

A Study on Prevalence of Latent Tuberculosis in Prison Inmates of a Single Outdoor Prison in Central Sri Lanka

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Abstract

Background: It is believed globally, that the prevalence of latent Tuberculosis among prison inmates is greater than that of the general population. According to the WHO (World Health Organization), it is estimated that the risk of developing Tuberculosis is 100 times more than an average individual who lives outside the prison. Although, there are studies suggesting that latent tuberculosis prevalence is high among prison inmates, no established study has been done particularly within Sri Lanka. An appropriate estimate of the disease is essential to formulate health service plans most fitted for prisoners.

Method: A cross sectional study was performed on 94 participants (male) recruited randomly among the prisoners of Pallekale open prison. Data was collected using an interviewer based questionnaire and screening for latent tuberculosis was done by Mantoux test. The subjects also underwent investigations to exclude active disease where necessary.

Results: Out of the 94 inmates, 19 (20%) had a positive Mantoux test, out of which 6 (31.6%) had a result of more than 15mm. There were 57 (60.6%) amateur prisoners and the remaining 37 (39.4%) prisoners had a history of repeated sentences of imprisonment. 9(24.3%) recurrent prisoners were found to have a positive result. Comparison of the prevalence of Mantoux test positivity among amateur and recurrent sentenced prisoners revealed no difference ($p= 0.801$). Out of the 94 inmates, 87 (97.6%) were smokers. There was no difference in the prevalence of Mantoux positivity among smokers and non-smokers ($p=0.724$).

53 (56.4%) of the chosen subjects had spent more than 6 months in prison. There was no association between time spent in prison and Mantoux positivity ($p= 0.089$).

Conclusion: The prevalence of latent tuberculosis, among prison inmates in the open prison Pallakelle, was 20%. Mantoux positivity was not significantly associated with smoking, recurrent sentencing or duration of imprisonment.

Key words – latent tuberculosis, Mantoux test, prison inmates

Introduction

Tuberculosis is a disease that is caused by a bacterium called *Mycobacterium tuberculosis* which spreads by air droplets and it can affect any part of the body except hair and nails. Tuberculosis is one of the leading causes of death worldwide, along with HIV¹. According to WHO, tuberculosis is the commonest cause of mortality in HIV infected people. The disease is frequent all over the globe and is responsible for 1.3 million deaths in 2017². Recent studies indicate that the prevalence of latent tuberculosis around the world is as high as one quarter of the worldwide population³. In developing countries TB deaths attribute to a percentage of 7% of all deaths³.

Sri Lanka is a developing nation with admirable health indices and has set an ambitious goal to eradicate tuberculosis by 2025⁴. Tuberculosis, at times was called the poor man's disease, since the prevalence coincides with poverty. Hence, the low socioeconomic population is more prone to get exposed to the disease. Poverty can lead to multiple risk factors, some of which are, overcrowding, confinement of spaces in public transportation, overcrowded housing, poor hygiene etc. On the other hand, Sri Lanka is a tourist destination, even though it benefits the country's economy; on the contrary there are negative aspects to it as locals are prone to get in contact with the infectious people from all over the world.

However, it is not near impossible to overcome this obstacle. Although, Sri Lanka is a third world country, the health indexes are simply astonishing and are at its verge of eradicating many diseases compared to other countries in the same region.

With all this taken into consideration, Tuberculosis is a major health predicament that will be a challenge to eradicate. Acquisition of the knowledge in prevalence of the disease will be beneficial to pave the path for the preventive measures. It is ideal that we study the spread of the disease and its contributing factors to emphasize the public awareness of the disease, which can make a tremendous impact on solving the problem. It can be done in numerous ways after obtaining confirmative data analysis.

Latent Tuberculosis

Latent tuberculosis can be defined as a state of persistent immune response to stimulation by *Mycobacterium tuberculosis* antigens without evidence of clinically manifested active TB⁵. Hence, the person is not symptomatic and is not infectious. However, the person is at risk of conversion to active disease, which is why identification of this phase is of paramount importance. In our ambitious goal of eradicating TB, identification of groups at higher risk of latent TB, and its subsequent conversion to active disease will be a public health priority.

Since the patient is asymptomatic, certain methods of screening should be employed to detect the latent phase of the disease. These screening methods include Mantoux test and Interferon-Gamma Release Assay (IGRAs). There is no wide access to Interferon-Gamma Release Assay (IGRAs) method in Sri Lanka, therefore, in order to collect data for this research, Mantoux test was carried out.

Risk factors for developing Tuberculosis in prisons

The prevalence of tuberculosis in prison inmates is formidable compared to the general population. According to WHO, it is as high as 100 times⁶ the civil population. There are numerous reasons causing these high rates⁷.

First and foremost, the prison environment is often characterized by overcrowding, the inmates being confined into a diminutive space; facilitate its transmission from one prisoner to another. Majority of the prisoners come from a poor socioeconomic context, which puts them at risk of acquisition of the microbe prior to their sentencing. These factors include overcrowded housing with poor sanitation, nutritional deficiencies, increased incidence of immunosuppression due to uncontrolled diabetes, substance abuse and human immunodeficiency virus (HIV) infections.

Poor hygiene of these inmates and lack of proper ventilation within the prison cells with poorly designed infrastructure turn prison into a perfect breeding ground for Tuberculosis dissemination.

Inadequate healthcare due to shortfall of doctors as well as medical equipment supply for the whole prison has made it difficult to detect the disease at its early stages. In turn, they present with an advanced stage of Tuberculosis which carries the risk of developing multi resistant form of the disease. Furthermore, not being able to initiate preventive measures to reduce the spread of the disease is also a main concern. Lack of awareness of the disease among the prison inmates is another problem that leads to the wide spread of the disease.

There are no typical clinical features distinctive to tuberculosis. It can be presented in many ways. Hence, in an overcrowded place like the prison, with numerous risk factors mentioned above, along with people who are more prone to develop the disease easily, facilitates the evolution of a latent TB infection into a clinical disease. There are several studies that have been conducted in different countries, to determine the prevalence of latent tuberculosis as well as active Tuberculosis in prison inmates.

There has been a study carried out by B J Gray et al that studied the prevalence of latent TB in prison inmates in a UK prison⁸. It was discovered that there was a prevalence of 7.1% of latent tuberculosis among the male inmates of the prison and it was quite high in comparison to low percentage of incidence in the general population.

A metaanalysis conducted in Ethiopia⁹ revealed that the percentage of prevalence of tuberculosis is remarkably high among the prisoners in Ethiopia. 4086 inmates were screened positive for TB and the infected percentage was remarkably high at 8.33%. However, this study did not contain information on latent tuberculosis, which would be expected to be at a much higher rate.

Prisoners have long been identified as a group at high risk of tuberculosis and therefore in order to eradicate tuberculosis, solid data needs to be obtained within Sri Lanka in order to lay down a proper preventive strategy.

Method

This cross-sectional study was performed from September 2019 to February 2020. After obtaining the permission from the prison superintendent, a wide informative discussion was carried out with the inmates and consent was obtained. Inmates who have been treated previously for tuberculosis, those who have undergone a Mantoux test previously, those who did not give consent for the study and those who have features suggestive of active tuberculosis were excluded from the study. A total of 94 inmates who met the criteria for selection into the study were selected randomly. The 94 inmates who took part were subjected to a preset interviewer based questionnaire which was filled out by the principal investigator. Following that, the Mantoux test was carried out with safety precautions, by trained nurses according to standard protocol. Another visit was arranged 3 days following the first day, to interpret the Mantoux test.

Screening Technique.

PPD-RT-23 (2 TU/0.1 ml) was used for the Mantoux test in accordance to the national TB control program¹⁰. It is a purified protein derivative that is injected to the skin (intradermally) to the anterior aspect of the left forearm. Before injection, it is important to make sure that there are no keloids, preexisting rashes, scars or any skin condition in the region that is selected. The area will be cleaned using alcohol before the procedure. 0.1 ml solution is drawn into a single dose tuberculin syringe with a short bevel needle(27G). Then it is injected into the skin at an angle of 5 degrees to 15 degrees¹⁰. After the injection of tuberculin, one should expect an intradermal wheel of 8 to 10 mm in size in the injected area which will remain for about 10 minutes. If it fails to appear, then the whole procedure should be repeated in the other arm.

The resultant induration is measured after 72 hours and is considered positive if more than 10 mm. An induration of more than 15 mm is considered highly positive. Under certain circumstances such as HIV and severe malnutrition, an induration of more than 5 mm is considered positive¹⁰.

The inmates who got a positive result were further subjected to a chest x-ray and basic investigations at the Bogambara chest clinic to exclude active tuberculosis.

Setting

This study took place in the premises of Pallakele open prison involving their inmates. This open prison is distinctive from other closed penitentiaries since the prisoners are not accommodated in closed spaces. These prisoners have the freedom to occupy themselves in different in-prison chores as well as farming yards during the day time. There is adequate ventilation in their rooms with sun light exposure. Furthermore, there is an in-built prison hospital which is equipped with a microscopic sputum centre.

The data obtained from the study was analysed using Statistical Package for Social Sciences (SPSS).

Results

For this study, 94 inmates were enrolled from the Pallakelle open prison where the age ranged from 21 years of age to 63 years of age. The mean age was 38. The prisoners were all male.

There were 57 of amateur prisoners, which accounts 60.6% of the total number of prisoners and the remaining 37 prisoners (39.4%) had a history of repeated sentences of imprisonment. The repeated sentenced prisoners were then further divided depending on the number of times they have been subjected to imprisonment (Figure 1).



Figure 1 – Classification of prisoners according to number of times they have been imprisoned.

Out of the 94, 87(92.6 %) were smokers and 7 were nonsmokers. There were no IV substance abusers, and prisoners were reluctant to reveal or refused to state whether they used narcotics.

After completing the questionnaire, Mantoux test was carried out, and those who had a reading more than 10 mm were considered positive. Out of 94 patients, 19 (20%) were positive, whereas 75 (80%) were negative (Figure 2). Out of the 19 inmates who had a positive result, 6 had a result of more than 15mm which accounted for 31.6%.

Percentages are further demonstrated in Figure 3.

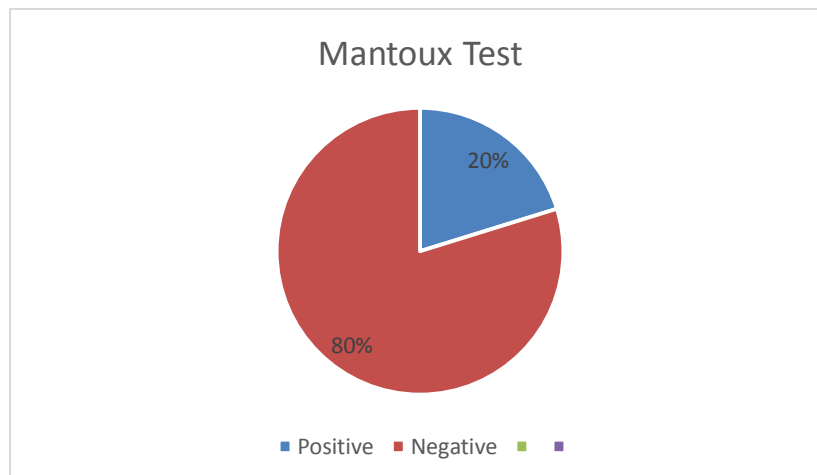


Figure 2 – Pie chart of Mantoux reading of all subjects

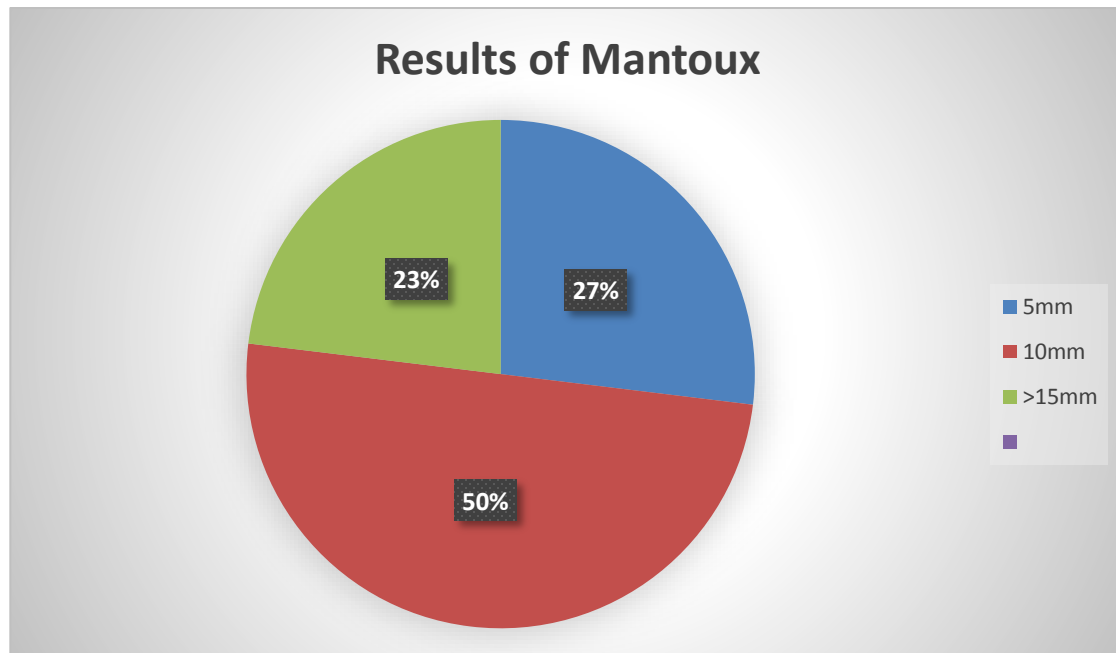


Figure 3 – Pie chart depicting the result of Mantoux according to degree of induration

The comparison between the amateur prisoners and recurrent prisoners are stated below (Table 1). Recurrent prisoners are the inmates who had been imprisoned on previous occasions prior to this prison time.

	Amateur Prisoners	Recurrent Prisoners	Total
Mantoux Positive	10 (18.2%)	9 (23.1%)	19 (20.2%)
Mantoux Negative	45 (81.8%)	30 (76.9%)	75 (79.8%)
Total	55	39	94

Table 1 – Mantoux results cross tabulation with classification of inmates according to number of prison sentences

The prevalence of Mantoux test positivity among amateur and recurrent sentenced prisoners was compared using Chi squared test and indicated that there was no significant difference between the two groups ($p=0.801$).

The prevalence of Mantoux test positivity in prison inmates was compared among smokers and nonsmokers (Table 2). Fisher’s exact test revealed a p value of 0.724 indicating no difference in these two groups.

		Smoking		Total
		Yes	No	
Mantoux result	Positive	17	2	19
	Negative	70	5	75
Total		87	7	94

Table 2 – Cross tabulation of smoking status and Mantoux results

The prisoners were then again classified upon the duration of their imprisonment, those who spent less than 6 months and more than 6 months. 53 (56.4%) prisoners had spent more than 6 months in the prison, and the rest 41 (43.6%) had spent less than 6 months in prison (Table 3).

		Time Spent in the Prison		Total
		More than 6 Months	Less than 6 Months	
Mantoux Result	Positive	16(30.2%)	3(7.31%)	19
	Negative	37(69.8%)	38(92.7%)	73
Total		53	41	94

Table 3 – Cross tabulation between time spent at prison and Mantoux results.

Here the Fisher’s exact test was used and the p value obtained was 0.073, which signifies that there is no significant correlation between latent tuberculosis and the time spent in the prison environment.

Discussion

Globally, it is believed that the occurrence of latent tuberculosis among prison inmates is high. But these figures depend on the particular nation’s infrastructure and the funding used for maintain the prisons. For an instance, research conducted in UK revealed latent tuberculosis prevalence is as low as 7.1 % among their prison inmates⁸ where a prison in Malaysia, latent tuberculosis prevalence is as high as 88%¹¹. A recent study that was done in Brazil revealed latent tuberculosis prevalence rate of 25.2%¹². These figures clearly demonstrate how variable the prevalence of latent TB can be, depending on the infrastructure of the studied community. Therefore in order to interpret the results of this study, the prevalence of latent tuberculosis in the Sri Lankan community, and also the nature of the prison under study needs to be taken into account.

The prevalence percentage of latent tuberculosis from this study was 20.2%, and it is comparatively a small figure in comparison to the occurrence of latent tuberculosis in the district of Colombo, Sri Lanka, which was 32.1%¹³ according to a study conducted by Dr. M.G Mallawaarachchi in 2009.

Latent tuberculosis prevalence is much higher among the prison inmates as compared to the general public^{6,14}. There are numerous factors contributing to the high prevalence. Overcrowding, closed ventilation, poor hygiene, inadequate access to medical care, malnourishment and immunosuppression are some of those examples. As noticed in the results, this study does not reveal a high proportion of latent tuberculosis among inmates of this particular open prison.

The open prison at Pallakele has a unique environment which sets it apart from other closed penitentiaries. The hospital has an in-built prison hospital with adequate number of staff and medical officers along with accessibility to a sputum examination center. These prisoners have the freedom to occupy themselves in different in-prison chores as well as farming yards in an open field miles apart from each other during the day time. There is adequate ventilation in their rooms with sun light exposure. Also, the close contact with prison inmates is minimal in comparison to a closed prison. There is a mass screening done for tuberculosis by the District Tuberculosis Control Officer (DTCO) every 3 months at the microscopic sputum center in the prison hospital. The risk factors for developing tuberculosis are very minimal in this setup which is exceptional.

One of the drawbacks in our study was the inability to screen for HIV infection. In a study that was done in Pakistan it was revealed that the HIV prevalence rate was 4% in prison inmates¹⁵. We do not have similar studies in Sri Lanka and therefore we do not have an estimate for the prevalence of HIV. In the presence of HIV

infection Mantoux test is considered positive if found to be >5mm. Therefore the number of Mantoux positive individuals could have been higher if a concurrent assessment of the HIV status was done.

Mantoux Tests can give false negative results. The main causes for false negative results include malnutrition, immunosuppression and HIV. Prisoners are more prone to be part of the above mentioned conditions, which in turn means, there is a high chance of prisoners getting a false negative reading in comparison to a layman.

Conclusion

The prevalence of latent tuberculosis among prison inmates in the open prison Pallakelle, was 20.2% which is less than the current global estimate of 24.8%¹⁶. Smoking, recurrent prison sentencing and longer duration of imprisonment (> 6 months) was not found to be associated with latent tuberculosis. The open environment at this particular prison, adequate sunlight and ventilation, and adequate health care infrastructure may have contributed to the reduced prevalence of latent tuberculosis.

Suggestions

This study is an eye opener to the effects of better living conditions for inmates. However, before solid conclusions can be done, further studies are needed in closed penitentiaries, with a more representative group inclusive of females, inmates with comorbidities and older inmates. Concurrent assessment of HIV status may also improve the results.

Authors' contributions

RE and SS conducted the research and drafted the manuscript. DM supervised the research and manuscript, SR support data collection and analysis

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