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*Full Length Research Paper*

# High prevalence and poor treatment outcome of tuberculosis in North Gondar Zone Prison, Northwest Ethiopia

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**The aim of this study was to assess the trend of tuberculosis (TB) prevalence and treatment outcome in a prison system of Northwest Ethiopia. Patients' data on age, sex, TB type, treatment outcome and human immunodeficiency virus (HIV) status was collected from medical records of North Gondar Zone Prison TB Clinic for all patients with TB from 2002 to 2011. The data was analyzed using Statistical Package for Social Sciences (SPSS) version 16. The prevalence of all forms of TB during the ten years ranged from 579 to 2623 per 100,000 populations. The highest treatment success rate, 80% was observed in the year 2002, whereas the lowest treatment success rate, 42% was observed in the year 2004. A total of 114 TB patients were screened for HIV from 2009 to 2011, of which 14 (12.3%) were HIV positive. The prevalence of TB/HIV co-infection ranged from 163 per 100,000 populations in 2009 to 288 per 100,000 populations in 2010. There were high prevalence rates of TB and TB/HIV co-infection among the inmates of North Gondar Zone Prison with poor treatment success rates in comparison to the national figure and world health organization (WHO) target.**

**Key words:** Tuberculosis prevalence, treatment outcome, prison, tuberculosis/human immunodeficiency virus (TB/HIV) co-infection.

## INTRODUCTION

Prisons are not mere static venues holding large populations. They represent dynamic communities where at-risk groups congregate in a setting that exacerbates disease and its transmission, including tuberculosis (TB). Prevalence rates of TB in prisons usually exceed the rates in the specific country substantially and can reach up to 50 times higher than national averages (Baussano et al., 2010; WHO, 2007). In line with this, a study from three major prison settings of Eastern Ethiopia showed a very high prevalence of pulmonary TB, about seven times higher than that of the general population (Abebe et al., 2011).

Routine recording and reporting of the number of TB cases diagnosed and treated, and monitoring of the outcomes of treatment was one of the five elements of TB control emphasized in the directly observed

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treatment, short course (DOTS) strategy, and remains one of the core elements of the Stop TB Strategy (WHO, 2001). DOTS as a strategy was introduced to the TB control programme at North Gondar Prison Administration TB clinic in 2002. Nevertheless, achieving the main goals of the DOTS in prisons would be very difficult for prison inmates since they will be freed every time, some of them under treatment for TB. There is a high chance to disappear into the countryside where it is usually difficult to trace and link with the existing health system. Furthermore, even within the prison system, many prisoners would be transferred to other prisons without effective follow up system.

To our knowledge, there was no enough study conducted on trend of TB prevalence and TB treatment outcome in Ethiopian prison inmates. Therefore, this study was conducted to assess the ten years trend of TB prevalence and treatment outcome among prison inmates of North Gondar Zone Prison, Northwest Ethiopia.

## MATERIALS AND METHODS

North Gondar Zone Prison Administration is located to the eastern part of the Gondar city which currently accommodates 1754 prison inmates, 1716 men and 38 women. It has got one clinic rendering service to the prison inmates and the prison staff. The clinic also provides TB and HIV diagnostic and treatment services to the inmates and the staff. The medical charts for all the prison inmates who were diagnosed with TB in the prison from 2002 to 2011 were thoroughly reviewed. The medical records of all the 321 TB patients seen in North Gondar Zone Prison were examined. The registration documents reviewed contain basic information, such as patient's age, sex, TB type, treatment outcome and HIV status. Data was analyzed based on TB type (smear-positive pulmonary TB, smear-negative pulmonary TB, extra-pulmonary TB), treatment outcome (cured, completed, defaulted, relapse, death, transferred out), and HIV sero-status.

### Definition

According to the standard definitions of the National Tuberculosis and Leprosy Control Program guideline (NTLCP) adopted from WHO (Ministry of Health of Ethiopia 2008), the following clinical case and treatment outcome definitions were used.

#### *Pulmonary TB, smear-positive*

A patient with at least two sputum specimens which were positive for acid-fast bacilli (AFB) by microscopy, or a patient with only one sputum specimen which was positive for AFB by microscopy, and chest radiographic abnormalities consistent with active pulmonary TB.

#### *Pulmonary TB, smear-negative*

A patient with symptoms suggestive of TB, with at least two sputum specimens which were negative for AFB by microscopy, and with chest radiographic abnormalities consistent with active pulmonary TB (including interstitial or miliary abnormal images), or a patient with two sets of at least two sputum specimens taken at least two weeks apart, and which were negative for AFB by microscopy, and radiographic abnormalities consistent with pulmonary TB and lack of clinical response to one week of broad spectrum antibiotic therapy.

#### *Extrapulmonary TB (EPTB)*

This included TB of organs other than the lungs, such as lymph nodes, abdomen, genitourinary tract, skin, joints and bones, meninges, etc. Diagnosis of EPTB was based on fine needle aspiration cytology or biochemical analyses of cerebrospinal/ pleural/ascitic fluid or histopathological examination or strong clinical evidence consistent with active extrapulmonary TB, followed by a decision of a clinician to treat with a full course of anti-TB chemotherapy. In all the cases of EPTB, sputum examinations and chest radiographs were used to investigate the involvement of lung parenchyma.

#### *Treatment outcome*

The treatment outcome was divided into seven categories according to NTLCP guideline. These categories were: cured (finished treatment with negative bacteriology result at the end of treatment), completed treatment (finished treatment, but without bacteriology result at the end of treatment), failure (remaining smear positive at five months despite correct intake of medication), defaulted treatment (patients who interrupted their treatment for two consecutive months or more after registration), died (patients who died from any cause during the course of treatment), transferred out (patients whose treatment results are unknown due to transfer to another health facility) and successfully treated (A patient who was cured or completed treatment).

#### *Treatment success rate (TSR)*

It is the sum of the percentages of cure and treatment completed rounded off to the nearest digit (WHO, 2001).

### Statistical analysis

Data were entered and analyzed using SPSS version 16. The prevalences of TB and HIV were calculated taking the whole prison population during the respective years. P value less than 0.05 was taken as significant.

### Ethical issues

Institutional ethical clearance was obtained from the Institutional Review Board of University of Gondar. Permission from the prison authorities was also obtained before the start of the study. All patients' information was kept strictly confidential.

## RESULTS

The number of inmates in North Gondar Prison ranged from 1429 to 2085 during the ten years period with a mean of 1728. During the study period, 321 TB cases were reported and given treatment according to the national guideline. Majority, 311 (96.9%) were male. The mean (±standard deviation (SD), range) age of the TB

**Table 1.** Distribution of TB types (n=321), North Gondar Zone Prison, 2002-2011.

| Year | SP TB [N (%)] | SN TB [N (%)] | EPTB [N (%)] | Total [N (%)] |
|---|---|---|---|---|
| 2002 | 1 (10) | 4 (40) | 5 (50) | 10 (3.1) |
| 2003 | 4 (12.9) | 18 (35.5) | 16 (51.6) | 31 (9.7) |
| 2004 | 6 (17.6) | 11 (55.9) | 9 (26.5) | 34 (10.6) |
| 2005 | 3 (10) | 21 (66.7) | 6 (20) | 30 (9.3) |
| 2006 | 2(6.4) | 23 (74.2) | 6 (19.4) | 31 (9.7) |
| 2007 | 1(3.6) | 16 (53.6) | 11 (39.3) | 28 (8.7) |
| 2008 | 7 (15.9) | 22 (50) | 15 (34.1) | 44 (13.7) |
| 2009 | 6 (15.4) | 22 (56.4) | 11 (28.2) | 39 (12.1) |
| 2010 | 4 (14.3) | 17 (60.7) | 7 (25) | 28 (8.7) |
| 2011 | 4(8.7) | 28 (58.7) | 15 (32.6) | 46 (14.3) |
| Total | 38(11.8) | 182 (56.7) | 101 (31.5) | 32 (100) |

TB: Tuberculosis; EPTB: extrapulmonary tuberculosis; N: number; SP: smear positive; SN: smear negative.

**Table 2.** Prevalence of all forms of TB per 100,000 populations in comparison to that of the general population in North Gondar Zone Prison, 2002 to 2011.

| Year | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| Prevalence of TB at the prison per 100,000 population | 579 | 2257 | 1505 | 1736 | 2169 | 1812 | 2557 | 2124 | 1343 | 2623 |
| Prevalence of TB at the general population per 100,000 population | 370 | 520 | 533 | 546 | 641 | 579 | 432 | 406 | 394 | 578 |
| TB in prisons/TB in the general population | 1.6 | 4.3 | 2.8 | 3.2 | 3.4 | 3.1 | 5.9 | 5.2 | 3.4 | 4.5 |

TB: Tuberculosis.

positive inmates was 34 (±13.9, 12 to 87) years. Most, 249 (77.6%) were new cases, but there were 4 (1.2%) defaulters and 5 (1.6%) relapses. TB type was categorized as smear positive pulmonary TB in 38 (11.8%), extra pulmonary TB in 101 (31.5%), and smear negative pulmonary TB in 182 (56.7%) (Table 1).

The prevalence of all forms of tuberculosis per 100,000 populations during the ten year period ranged from 579 in 2002 to 2623 in 2011. It was consistently increasing throughout the years and was also higher than the report for the general population (Table 2).

TB treatment outcome was categorized as cured 20 (6.2%), completed 158 (49.5%), defaulted 9 (2.8%), died 10 (3.1%) and transferred out 124 (38.6%). The TSR was calculated for all the ten years. The highest TSR, 80% was observed in 2002 and the lowest TSR, 42% was observed in the year 2004. The prison TSR was lower than the national TSR and WHO target throughout the study period except for the year 2002 (Table 3).

Provider initiated HIV counseling and testing for the TB positive inmates was performed over three years from 2009 to 2011. From the total of 113 screened TB positive inmates, 14(12.4%) were HIV positive. The prevalence of HIV infection was found to be 3/39 (7.7%), 6/28 (21.4%) and 5/47 (10.6%) in the years 2009, 2010 and 2011, respectively. The prevalence of TB/HIV co-infection was 163, 288 and 285 per 100,000 populations (Table 4).

## DISCUSSION

It has been reported that prevalence rates of TB in prisons are usually higher than national averages (Baussano et al., 2010; WHO, 2007). This was reflected in the current study by the high prevalence rate of TB throughout the years ranging from 579/100,000 population in 2002 to 2623/100,000 population in 2011. The high TB prevalence rate observed in this study in the prison setting was also in agreement with the prevalences in the prisons of Eastern Ethiopia which is 1913/100,000 populations (Abebe et al., 2011). However, studies from Zambia, Botswana, Russia and Georgia showed much higher prevalences (Habeenzu et al., 2007; CDC, 2003; Slavuckij et al., 2002; Aerts et al., 2000). On the other hand, lower prevalences were reported from prisons of Asian and European countries, 568/100,000 in Thailand, 259/100,000 in Taiwan, 341/100,000 in Turkey and 215/100,000 in France (Sretrirutchai et al., 2002; Chiang et al., 2002; Hanau-Berçot et al., 2000; Kiter et al., 2003). The low prevalence in these countries could be due to a good TB control strategy in the general population as well as in their prisons. Nevertheless,

**Table 3.** Treatment outcome and TSR of the TB patients at North Gondar Zone Prison, 2002 to 2011.

| Year | Treatment outcome | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Cured [N (%)] | Completed [N (%)] | Defaulted [N (%)] | Died [N (%)] | Transferred out [N (%)] | Total [N (%)] | TSR at the prison (%) | TSR at the general population (%) |
| 2002 | 0 (0) | 8 (80) | 0 (0) | 0 (0) | 2 (20) | 10 (3.1) | 80 | 76 |
| 2003 | 3 (7.7) | 16 (41) | 1 (2.6) | 1 (2.6) | 17 (43.6) | 39 (12.2) | 49 | 70 |
| 2004 | 2 (7.7) | 9 (34.6) | 0 (0) | 2 (7.7) | 13 (50) | 26 (8.1) | 42 | 79 |
| 2005 | 2 (6.7) | 13 (43.3) | 0 (0) | 5 (16.7) | 10 (33.3) | 30 (9.4) | 50 | 78 |
| 2006 | 1 (3.2) | 14 (45.2) | 2 (6.5) | 0 (0) | 14 (45.2) | 31 (9.7) | 48 | 84 |
| 2007 | 0 (0) | 13 (46.4) | 0 (0) | 0 (0) | 15 (53.6) | 28 (8.7) | 46 | 84 |
| 2008 | 4 (9.1) | 17 (38.6) | 6 (13.6) | 1 (2.3) | 16 (36.4) | 44 (13.7) | 48 | 84 |
| 2009 | 2 (5.1) | 27 (69.2) | 0 (0) | 0 (0) | 10 (25.6) | 39 (12.1) | 74 | 84 |
| 2010 | 3 (10.7) | 13 (46.4) | 0 (0) | 0 (0) | 12 (42.9) | 28 (8.7) | 57 | 84 |
| 2011 | 3 (6.5) | 28 (60.8) | 0 (0) | 1 (2.2) | 15 (32.6) | 46 (14.3) | 67 | 84 |
| Total | 20 (6.2) | 158 (49.2) | 9 (2.8) | 10 (3.1) | 124 (38.6) | 321 (100) | - | - |

N: Number; TB: tuberculosis; TSR: treatment success rate.

**Table 4.** Distribution and prevalence of TB/HIV co-infection at North Gondar Zone Prison, 2009-2011.

| Year | HIV status of the TB patients | | Total N | TB/HIV prevalence (per 100,000 populations) |
|---|---|---|---|---|
| | Positive [N (%)] | Negative [N (%)] | | |
| 2009 | 3(7.7) | 36(92.3) | 39 | 163 |
| 2010 | 6(21.4) | 22(78.6) | 28 | 288 |
| 2011 | 5(10.6) | 42(89.4) | 47 | 285 |
| Total | 14(12.3) | 100(87.7) | 114 | - |

HIV: Human immunodeficiency virus; TB: tuberculosis; N: number

the high prevalence of TB in the study area could pose problems to the TB control in the general population as TB from prisoners may spread through visitors into the community. Characterization of the associated factors for the high prevalence with a subsequent improvement of the TB control system in the prison could impact on the TB control in the community.

This study also showed that smear positive pulmonary TB was found in only 11.8% of the cases. The reason for this low smear positivity might be due to the poor prison laboratory facilities, inadequate training of laboratory personnel in the prison TB clinic, and by the overall low case detection rate (31 to 38%) in Ethiopia (WHO, 2011). On the other hand, the proportion of smear negative pulmonary TB cases was consistently high throughout the study period (35.7 to 74.2%) and remained the highest as compared to smear positive and EPTB cases over the years (except in 2003 where EPTB was the highest) (Table 1). The large number of smear negative pulmonary TB cases could be due to the poor laboratory facility and high proportion of TB/HIV co-infection. The overall situation obviates the need of strong capacity building in prison health systems and policy commitment towards improving the extremely low smear positivity.

The trend of TSR during the ten years was below the national TSR and the WHO target (Table 2) (WHO, 2007, 2011, 2004, 2005, 2006, 2008, 2009). While the most effective means of breaking the transmission chain, and thus preventing infection and possible disease in the rest of the community, is to provide appropriate treatment to cure existing cases, the prison's TSR is alarmingly low facilitating transmission and development of drug resistance. The low TSR could be explained, however, by the high transferred out rate of the TB positive inmates to another prison or health institution through the study period. This result, then, emphasizes the necessity of improved DOTS and zonal TB control program in the prison.

Death and default were recorded in five and three of the ten years, respectively. This study also revealed a consistently high transferred out of the prisoners throughout the ten years ranging from 20% in 2002 to 53.6% in 2007. The transfer could be to another prison in the country or after freedom to the nearby health institutions where the prisoners live. Since there are no systems which help to trace and know the final treatment outcome of the transferred out patients, there is a chance they could end up with default, death or treatment failure. If default or treatment failure happened to be the outcome, development and spread of drug resistance to

the community could be the immediate repercussion. On the other hand, as prisoners might face difficulties to return to their home in fear of the victims, they may flee to other areas where they cannot access TB treatment. This could then result into default and subsequently to drug resistance. The result of this study then underscores the importance of studying TB treatment outcome of several prison systems in the region where prisoners are interchanged frequently including the health institutions where the prisoners live after freedom. Devising a mechanism to trace and know the final treatment outcome of the transferred out TB cases could also be of paramount importance in terms of TB control program.

The prevalence of TB/HIV co-infection was found to be high throughout the three years ranging from 163 per 100,000 populations in 2009 to 288 per 100,000 populations in 2011. The prevalence of TB/HIV co-infection in other African prisons ranges from 7700 to 21400 per 100,000 populations which is much higher than the results of this study (Martin et al., 1994; Chaves et al., 1993). Nevertheless, the prevalence rates in all the three years were very high demanding a fair share of attention from all concerned parties.

The major limitations of this study were that the HIV status of the prison inmates treated for TB before September 2009 was not found, since there was no HIV screening service in the prison's TB/HIV clinic.

## Conclusion

There was a high prevalence of TB with very low smear positivity and very low TSR in the North Gondar Zone Prison. The high rate of transferred out without subsequent follow up systems, fairly high mortality and TB-HIV co-infections in the prison demand urgent response from all responsible bodies. Hence, TB control programs should give special emphasis towards prison health systems so as to increase case detection rate through periodic active screening for TB and HIV; strengthen DOTS programme to improve the treatment success rate; and establish efficient referral and contact tracing mechanisms for transferred out cases.

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### REFERENCES

Abebe DS, Bjune G, Ameni G, Biffa D, Abebe F (2011). Prevalence of pulmonary tuberculosis and associated risk factors in Eastern Ethiopian prisons. Int. J. Tuberc. Lung Dis. 15(5):668-73.

Aerts A, Habouzit M, Mschiladze L, Malakmadze N, Sadradze N, Menteshashvili O, Portaels F, Sudre P (2000). Pulmonary tuberculosis in prisons of the ex-USSR state Georgia: results of a nation-wide prevalence survey among sentenced inmates. Int. J. Tuberc. Lung Dis. 4(12):1104-10

Baussano I, Williams BG, Nunn P, Beggiato M, Fedeli U, Scano F (2010). Tuberculosis incidence in prisons: a systematic review. PLoS Med 7: e1000381.

Centers for Disease Control and Prevention (CDC) (2003). Rapid assessment of tuberculosis in a large prison system--Botswana, 2002. MMWR Morb Mortal Wkly Rep. 52(12):250-2.

Chaves F, Dronda F, Gonzalez Lopez A, Fernandez Gonzalez F, Catalan S (1993). Tuberculosis in a prison population: a study of 138 cases. Med. Clin. (Barc) 101: 525-29.

Chiang CY, Hsu CJ, Hsu PK, Suo J, Lin TP (2002). Pulmonary tuberculosis in the Taiwanese prison population. J. Formos Med. Assoc. 101(8):537-41.

Habeenzu C, Mitarai S, Lubasi D, Mudenda V, Kantenga T, Mwansa J, Maslow JN (2007). Tuberculosis and multidrug resistance in Zambian prisons, 2000-2001. Int. J. Tuberc. Lung Dis. 11:1216-20.

Hanau-Berçot B, Grémy I, Raskine L, Bizet J, Gutierrez MC, Boyer-Mariotte S, Brégeault A, Lagrange PH, Sanson Le Pors MJ (2000). A one-year prospective study (1994-1995) for a first evaluation of tuberculosis transmission in French prisons. Int. J. Tuberc. Lung Dis. 4(9):853-9.

Kiter G, Arpaz S, Keskin S, Sezgin N, Budin D, Seref O (2003). Tuberculosis in Nazilli District Prison, Turkey, 1997-2001. Int. J. Tuberc. Lung Dis. 7(2):153-8.

Martin V, Gonzalez P, Cayla JA, Mirabent J, Cañellas J, Pina JM, Miret P (1994). Case-finding of pulmonary tuberculosis on admission to a penitentiary centre. Tuberc. Lung Dis. 75: 49-53.

Ministry of Health of Ethiopia (MOH) (2008) Tuberculosis, Leprosy and TB/HIV Prevention and Control Programme Manual. Addis Ababa: MOH 4th edition. 2008. (Treatment of tuberculosis guidelines, 4th ed. Geneva, World Health Organization (WHO/HTM/STB/2009.420).)

Slavuckij A, Sizaire V, Lobera L, Matthys F, Kimerling ME (2002). Decentralization of the DOTS programme within a Russian penitentiary system. How to ensure the continuity of tuberculosis treatment in pre-trial detention centers. Eur. J. Public Health 12(2):94-8.

Sretrirutchai S, Silapapojakul K, Palittapongarnpim P, Phongdara A, Vuddhakul V (2002). Tuberculosis in Thai prisons: magnitude, transmission and drug susceptibility. Int. J. Tuberc. Lung Dis. 6(3):208-14.

World Health Organization (WHO) (2001). Global WHO Report 2001. Tuberculosis Control. Country Profile: Ethiopia Available at: http://www.who.int/tb/publications/global_report/2001/pdf/eth.pdf.

World Health Organization (WHO) (2011). WHO Report 2011. Global Tuberculosis Control. Country Profile: Ethiopia Available at: http://www.who.int/tb/publications/global_report/2011/pdf/eth.pdf.

World Health Organization (WHO) (2004). WHO Report 2004. Global Tuberculosis Control. Country Profile: Ethiopia Available at: http://www.who.int/tb/publications/global_report/2004/pdf/eth.pdf.

World Health Organization (WHO) (2005). WHO Report 2005. Global Tuberculosis Control. Country Profile: Ethiopia Available at: http://www.who.int/tb/publications/global_report/2005/pdf/eth.pdf.

World Health Organization (WHO) (2006). WHO Report 2006. Global Tuberculosis Control. Country Profile: Ethiopia Available at: http://www.who.int/tb/publications/global_report/2006/pdf/eth.pdf.

World Health Organization (WHO) (2008). WHO Report 2008. Global Tuberculosis Control. (WHO/HTM/TB/2008.393), Country Profile: Ethiopia Available at: http://www.who.int/tb/publications/global_report/2008/pdf/eth.pdf.

World Health Organization (WHO) (2009). WHO Report 2009. Global Tuberculosis Control. Country Profile: Ethiopia. Available at: http://www.who.int/tb/publications/global_report/2009/pdf/eth.pdf.

World Health Organization (2007). WHO Report 2007. Status Paper on Prisons and Tuberculosis. Copenhagen, World Health Organization, Geneva.