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Prevalence and Associated Risk Factors of Pulmonary Tuberculosis Among Prisoners in Benishangul Gumuz Region, Ethiopia

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Abstract: *Background*: Prison systems worldwide are known as hotspots for the concentration and dissemination of tuberculosis (TB). The prevalence of TB in prisons can to be 10 to 100-fold higher than in the general population. *Methods*: A cross sectional study was conducted among inmates and staffs from August to October 2018. About 214 presumptive TB cases had undergone the interviewee and GeneXpert test was used for the diagnosis of TB. The factors associated with TB were evaluated using bivariate and multivariate analyses. *Result*: Of the 214 study participants, 2PTB patients were already diagnosed and on treatment before the study, 212were tested using GeneXpert resulting in 5 (2.3%) new MTB cases. Together with the 2PTB patients, the overall prevalence of PTB was 279 per 100,000 inmates, which is about 1.7 higher than in the general Ethiopia population. Pulmonary tuberculosis was statically significantly associated with imprisonment with known TB patient in same room (AOR=36, 95%CI=(4.1, 321)), and with cough for 3 months or more (AOR=230, 95%CI=(68.4, 2220). Those who had stayed for more than 3 months of imprisonment with a known TB patient were 20 times more likely to have PTB as compared to less months (AOR=20.1, 95%CI=(2.01, 201). *Conclusion*: The study confirmed the high TB burden in prisons and suggests there is ongoing transmission. Imprisonment history and morbidity factors were identified to be the underlying causes of the high TB transmission and active TB infection. Therefore, implementation of effective TB control and prevention measures could help reduce TB in prison.

Keywords: Ethiopia, Factors**,** Presumptive, Prevalence, Prisoners, Tuberculosis

1. Introduction

Prisons are regulated but not closed systems, due to the numbers of people who constantly enter, leave and re-enter into them. Therefore, prison health is a critical part of public health as health problems within and outside prisons are interrelated [1]. Literature reveals successful TB control program requires effective TB control in prisons and failure to control TB in prisons has the potential to disrupt community TB control programs [2]. Prisons are increasingly becoming ideal breeding grounds for the concentration and dissemination of TB including multidrug-resistant TB [MDR-TB], from which infection is transmitted to the general population that if people are released while on treatment and not well taken care of and people not detected who leave the prison with TB [3, 4].

According to the WHO, the prevalence of TB in prisons is very high, 10-to 100-fold higher than in the general population and can be up to 25% of the TB burden in a given country [5]. A high level of multidrug resistance has also been reported from prison settings [5]. Ethiopia ranks among the top countries in Africa with a large prison population having an estimated prison population rate of 128 per 100,000 populations [6].

The National surveillance system provides aggregated data and data from prison is not separately reported. Therefore, information on the burden of TB in Ethiopian prisons can only be obtained from different studies and limited work has been published on TB in prisons in Ethiopia. The data that are available indicate the high risk of TB occurrence in such settings, with the average TB prevalence in prison inmates being much higher than in the general population but also suggesting a great variability of prevalence among different prisons. Studies done in Eastern Ethiopia Prisons [7] suggested that the observed variability and the higher TB burden in prisons located further from the capital could be due to extent to which the national TB control measures reach the prison, as they might not similarly have been implemented in all prisons.

Benishangul Gumuz region is one of deprived regions of Ethiopia and has low TB case detection, which at 50% is much lower than the national level of 71% [8]. The regional health bureau annual report indicated the need to improve TB control measures in prisons/congregate settings of the region for the potential high TB burden in prisons. Therefore this study was designed with the purpose to detect TB cases residing within the prison and to determine the prevalence and associated risk factors like socio-demographic, behavioral and prison…etc. related factors of pulmonary tuberculosis and DR-TB cases among prisons in Benishangul Gumuz Region.

Therefore, this study will investigate prevalence and associated risk factors of pulmonary tuberculosis and DR-TB cases among the prison population in Benishangul Gumuz Region. This study will produce important results for decision makers, for planners, for providers and other stakeholders. The study will also be used as a baseline to start a control program of entry screening and periodic mass screening. Hence the study will help to collect the evidence to support and improve TB prevention and control interventions for prisons in the region as well as in other similar settings of the country.

2. Methods and Materials

2.1. Study Setting

Benishengul-Gumuz regional state is one of the nine national regional states of Ethiopia, which is located in the northwest part of the country. Its capital Assosa is located 661 km away from the national capital Addis Ababa. The region is administratively divided in to three zones, 20 woredas, one town administration and 475 kebeles. The region has a total population of 1,066,001. There are three prisons in the region which in total have over 2513 prisoners. The three prisons are located in the three zonal towns of Kamashi, Metekel and Assosa administrative seats of the regional governments of Benishangul Gumuz region.

These prisons have a dedicated clinic for the prisoners with diagnosis and treatment services for TB and HIV. According to the 2010 E.C Benishangul Gumuz regional health bureau report, the estimated case detection rate for the region was 53% which is far from the national target of 72%. Case detection in the region prisons was even lower (23%) [8].

2.2. Study Design

A cross sectional study was conducted to determine the prevalence of pulmonary and rifampicin resistance TB in prisons and identify associated risk factors for TB/DR-TB among prisoners from August 2018 to October 2018 in Benishangul Gumuz region of Ethiopia.

2.3. Population

2.3.1. Source Population

All the three prisons found within the region with a total 2513 prisoner and prison staffs population are the source population

2.3.2. Study Population

Prison population who had sign and symptoms and pulmonary TB (presumptive TB) cases and those are on treatment during data collection period. Those Pulmonary tuberculosis cases who were already on treatment were only interviewed and included as cases in the burden estimation.

2.4. Sampling Procedure

Sample size was calculated using a single proportion formula.

Where, P is the estimated prevalence of TB among the study population and the degree of precision is represented by d. With an assumption of d=0.05, α=0.05, and $P = 0.22$ since there are documented evidence about the magnitude of TB in other similar setting 21.9% [9], the total sample size required for the study was therefore be 248 presumptive cases to be tested.

About 2393 (95.2%) participated in a symptomatic based mass screening to identify presumptive TB/DRTB TB cases. Initially it was assumed that the total sample size required for the study was 248 presumptive TB/DR-TB cases. Based on this assumption presumptive TB cases were assigned proportional to Prisons populations. Accordingly 94, 78 and 42 individuals from Gilgelbelese, Assosa and Kamashi prisons respectively, who were presumptive TB cases and those who were already on Anti- TB treatments were found and included in this study. All these presumptive cases had undergone the interviewee, diagnostic test with GeneXpert MTB/RIF assay tests. Hence in the study a total of 214 screening result positives were found in the three prisons which is 86% of the targeted sample size.

2.5. Inclusion & Exclusion Criteria

2.5.1. Inclusion

(i). For Interviewee

Prisons and prison staffs who had sign and symptoms of pulmonary TB were included

(ii). For Diagnostic Test

Inmates with any cough of 2 weeks or more (or any duration if known HIV positive with or without sputum production), fever, chest pain, with current or previous TB treatment, unexplained weight loss for last 3 months, known contact with TB patient and loss of appetite were included and asked to submit one morning sputum sample for testing with GeneXpert MTB/RIF assay.

2.5.2. Exclusion

Inmates who were severally ill, unable to communicate or had a mental disorder were excluded.

2.6. Variables

2.6.1. Dependent Variable

Status of TB.

2.6.2. Independent Variables

Socio- demographic variables, duration of stay in prison, cell block/crowd, previous TB status, HIV status, history of TB treatment and presence of common sign and symptoms of TB are independent variables.

2.7. Data and Sample Collection Procedure

Three teams consisting of two nurses and health officer were assigned as data collectors, and also a laboratory technologist for sputum sample collection and a health officer/BSc nurse as a supervisor were involved. Prior to the beginning of the data collection activity, all research teams; data and sample collectors and supervisors were trained on an overview and objective of the study and exhaustively on the study questionnaire.

For data collection and analysis, am Identification number/code was assigned for each prison and all participants included in the study were subsequently numbered. Primarily, registration of all prison inmates and prison wardens were undertaken in each prison. After registration was completed and consent was obtained; all the prisoners and staffs were interviewed using a pre-tested and standardized questionnaire which was adopted from National guideline and previous studies. Questionnaires were prepared initially in English and then translated to Amharic for data collection and then back to English.

Participants having any of the presumptive PTB symptoms were requested to give a morning sputum sample for GeneXpert MTB/RIF test using the standard TB Laboratory test and result request form.

Thus, one sputum sample about 2-4 ml of purulent (mucoid) were collected from every presumptive TB/DRTB inmate's using a sterile falcon tube and samples were transported to Benishangual Gumuz regional laboratory center and Pawe hospital testing centers based on proximity to prisons by triple packaging system.

2.8. Data Quality Assurance Plan

Prior to data collection 3 days training was given to data and sample collectors. Standardized and pre-tested questionnaire was used. The questionnaire which was initially prepared in English was translated to working language, which is in to Amharic for interviewee and then back to English for analysis. Close monitoring of the data collection process was conducted by the PIs and supervisors. The most important task was establishing trust and responsibility with data collectors that could assure the quality of data. Collected data and code of the participant was closely kept by the principal investigators and supervisors. Well experienced and qualified laboratory technologists were recruited and used for sample collection and testing at GeneXpert sites.

To maintain the quality and integrity of specimens; samples collected from Kamashi and Asossa Prisons were transported to the Benishangul Gumuz regional laboratory testing center located at Assosa town and samples from gilgelbeles prison were transported to Pawie general hospital testing laboratory for GeneXpert MTB/RIF assay, using the recommended triple packaging system. All the standard precautions were applied to reduce contamination of samples and enhance the recovery of mycobacterium.

To assure the quality of GeneXpert test; testing was performed by a senior Laboratory technologist trained on GeneXpert MTB/RIF and standard operating procedures for GeneXpert testing were followed. Unsuccessful GeneXpert test results (errors, invalid and no result) was monitored by module and user type. In case of errors, invalid and no result tests results, testing was repeated using a new morning sample. To avoid transcription related errors automatic print out results were used.

2.9. Data Processing and Analysis

Data was collected using standardize paper questionnaire to collect necessary information, for screening presumptive TB symptoms/cases and laboratory request form was used for presumptive pulmonary TB suspects/cases to evaluate TB. The data entered in a SPSS version 20.0. Prior to analysis data was checked for completeness by running frequency and appropriate clean was done.

Data was summarized and presented using tables and graphically. The relationships between risk factors and TB were evaluated using bivariate and multivariate analyses. A p-value of <0.05 is considered as significant. A logistic regression analysis performed to determine significant risk factors for TB disease among inmates and odds ratios were used as measure of effect with corresponding 95% confidence interval.

2.10. Ethical Approval

The study was first approved by the research ethics committees of the Benishangul Gumuz regional health bureau. All participants were asked to written consent to voluntary participation. Study procedures were explained to the participants by trained nurses, and participant information sheets read out by data collectors by working language. Their understanding was ascertained prior to obtaining consent by asking participants to repeat back in their own words, their

understanding of the study and procedures if they took part. Consent was specifically sought to undertake antibody HIV testing from study participant. Participants were informed able to refuse at any time with no consequences to their healthcare or any other services as a result of this. TB patients were initiated treatment and linked to TB clinics.

Table 1. *Multivariate analysis for factors and PTB among prison of Benishangul Gumuz Region, Oct. 2018 (N=214).*

Variables	MTB Detected		Crude OR, 95% CI for Exp (B)	Adjusted OR, 95% CI for Exp (B)	P-Value
	yes	No			
Duration of cough in months					
1-4	1	206	1		<0.001
>4	6	1	236 (68.9 - 2220)	230 (68.4 - 2220)	
Imprisoned with Known TB patient in same room					
No	1	175	1.00	1	0.001
Yes	6	32	38 (4.5-330)	36 (4.1- 321)	
Length of imprisonment with known TB patient in same room					
1-3 months	1	28	1.00	1.00	0.009
> 3months	5	4	21.7 (2.1-221)	20.1 (2.0-201)	
Cough with sputum					
No	0	36	1	1	0.36
Yes	7	171	3.95 (0.9-18.5)	3.1 (0.7-24.6)	

3. Result

3.1. Baseline Characteristics

In this study, from the total of 2513 inmate incarcerated and staffed in the 3 different prisons, 2393 (95.2%) underwent presumptive TB symptom screening. Of all 2393, about 2159 (90.2%) were prisoners, while the rest 234 (9.7%) were prison staffs/wardens. Similarly, the number and proportion of prison populations participated in a symptomatic based mass TB screening by prisons were; 1027 (42.9%), 906 (37.9%) and 460 (19.2%) from gilgelbelese, assosa and kamashi prisons respectively. Among them, two hundred fourteen (8.9%) fulfilled the TB screening criteria. Of the 214 study participants, 212 (99%) and 2 (1%) were prisoners and prison staffs/wardens respectively. As shown in figure 4, the number and proportion of study participants by prison showed that 94 (44%), 78 (36%) and 42 (20%) were from gilgelbelese, assosa and kamashi prisons respectively.

3.2. Characteristics of Study Participants

Out of the 214 participants (prisoners and wardens) study participant the mean age is 34.4 with SD+ 15. About half 104 (48.6%) of respondent had age below 29 years of old. The smallest age is 18 and the highest/maximum is 90 years old. The longest duration of stay in prison was 20 years where as shortest stayed one-month period. About half, 120 (56.1%) had completed grade five and higher education level, while 47 (22%) were uneducated. Nearly all respondents were male 213 (99.5%).

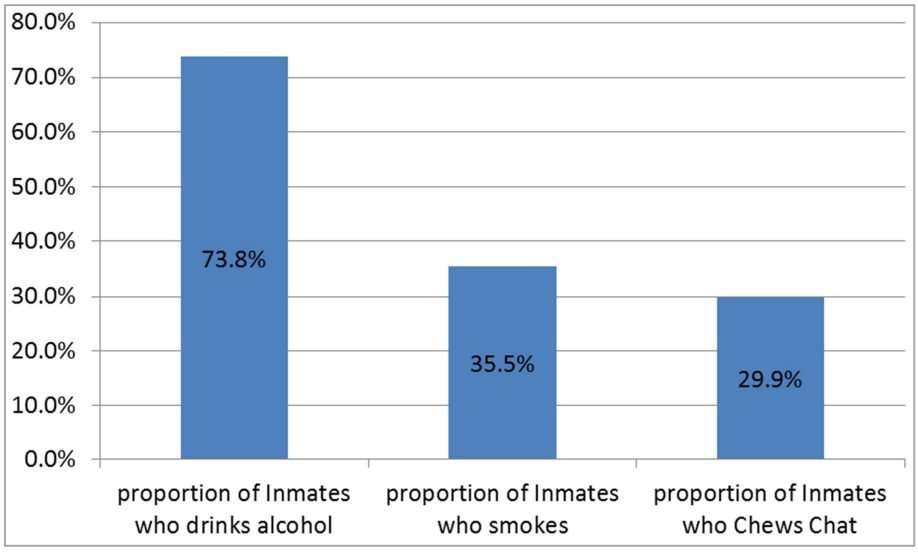

Figure 1. *Characteristics of Personal Behavior of study participants in prisons BG, Oct. 2018.*

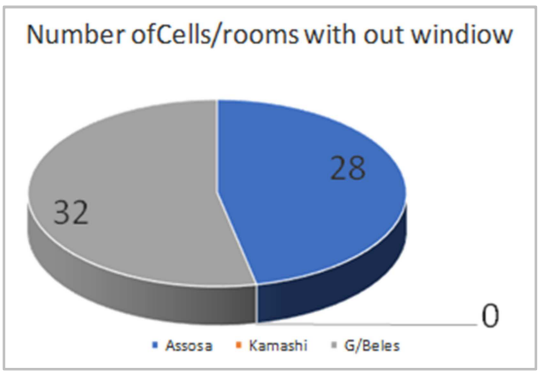

Figure 2. *Number of Cells/rooms without windows in prisons of BG, Oct/2018.*

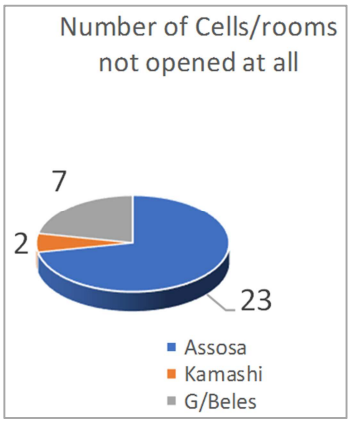

Figure 3. *Number of Cells/rooms that never opens windows by prison location in BG, Oct/2018.*

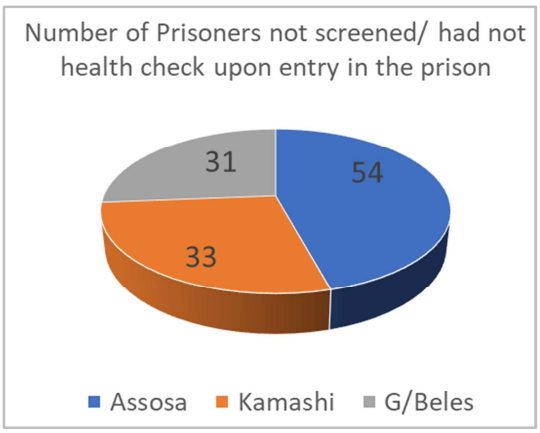

Figure 4. *Prisoner that never had entry screening/health checks by prisons location in BG, Oct/2018.*

3.3. Prevalence of Tuberculosis Among Prisoners

Out of the 214 (6.2%) inmates who were included in the study and fulfilled the TB screening, 2 (0.93%) of them were already diagnosed with TB before the study and were already on anti-tuberculosis treatment. Among the remaining 212 participants who were tested using GeneXpert for MTB, 5 (2.3%) PTB cases were newly diagnosed with active pulmonary tuberculosis in this study by GeneXpert MTB/RIF assay. Thus, together with the 2 patients who had started anti-TB treatment before the study, the overall PTB prevalence among study subjects was 3.3% (7/214), (95% CI: 1- 6). Among all prisoners and warden, the overall prevalence of TB was 0.28% (7/2513), (95%CI: 0.07 –0.67) or 279 per 100,000 prison populations.

Thus, the estimated prevalence of TB among prisons ranges with the highest 525.2 per 100,000 prison populations found in Assosa prison followed by 185.7 TB cases per 100,000 prison populations at gilgelbelese prison, but no case were found in kamashi prison.

All TB cases lived in rooms comprises of 20 -241 inmates and all live in room size of less than 3 m^2/capital. 4 (57%) of the total TB detected cases were imprisoned in room with >50 number of prisoners per cell/room. All TB cases had not undergone screening/ health check while entry to prisons. Of the all cases 5 (two-thirds) had experienced cough more than two weeks to six months before this study.

3.4. Personal Behavior

The great majority 158 (73.8%) of imamates drink alcohol, of which 80 (37.4%) of them drink alcohol more than three days per week. One third 76 (35.5%) of the respondents were cigarette smokers. About 64 (29.9%) of the respondents were chat chewer.

3.5. Imprisonment History and Prison Setup

The length of stay in prisons ranges months to 20 years with a mean of 33.4 months (2.8 years). Thirty-six (16.8%) experienced of imprisoned with known TB patient in the same room from one month to 24 months (2 years). About 84 (39.3%) had been imprisoned with chronically coughing person that ranges from1 month to 10 years range in same cell. About 60 (28%) did not have windows in their room or cell. Of all 154 with windows, 32 (20.7%) of windows were never ever opened at all. Only less than half (43.6%) windows opened fully.

3.6. Morbidity History and Status

Most 146 (66.6%) had visited the clinic for their current complaint, of which 51 (38.9) had visited once, while 47 (35.9%) and 32 (24.4%) of them had visited the clinic twice and three times or more for their current complaint. Out of the total 146 participants who visited the clinic, majority 122 (77.2%) had received treatment, on the other hand significant 36 (22.8%) of prison inmates did not have received any treatment. About 59 (28%) did already had TB symptoms before imprisonment.

More than half of the prisoners, 117 (54.7%) were not screened upon entry in the prison. Poor entry of screening was higher in Assossa followed by Kamashi and then G/Beles. Twenty-eight (13.1%) of the prisoners had been diagnosed with TB, of which 13 (46.4%) of them were diagnosed TB before imprisonment. But 3 (8%) of previously diagnosed TB cases didn't received the anti-TB treatment.

3.7. Factors Associated with Tuberculosis Among Prisoners

Pulmonary tuberculosis was significantly associated with

Imprisoning with Known TB patient in same room (COR=38, 95%CI=(4.5, 330), with Length of imprisonment with known TB patient in same room (COR=21.7, 95%CI=(2.1, 221) and with duration of cough longer than 4 months (COR=236, 95%CI=(68.9, 2220). But no statically association was fond between PTB and the rest morbidity factors of the prison study population.

No association found between PTB and socio-demographic factors, morbidity factors like Contact with known TB patient at home, imprisonment with other chronic diseases & body mass index among of the study population.

But, most importantly, out of the total identified PTB cases most 5 (71%) of inmates mentioned their cell/room windows were not opened at all. All TB cases identified did not undergone screening/ health check while entry to prisons. All the TB cases live in rooms comprises of 20 -241 inmates and all live-in room size of less than 3 m^2/capital. Five of the cases (two-thirds) had experienced cough of more than two weeks to six months before this study. Even of all TB cases identified, half were described their experience of visited health facilities either in prison or elsewhere for current complains. And all of them had visited health facilities at least twice for current complains.

4. Discussion

Prisoners are at high risk of Tuberculosis infection. In this study the overall prevalence of PTB was 279 per 100,000 inmates. In comparison to estimate of WHO in 2017, the prevalence in this prison study was still as higher than that estimated all form of TB for the general Ethiopian population which was 164 per 100,000 populations [10]. While, this study addressed only pulmonary TB cases, which excludes Extra Pulmonary TB that account forty percent of all TB cases as WHO estimate, this study still found 3.4 times higher prevalence of PTB as compared to WHO Estimate to General Population. This finding is very congruent to WHO estimate, the prevalence of TB in prisons is very high higher than in the general population, and up to 25% of the TB burden in a given country [5].

According to the same report the prevalence of extra pulmonary TB account 31% of the total estimated TB cases While, the current study was addressed only pulmonary TB cases, the prevalence of PTB in this study was 2.4 times higher than the 2017 notified pulmonary TB cases nationally [10].

On the other hand, the overall TB prevalence in this study was lower than reported from the previous Ethiopian studies; eastern Ethiopia prison1913 per100 000, 13 zonal prisons of Ethiopia 458.1 per 100,000, North Gondar zone, Gamo Gofa zone and Hadiya Zone prison of Southern Ethiopia fond 1,482.3, 629 and 349.2 per 100.000 inmates respectively which were conducted in 20012 to 2015 [11-14, 7].

The lower TB prevalence in this study might be also associated with the observed decline of TB prevalence in the general population over the last decay years. The national TB survey of 2010/2011 reported a TB prevalence of 277/100000 in 2013 the prevalence of TB in the general population was declined to 211/100000 [15]. Further, Ethiopia is among those African countries which had achieved the 2015 global targets announced by the stop TB partnership, reflecting the efforts of the national government and its allies to control TB in the country, including TB in prisons.

This study found TB prevalence among different prisons, varying from no TB case detected in Kamashi prisons to the highest 5 PTB cases found in Assosa prison. In line with this, the study found nonexistence of entry of screening was higher in Assossa prison (30.7%) followed by Kamashi (32.5%) and Gilgelbeles (35.1%) prisons. on the other hand, out of the 32 (20.5%) inmates windows that were not ever opened at all, most, 23 (71.9%) were found in Assosa prison followed by Gilgeleblese 7 (21.9%) and 2 (6.3%) in Kamashi prison. Similarly, of the 68 (43.6%) of the windows that were opened full day, about half (51.5%) were found in Kamashi prison alone. On top of these, all TB cases identified had not undergone screening/ health check while entry to prisons. Most TB detected'5 (71%) inmates cell/room windows were not opened at all, live-in room size of less than 3 m^2/capital which is too over crowded. The data suggest that there might be weak to implement systematic and effective TB-control strategies.

In line with this finding, studies reveled that Prison conditions often promote exposure to infection, overcrowding, delayed diagnosis and cure of infectious cases, poor ventilation [5]. Previous studies also revealed that, inmates imprisoned in rooms without a window had a four times higher TB risk than those incarcerated in rooms where a window was present [1, 16]. However, window opening, and room size/overcrowding were not significantly associated with PTB.

As the study also notes, most 71.4% of all prevalent TB cases were newly diagnosed in this study. In line with this, the study shows that all TB cases identified had not undergone screening/ health check while entry to prisons. Furthermore, out of all sampled, more than half 117 (54.7%) had not been screened or had not got health check upon entry in the prison. This entitles in contrary to many studied. The findings of this study might imply that TB prevention and control activities among the prisons were not effectively applied.

This finding unlikely come up with no association with most factors like previous contact with known TB at home, alcohol consumption, remoteness of prisons and history of morbidity.

This study found Pulmonary TB is much higher among Imprisoned with Known TB patient in same room compared to not imprisoned with TB patients 36 (4.1- 321) (AOR=36, 95%CI=(4.1, 321). And also those who had more than 3 months length of imprisonment with known TB patient in same room are 20 times more likely to had PTB as compared to less months length of imprisonment with known TB patient (AOR=20.1, 95%CI=(2.01, 201). Similarly, the study conducted in large prison of Bangladeshi revealed that one of the main risk factors of TB in prison were exposure to TB patients (AOR=3.16, 95%CI (2.36–4.21) [17]. Congruently,

the study conducted in Wolaita Zone, Southern Ethiopia revealed Pulmonary tuberculosis was significantly associated with sharing a cell with a known TB patient (AOR=7.09, 95%CI=(1.59, 31.64) [18]. In support to this significant association, most all-important factors shows agreement; all most (71%) MTB detected' inmates cell/room windows were not opened at all, all TB cases identified had not undergone screening/ health check while entry to prisons, all TB cases live congested & overcrowded (20 - 241 inmates and live-in room size of less than 3 m^2/capital, 75% had experienced cough more than two weeks to six months before this study and all had visited health facilities at least twice for current complains. Prevalence of pulmonary tuberculosis is significantly much higher with cough for more than 3 months and above (AOR=230, 95%CI=(68.4, 2220). For this high PTB prevalence among chronic cougher could be attributed to the absence of adequate TB prevention and control activities in the prisons and limited access to health and referral services. This is might also be associated with the lack of adequate screening of prison inmates during entry into the prisons, Poor ventilation, overcrowded living condition, Absence of early case identification and non-existent of periodic TB screening for prison inmates (Concern associated with availability and utilization of endorsed screening strategies).

In congruent to the above, this study also comes up the prisons all room/cells are less than 3m². As a result, all rooms' sizes are much below the international standard 6m² of living space for a single-occupancy cell or 4m² of living space per prisoner in a multiple-occupancy cell. Accordingly, this study implies in the prisons all room/cells are too overcrowded and substandard. Studies showed that overcrowding and poor ventilation are considered underlying reasons for high risk of TB transmission in prisons [5].

This implies that the existing TB prevention and control measures in prison facilities are not adequate. Therefore, to improve TB prevention and control in these prisons require such as, strongly carrying out of adequate health seeking behavior activities through health information and education, giving due attention for early identification of inmates with active TB diseases through systematic TB screening (entry screening, outpatient department or routine screening or passive screening, periodic or mass screening and exit screening), isolation of contagious inmates and appropriate use of recommended TB infection control measures. In addition to this the finding of the study might also be associated with prisons to avoid and work on over crowdedness and housing condition ventilations which is crucial to prevent air borne diseases such as TB as the probability of transmission of TB infection is increased by crowding and delays in medical evaluation and treatment.

5. Conclusion

In this study the overall prevalence of PTB was 279 per 100,000 inmates which are higher than that estimated all form TB for the general Ethiopian population.

This study realized very poor TB checkup during entry and in regular basis. Very substantial inmates live in poor ventilation due to either cell/room windows were not opened at all or lacks window. As a result, all rooms' sizes are 3m² of living space per prisoner which is much below the standards. The study suggests that there is weak to implement systematic and effective TB-control strategies.

Imprisoned with known TB patient in same room and cough for more than 4 months are statically significant factors for PTB in prisons. But no statically, association was found with most factors: socio-demographic factors (age, educational status, residence), personal behavior (drink alcohol, smoking, chew 'chat), prison factors (time imprisoned in the current prison, imprisoned with chronic cougher in same room, prisoner per cell/room, presence of window) and history of morbidity.

6. Recommendations

Failure to control TB in prison settings has the potential to disrupt the general population TB control programs. Lack of service standardization, low access to quality TB prevention and care services, lack of implementation of TB prevention and care services in prisons, situational and environmental predisposing factors in the prison settings, overcrowding, poor ventilation and limited health services are the major findings revealed by the study. Hence, considering the importance of TB prevention and care service in prison settings for national TB control program, the following recommendations are critical:

1) Improving health seeking behavior through health information and education and provide health education to all inmates on how to prevent TB transmission in prisons among facilities.
2) Early identification of inmates with latent TB infection and active TB through systematic TB screening approach, through entry screening, outpatient department routine screening (or passive screening), periodic or mass screening and exit screening.
3) Establish TB diagnostic and treatment services in prisons and prompt isolation of contagious inmates.
4) Appropriate use of TB infection control methods including isolation of inmates with presumptive TB (or diagnosed with TB) should be in place. Administrative unit of the respective prisons have to arrange isolation rooms for both symptomatic inmates and those diagnosed with active TB.
5) Identify inmate's facility staffs and regular visitors who have close contact with presumptive or diagnosed TB cases and appropriate screening of all identified close contacts for symptoms of active TB and identifying inmates who have been sharing a cell with a person with active TB since symptoms started and register them for contact investigation.
6) Prison administrations have to provide technical and logistic support to make existing accommodation prison facilities and consultation rooms to have good air

circulations, adequate spaces and to ensure newly constructed address the TB infection control issues.

7) Creating a coordinating mechanism at all levels.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding to this research work.

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References

[1] S. X. Jittimanee, N. Ngamtrairai, M. C. White, S. Jittimanee. A prevalence survey for smear- positive tuberculosis in Thai prisons. INT J TUBERC LUNG DIS. 2007, 11 (5): 556–561.

[2] Winetsky DE, Almukhamedov O, Pulatov D, Vezhnina N, Dooronbekova A, et al. 2014. Prevalence, Risk Factors and Social Context of Active Pulmonary. Tuberculosis among Prison Inmates in Tajikistan. PLoS ONE 9 (1): journal.pone.0086046.

[3] Stern V. Problems in prisons worldwide, with a particular focus on Russia. Ann N Y AcadSci 2001; 953: 113–119.

[4] Walmsley R. World prison population list. I. London, UK: International Centre for Prison Studies, King's College, 2007.

[5] World Health Organization, Tuberculosis in Prisons, WHO, Geneva, Switzerland, 2014, http://www.who.int/tb/challenges/.

[6] FMOH. Standard Operating Procedures for the implementation of TB prevention and control activities in prisons and detention Centers in Ethiopia, February 2017, Addis Ababa.

[7] S. Ali, A. Haileamlak, A. Wieser et al., ''Prevalence of Pulmonary Tuberculosis among Prison Inmates in Ethiopia, a Cross-Sectional Study'', PLOS ONE DOI: 10.1371/ journal. Pone.0144040 December 7, 2015Literature Review on TB Control in Prisons 11/18/2008.

[8] Benishangul Gumuz Regional Health Bureau annual report, Assosa Ethiopia. July 2017.

[9] Winsa BB, Mohammed AE. Investigation on Pulmonary Tuberculosis Among Bedele Woreda Prisoners, Southwest Ethiopia. International Journal of Biomedical Science and Engineering. 2015; 3 (6): 69-73.

[10] World Health Organization: Global tuberculosis report 2018. Geneva: 2018.

[11] Solomon A, Abraham H, Andreas W et al. Prevalence of Pulmonary Tuberculosis among Prison Inmates in Ethiopia, a Cross-Sectional Study'' PLOS ONE DOI: 10.1371/ journal. Pone.0144040 December 7, 2015.

[12] Moges B, Amare B, Asfaw F, Tesfaye W, Tiruneh M, Belayhun Y, et al. Prevalence of smear positive pulmonary tuberculosis among prisoners in North Gondar Zone Prison, northwest Ethiopia. BMC Infectious Diseases 2012; 12: 352 doi: 10.1186/1471-2334-12-352 PMID: 23241368.

[13] Zerdo Z, Medhin G, Worku A, Ameni G. Prevalence of pulmonary tuberculosis and associated risk factors in prisons of Gamo Goffa Zone, south Ethiopia: A cross-sectional study. American Journal of Health Research 2014; 2: 291–297.

[14] Terefe G. Fuge and Samuel Y. Ayanto. Prevalence of smear positive pulmonary tuberculosis and associated risk factors among prisoners in Hadiya Zone prison, Southern Ethiopia. BMC. 2016; 9: 201.

[15] FMOH. National comprehensive Tuberculosis, leprosy and TB/HIV training manual for health care workers, March 2016.

[16] Aert A, Hauer B, Wanlin M, Veen J. Tuberculosis and tuberculosis control in European prisons. Int J Tuberc Lung Dis. 2006; 10 (11): 1215-23.

[17] Banu S, Hossain A, Uddin MKM, Uddin MR, Ahmed T, Khatun R, et al. Pulmonary Tuberculosis and Drug Resistance in Dhaka Central Jail, the Largest Prison in Bangladesh. PLoS ONE 2010; 5 (5): e10759. doi: 10.1371/journal.pone.0010759 PMID: 20505826.

[18] Bayu Begashaw, Abera Beyamo Mekiso, Tegene Legesse. Prevalence of Pulmonary Tuberculosis and Associated Factors among Prisoners in Wolaita Zone, Southern Ethiopia: Cross-sectional Study. American Journal of Public Health Research. 2016; 4 (4): 142-48.