)	0.78		
	283 (17.7)	266 (94.0)	17 (6.0)	0.91 (0.44 - 1.86)	0.79		
m						1.69 (1.08 - 2.63)	0.01
ary TB	1,214 (76.0)	1,130 (93.1)	84 (6.9)	1			
ulmonary TB	383 (24.0)	342 (89.3)	41 (10.7)	1.61 (1.08 - 2.38)	0.02		
egory						0.97 (0 .67 - 1.40)	0.88
	1332 (83.4)	1233 (92.6)	99 (7.4)	1			
e/ Return After Loss low Up/Failed	78 (4.9)	76 (97.4)	2 (2.6)	3.04 (0 .73 - 12.59)	0.12		
	186 (11.7)	162 (87.0)	24 (13.0)	0.54 (0 .33 - 0 .87)	0.01		
atus						0 .63 (0.42 - 0.94)	0.02
ve	518 (32.4)	497 (96.0)	21 (4.0)	1			
e	1042 (65.3)	944(90.6)	98 (9.4)	0.40 (0.25 - 0.66)	0.00		

Figures

Figure 1

Study flow chart