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Factors Associated with the Development of Pulmonary Tuberculosis among Inmates in Four (4) Correctional Facilities of Copperbelt Province - Zambia

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Abstract

Correctional facilities have often been cited as reservoirs for Tuberculosis (TB), presenting a potential threat to the general population. Although correctional facilities are recognized as ideal settings for interventions, little is known about the TB epidemiology within them. The purpose of my study was to determine factors associated with the development of pulmonary tuberculosis among inmates in the selected correctional facilities of Copperbelt province of Zambian. The design of the study was a descriptive cross-sectional study that aimed at determining factors associated with the development of PTB among inmates, a case study of Ndola Remand, Chingola, Luanshya, and Mufulira Correctional Facilities. A semi-structured self-administered questionnaire was used to obtain data regarding factors associated with the development of PTB amongst inmates. From the total of 384 study participants, 143 had records of having PTB during the research period, and 241 had no records of having TB disease. With evidence obtained from this study has identified the areas that need attention in terms of control and prevention of TB in the four (4) correctional facilities. Furthermore, the factors associated with TB positivity in the present study included HIV status, sharing of cells with TB patients, and cigarette smoking and alcohol consumption.

Keywords: *Correctional Facility; Inmates; Tuberculosis, TB risk factors.*

Introduction

Tuberculosis in prison settings poses a major public health problem worldwide [1]. Prisons are settings in which TB transmission occurs, and high rates of active TB have been reported worldwide, especially in countries in sub-Sahara Africa [2]. There is an increasing recognition that the high risk of infection in Correctional Facility settings poses a problem not only for those imprisoned but also for the wider society [3].

Studies conducted [4] in Sub-Saharan Africa indicated that there is evidence of an increasing prevalence of active TB in prisons and multi-drug resistant (MDR) increasingly being detected. In terms of the driving factors, the study conducted [5, 6] identified HIV, living conditions, including overcrowding and poorly ventilated cells, as well as malnutrition associated with low immunity. According to [7] observed that there is high TB prevalence in prisons, accounting for up to 25 % of the TB burden in some low-income countries and is expected to be higher than the general population.

Prisoners constitute a high-risk group for the acquisition of Mycobacterium tuberculosis infection compared with the general population due to overcrowding, poor ventilation, low socioeconomic status, poor nutrition, and poor health condition of prison inmates, which can predispose them to a high risk of TB incidence [8]. Prison inmates are often highly mobile, rotating from one cell to another cell or from one prison to another prison during their tenure of incarceration, and later they may be released

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after some time and may contribute to tuberculosis transmission [9].

According to World Health Organization reports [10], the prevalence of TB was high in prisons in Sub-Sahara Africa, with the actual magnitude varying from country to country. Thus, a prevalence of 3574 per 100,000, 7576 per 100,000, and 6428 per 100,000 were reported in Malawi, Zambia, and Madagascar, respectively [11]. In Botswana, the point prevalence of tuberculosis among prisoners and guards was reported as 3797/100,000 and 2662/100,000, respectively [12]. According to [13] conducted a survey in three major prisons in the eastern parts of Ethiopia found an 8.9 % prevalence of pulmonary tuberculosis among prison inmates. A study conducted in the southern parts of Ethiopia reported a 19.4 % prevalence of pulmonary tuberculosis among prison inmates [14].

Tuberculosis case rates are much higher in correctional populations than in the general population [15] due to the overcrowding, closed living conditions, insufficient ventilation, generally low socioeconomic status, poor nutrition, and poor health of correctional inmates [14, 8]. There is an increasing recognition that the high risk of infection in Correctional Facility settings poses a problem not only for those imprisoned but also for the wider society [3]. Correctional facilities can act as reservoirs of tuberculosis disease for inmates and staff and for the community into which the inmates are released [16-18].

In 2015 there were 18,560 inmates crowded into 88 correctional facilities in Zambia: representing a 229% occupancy rate [19]. According to Zambia Correctional Service, Copperbelt province (region) Office (2021) revealed that the region alone from 2019-to 2021 third quarter of the year had a 5% of prevalence rate of tuberculosis. However, the current incident rate of Chingola, Luanshya, Mufulira, and Ndola remand stands at 0.69%, and the prevalence rate is about 6.7% as of 2021 third quarter of the year [20]. Possible risk factors associated with the development of tuberculosis in correctional facilities were studied in Malawi, Ivory Coast, and other developed countries, including age, HIV co-infection, poor nutritional factors, the longer length of stay in correctional facilities, and tobacco smoking. These factors were investigated in four (4) correctional facilities to determine their association with tuberculosis [21, 22]. It is crucial to identify and mitigate these risk factors associated with the development and spread of tuberculosis in high-risk and overcrowded environments such as correctional facilities.

Methodology

This was a prison-based cross-sectional descriptive study carried out from September to December 2021. A cross-sectional study design was used because the purpose of the study was to describe the population or a subgroup within the prison's population with respect to risk factors. The study was conducted in four (4) districts of Copperbelt province. The study sites was Chingola, Ndola Remand prison, Mufulira, and Luanshya correctional facilities, where the researcher had systematically collected information from the participants (inmates) at the facility and health Centre within the facilities. All inmates at four (4) Correctional Facilities, including those awaiting trial (remandee) and already sentenced inmates (convicts) were included in the study. The study had used the Probability sampling in selecting the sample and the study settings; hence a multistage sampling technique was employed. The participant was selected using simple random sampling as each element in the larger population has an equal chance of being selected into the sample. Selection of the prison's facilities employed the fishbowl technique of sampling where each number from the sampling frame was written on a slip and slips were put in a container and was ruffled. Slips were drawn at one a time without being replaced back. The procedure was repeated

until the required sample was attained. Data were analyzed using Statistical Package for the Social Sciences (SPSS) in order to describe the data and identify any significant. Ethical clearance was obtained from ERES coverage a local Institutional Review Board, and additional approval was obtained from Zambia Correctional Service headquarters.

Results

From the total of 384 study participants, 143 (37.2%) had records of having PTB during the research period, and 241 (62.8%) had no records of acquiring TB infection. Displayed under this segment are the results gathered from the field study in respect of the objectives of the study. Figure 1–4 report on identified risk factors. These factors are categorized into Age grouping, HIV status, cigarette smokers, history of alcoholism, length of stay incarceration, and previous history of TB. The variables have been grouped in order to give the overall picture. Similarly, findings have been presented in graphs and tables to facilitate understanding.

Figure 1: shows the frequency of age of respondent were (92.5%) of respondents were between 25 and 35 years of age. The younger age groups were between 16 and 24 years, 29 (7.6%). Table 1: 14% of participants have the age ranging from 14 to 24 years, while 86% have the age between 25, 35, and above.

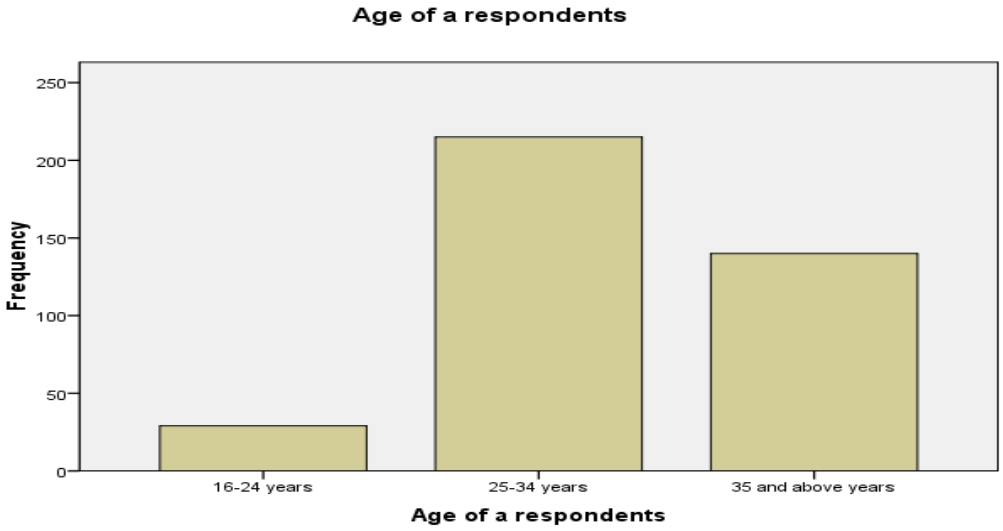

Figure 1. Frequency of Age of Respondents

Table 1. Have you ever had Suffered from Pulmonary TB * Age of a Respondents

Crosstab			Age of a respondents			Total
			16-24 years	25-34 years	35 and above years	
Have you ever had suffered from Pulmonary TB	yes	Count	20	61	62	143
		% Within Have you ever had suffered from Pulmonary TB	14.0%	42.7%	43.4%	100.0%
	no	Count	9	154	78	241
		% Within Have you ever had suffered from Pulmonary TB	3.7%	63.9%	32.4%	100.0%
Total		Count	29	215	140	384

	% Within Have you ever had suffered from Pulmonary TB	7.6%	56.0%	36.5%	100.0%

14% participants have the age ranging from 14 to 24 years, while 86% have the age between 25-35 and above

Figure 2: shows that the frequency of current HIV status were 164 (42.7%) respondents were positive, while 183 (47.7%) were negative and 37 (9.6%) were unknown their status. HIV infection: This is the most potent risk factor for the progression of latent TB to active TB, and HIV-infected persons are more likely to develop TB in the presence of latent TB than HIV-negative persons. This is because the HIV virus affects the CD4+ T cells, which mediate the cellular immune response to TB in a quantitative and qualitative manner. Table 2: A total of 53 participants were HIV positive, while 68 participants were HIV negative, and 22 did not know their status.

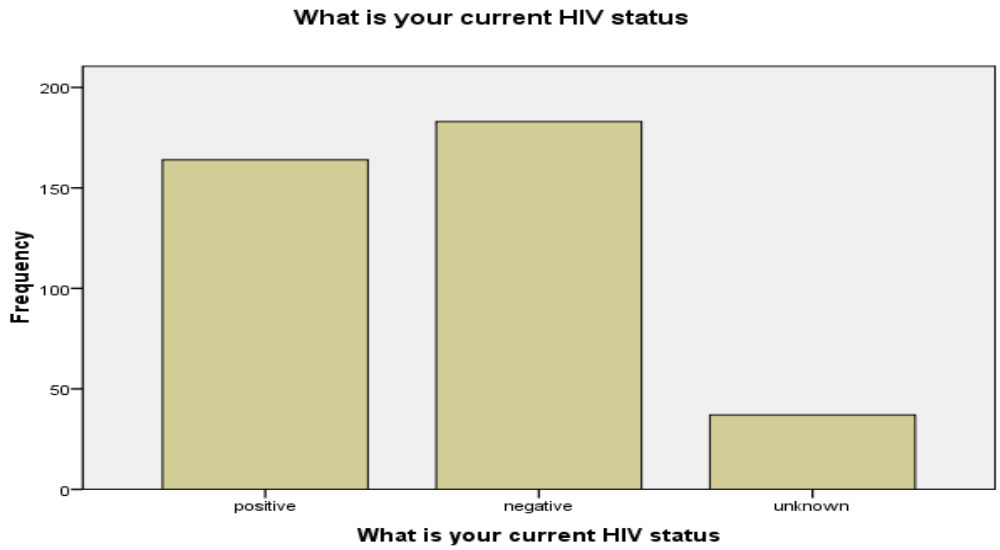

Figure 2. Frequency of Current HIV Status

Table 2. Have you ever had Suffered from Pulmonary TB* what is your Current HIV Status

Crosstab			What is your current HIV status			Total
			positive	negative	unknown	
Have you ever had suffered from Pulmonary TB	yes	Count	53	68	22	143
		% Within Have you ever had suffered from Pulmonary TB	37.1%	47.6%	15.4%	100.0%
	no	Count	111	115	15	241
		% Within Have you ever had suffered from Pulmonary TB	46.1%	47.7%	6.2%	100.0%
Total		Count	164	183	37	384
		% Within Have you ever had suffered from Pulmonary TB	42.7%	47.7%	9.6%	100.0%

A total of 53 participants were HIV positive while 68 participants were HIV negative and 22, they did not know their status.

Figure 3: frequency of smokers was 189 (49.2%) of the respondents reported having smoked cigarettes, while 195 (50.8%) had not done so. There were a higher proportion of respondents who had smoked in the previous. Smoking and alcohol has been found to be consistently associated with developing TB infection and disease in numerous observational studies. Table 3: Only (49.7%) of participants were smokers, while (50.3%) of participants were not smokers.

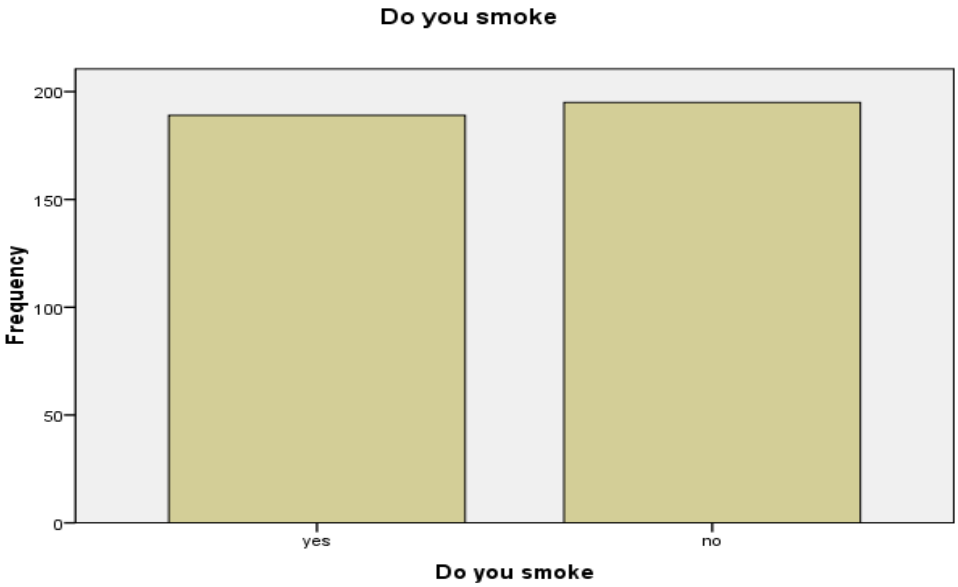

Figure 3. Frequency of do you Smoke

Table 3. Have you ever had Suffered from Pulmonary TB * Do you Smoke?

Crosstab			Do you smoke		Total
			yes	no	
Have you ever had suffered from Pulmonary TB	yes	Count	71	72	143
		% Within Have you ever had suffered from Pulmonary TB	49.7%	50.3%	100.0%
	no	Count	118	123	241
		% Within Have you ever had suffered from Pulmonary TB	49.0%	51.0%	100.0%
Total		Count	189	195	384
		% Within Have you ever had suffered from Pulmonary TB	49.2%	50.8%	100.0%

Only (49.7%) Participants were Smoker's while (50.3%) Participants were not Smokers.

Figure 4: Frequency of how long of being imprisoned were 76 (19.8%) respondents had stayed in the facility from 11 months, while 134 (34.9%) had stayed in the facility from 1-2 years and 116 (30.2%) have stayed for more than 3 years in the correctional facilities. Table 4: A total of 25 (17.5) participants have stayed in the facility from 1-12 months, while 60 (42%) participants have stayed in the facility from 12-24 months, and only 38 (26.6%) participants have stayed in the facility for 24 months and above.

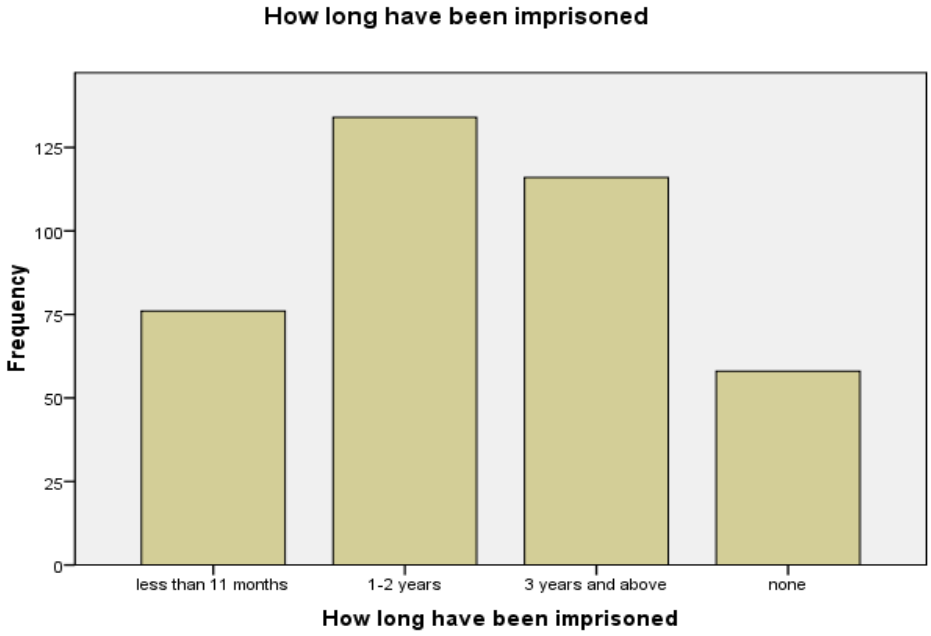

Figure 4. Frequency on How Long have been Imprisoned

In Table 4, a total of 25 (17.5%) participants have stayed in the facility from 1-12 months, while 60 (42%) participants have stayed in the facility from 12-24 months, and only 38 (26.6%) participants have stayed in the facility for 24 months and above.

Table 4. Have you ever Suffered from Pulmonary TB * How long have you been Imprisoned?

Crosstab			**How long have been imprisoned**				**Total**
			less than 11 months	**1-2 years**	**3 years and above**	**none**	
Have you ever had suffered from Pulmonary TB	yes	Count	25	60	38	20	143
		% Within Have you ever had suffered from Pulmonary TB	17.5%	42.0%	26.6%	14.0%	100.0%
	no	Count	51	74	78	38	241
		% Within Have you ever had suffered from Pulmonary TB	21.2%	30.7%	32.4%	15.8%	100.0%
Total		Count	76	134	116	58	384
		% Within Have you ever had suffered from Pulmonary TB	19.8%	34.9%	30.2%	15.1%	100.0%

Discussion

The present study has been one of the very few research endeavours to determine factors associated with the development of PTB amongst inmates in four (4) correctional facilities of Copperbelt province. It is important to identify the main risk factors associated with the development of pulmonary tuberculosis amongst inmates in order to prevent its onset

and spread. Prisons are considered as reservoirs for facilitating Mycobacterium tuberculosis (MTB) transmission within their cells and to the community at large. Transmission occurs through prison staff, visitors, and released inmates. The estimated prevalence of pulmonary tuberculosis disease in the prison systems is reported to be much higher than the average estimates in the general population, irrespective of economic status and the population TB burden of the country [23].

However, this study provides evidence on the risk factors associated with pulmonary tuberculosis amongst inmates that can assist policymakers in the development of actions to tackle pulmonary Tuberculosis in Correctional Facilities. The growing epidemic of pulmonary Tuberculosis in Zambian Correctional Facilities is associated with the lack of effective control of tuberculosis within these institutions, such as late diagnosis and failure to isolate inmates with symptoms or suspected with pulmonary tuberculosis. The research has found that the four (4) Correctional Facilities were built prior to independence with their initial capacity was to accommodate 540 inmates, but the current situation at these four (4) facilities is different; the facilities is now accommodating over 1440 inmates, this means that these 4 Correctional Facility is more than 150% congested.

The study has shown strong associations between age and with the development of tuberculosis or had suffered tuberculosis before with (P= 0.001). The study has further established that there was a significantly association between those respondents who consume alcohol and smokers at the same time with the (P<0.001). This finding is in line with previous studies in (West African countries, Spain and India), in which a similar association between inmates who smokers' tobacco and consume alcohol and pulmonary tuberculosis was reported [13]. Similarly, several systematic reviews have found that rates of TB infection disease and mortality are significantly higher amongst inmates who smoke.

This study has shown a strong association between HIV status and the risk of developing TB (P<0.009). According to the CIDRZ, 24% of TB cases amongst inmates' 15-49-year-old adults in Zambia Correctional Facilities are common because of HIV. The major factors contributing to the increased number of HIV-associated TB cases in Zambian correctional facilities are the increased risk of reactivation of latent TB infection in HIV-infected persons because of decreased immunity and the increased risk of progression of TB disease because of HIV infection, which will in return, resulted into increase TB transmission rates in the correctional facility (Table 2).

In the study, the length of stay in prison was not significantly associated with PTB at the level of p = 5.056, despite the majority of study participants staying for a short duration. It was similar to that of Malawian, whereas Ivory Coast, and Cameroon studies indicated a short staying as the risk factor for TB. On the contrary, Spain and Georgian studies reported a longer staying as the risk factor. This point has already been presented in the literature review [11]. Instead, imprisonment was found to be significantly associated with PTB (with chi-square analysis (p=0.046)). Sharing of cells with a TB patient or a chronically coughing prisoner was identified to be risk factors for contracting PTB infection. This is partly explained by the lack of segregation of TB patients, absence of pre-detention TB screening, and overcrowding that prolong the period of infectiousness, thus favoring transmission of M. tuberculosis.

The cross-sectional nature of the study could be one of the possible reasons for not observing the significant association of this factor.

The four (4) Correctional Facilities were built prior to independence, and their initial capacity was to accommodate 540 inmates, but the current situation at these four (4) facilities is different; the facilities are now accommodating over 1440 inmates; this means that these four (4) Correctional Facility is more than 150%

congested. Overcrowding undermines the ability of the four (4) Correctional Facilities systems to meet basic human needs, such as accommodation. However, periodic amnesties and pardons are the only strategies used to relieve overcrowding.

The poor state of some cells in these four (4) correctional facilities were they do not have proper ventilation and overcrowding in Cells raises the significant risk of the pulmonary tuberculosis prevalence to be high than those in the general population. Certain levels of ventilation are needed to meet the requirements of health, and these require that windows be large enough to allow the entrance and circulation of fresh air. However, ventilation requirements are not met adequately in most Zambian Correctional Facilities. These facilities are crowded with poor ventilation, which facilitates the transmission of M. tuberculosis, improvements in housing conditions can help in the prevention of the disease occurrence.

Various factors make inmates in these correctional facilities setting more susceptible to TB infection. Our results revealed that HIV positivity, sharing of cells with TB patients, and alcoholism, smoking of tobacco has a statistically significant association with the prevalence of TB.

Conclusion

The evidence obtained in this study has identified the areas that need attention in terms of control and prevention of TB in the four (4) correctional facilities. Furthermore, the factors associated with TB positivity in the present study included HIV status, sharing of cells with TB patients, and cigarette smoking and alcohol consumption. Results observed from Ndola remand Chingola, Mufulira, and Luanshya correctional facilities confirm that TB disease exists among inmates. These findings are serious problems that should no longer be ignored. Inmates are the most vulnerable individuals yet the most marginalized population in our society.

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Declaring Conflict of Interest

Profession - Chief Inspector (Correctional officer) in the Zambia correctional services working in the same institution as an Environmental Health Officer.

Qualification - Bachelor of Science in Environmental Health from Rusangu University-Zambia. Currently stationed at Chingola correctional Centre - attached to Chingola correctional health post. I, declare that this research paper is my own work and that all the sources I, have quoted have been indicated and acknowledged using complete references. All protocols and procedure during data collection were followed and this research paper was purely academic.

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