Is mass screening enough to control tuberculosis in Ecuador’s prisons?

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ABSTRACT

Objective: To evaluate mass screening campaigns for tuberculosis in prisoners in Ecuador.

Material and method: Cross-sectional study of Chronic Cough (CC) detected amongst inmates who entered two prisons in Ecuador between January and December 2016 (n = 12,365). The time distribution of the CCs was analyzed with the uniformity test and its relationship with the diagnosed cases of PTB, the prevalence of PTB was calculated. A logistic regression model was performed to determine the factors modifiers of PTB positivity.

Results: 1,332 chronic cougher were recorded, the positivity rate was 17.3% (95% CI, 15.1-19.4), and the prevalence was 1.9% (95% CI, 1.6 - 2.1). There was an absence of uniformity in the detection and diagnosis by epidemiological weeks; there was a positive correlation between CC and PTB cases. The positivity rate was associated with the prison with the highest density (adjusted OR 3.8; 95% CI, 2.5-5.5).

Discussion: Massive screening campaigns are not enough to control tuberculosis in Ecuador’s prisons. The incidence found is high. It is necessary to strengthen the diagnostic process to treat all the cases found and thus break the chain of transmission.

Keywords: mass screening; tuberculosis pulmonary; prisons; Ecuador.

INTRODUCTION

The Roadmap for Tuberculosis Elimination in Latin America and the Caribbean places emphasis on actively searching for PTB cases by identifying chronic coughers and focusing efforts on vulnerable populations. Prison inmates are one such group1,2.

Controlling tuberculosis in prisons is a major challenge for public health. Screening when entering prison and at regular intervals during incarceration has been shown to be the most effective way to prevent cases of TB, as this approach enables early diagnosis and timely treatment to be applied, thus interrupting the chain of infection3,4.

In 2016, Ecuador declared that it had a prison population of 160 per 100,000 inhabitants, which places it in the middle ranking amongst South American countries5. It has been implementing a reform of the prison system since 2013, which includes major structural changes to some of the country’s prisons. However, deficiencies in the physical infrastructure and provision of basic services still exist6,7.

This study sets out to assess tuberculosis surveillance strategies in the form of mass screening campaigns, using official records in Ecuador, at two men’s prisons with a large population density in 2016, to enable the Ministries of Health and Justice to take the necessary measures to improve diagnosis of tuberculosis when entering prison.

MATERIALS AND METHODS

A cross-sectional study was carried out. The population was made up of 1,332 male prisoners with cough and sputum for more than fifteen
days, chronic coughing, detected inside the prison through screening campaigns or spontaneous demands, and officially recorded at two prisons at Guayaquil, Ecuador, in 2016.

The information was gathered from the CC and tuberculosis records (secondary sources), which are standardised instruments used by the National Tuberculosis Programme (NTP) to assess the measures taken throughout the country\(^{6}\). The data was directly recorded in a data base of the Statistical Package for Social Science (SPSS), which was purged before analysis to prevent duplication, since in the original source the subjects are included every time they are detected with CC. After the data was obtained, the number of visits and other variables for each individual were summarised.

Diagnosing tuberculosis in Ecuadorian prisons has some unique characteristics. According to national standards, the culture should be tested with the Löwenstein-Jensen medium, as well as the two sputum microscopies with the Ziehl-Neelsen stain, in combination with drug sensitivity tests involving the proportion method and polymerase chain reaction to detect anti-microbial resistance in time. Two samples of sputum were collected within the 24 hours after the medical consultation. The samples are examined outside the prison at a specialist hospital in the same city. If the result is positive, treatment and monitoring are then administered in the form of short-term therapy directly supervised by the NTP\(^{8}\).

To evaluate the effectiveness of the screening strategy implemented in the prisons, the prevalence of the PTB period was calculated, along with the proportion of detected CC, the positivity ratio, the time distribution of the CCs and diagnosed cases of PTB, as well as the period of delay in diagnosis by measuring if the screening is ongoing and uniform in nature.

Definition of variables

Type of penal institution: the two prisons in this study were regional and coastal. The regional prison is a maximum security centre where the reforms mentioned above have been put into effect\(^{6,7}\). It has a module exclusively for inmates with PTB. The total population in 2016 was 4,170\(^{9}\). The coastal prison, where changes are still in the process of implementation, had a total inmate population of 8,195 in the same year\(^{9}\).

The inmates of the regional prison serve prison sentences, while the prisoners at the coastal prison are in custody or serving final sentence. The inmates of the regional prison serve prison sentences, while the prisoners at the coastal prison are in custody or serving final sentence.

The variables used for the logistic regression were: age, the prison, the diagnosis time and number of medical consultations, and the response varia-
Table 2 shows the positivity ratio according to the prison, the diagnosis time and number of visits. As regards the prison, there was a 3.3 times greater probability of finding a case of PTB in the coastal prison than in the regional centre. When the diagnosis time was six days or more, there was a positivity ratio of 19.7%, significantly different from the ones where the diagnosis time was less (14.6%).

A similar state of affairs was observed amongst inmates that had two or more visits. The proportion of positive CCs was 25.7%, significantly different from those with fewer visits. The OR was 1.6.

While the variables for age, prison, diagnosis time and number of visits showed a significant association with cases of tuberculosis, the age, diagnosis time and number of visits showed no significance when they were adjusted with the multivariate analysis (Table 3).

DISCUSSION

Screening campaigns to diagnose tuberculosis are not enough to control tuberculosis in Ecuadorian prisons.

The prevalence rate of PTB in the two prisons, based on the official figures for the prison population, was 1,870/100,000 inmates, 57.5 times greater than the official figures for the population of Ecuador (32.5/100,000 inhabitants) in the same year. However, the official figure includes men and women, in accordance with the findings in systematic review articles, which reported a prevalence of tuberculosis between 3 and 1,000 times greater amongst prisoners than in the community.  

The prevalence varies according to the country: a prevalence was found amongst prisoners in Río Grande (Brazil) that was 69 times higher than in the community, while prevalence in Ugandan prisons was found to be five times higher than amongst the general public. Both studies included an analysis of tuberculosis/HIV co-infection, which was not considered in this study as information of this type is not included in the “CC book”.

The positivity ratio of PTB was 17.3% in the prisons that were studied. The calculated data for male prisoners was reported as follows: 32.4% in Brazil, 17.0% in Iran, and 3.5% in South Africa. Similar values were found in countries that included prisoners of both genders: Malaysia 17.4%, Thailand 12.0%, Ivory Coast 4.2% and Ethiopia 8.6%. This article found that PTB is more common amongst young inmates, and similar results have
Valcárcel-Pérez I, Molina JL, Fuentes Z. 
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Rev Esp Sanid Penit. 2021;23(3):108-114 
doi: 10.18176/resp.00038

Table 1. Prevalence rates of respiratory symptoms and cases of pulmonary tuberculosis.

| Prison     | Prison population*, n | Variable | Cases (n) | Prevalence % (CI 95%) |
|------------|-----------------------|----------|-----------|-----------------------|
| Regional   | 4,170                 | CC       | 592       | 14.2 (13.1-15.3)      |
|            |                       | PTB      | 45        | 1.1 (0.8-1.4)         |
|            |                       | MDR-TB   | 12        | 26.7 (13.7-39.6)      |
| Coastal    | 8,195                 | CC       | 740       | 9.0 (8.4-9.7)         |
|            |                       | PTB      | 186       | 2.3 (2.0-2.6)         |
|            |                       | MDR-TB   | 2         | 1.1% (0.4-2.6)        |
| Total      | 12,365                | CC       | 1,332     | 10.8 (10.2-11.3)      |
|            |                       | PTB      | 231       | 1.9 (1.6-2.1)         |
|            |                       | MDR-TB   | 14        | 6.1 (3.0-9.1)         |

Note. *The prison population officially declared by the Ecuadorian Ministry of Justice in its monthly report of inmates in January 2018 was used to determine the rates.

CI: confidence interval; CC: chronic cough; MDR-TB: multidrug-resistant tuberculosis; PTB: pulmonary tuberculosis.

Table 2. Positivity ratio of pulmonary tuberculosis according to the analysed variables.

|                  | CC (N) | Positivity ratio (%) | CI 95%        | RP* | CI 95% |
|------------------|--------|----------------------|---------------|-----|--------|
| **Prison**       |        |                      |               |     |        |
| Regional         |        |                      |               |     |        |
| Coastal          | 737    | 25.2                 | 22.0-28.4     | 3.3 | 2.4-5.0|
| **Time of diagnosis** | | | | |
| Less than six days§ | 595    | 14.6                 | 11.8-17.5     | 1.4 | 1.1-1.7|
| Six or more days | 635    | 19.7                 | 16.6-22.8     | 1.4 | 1.1-1.7|
| **Number of visits** | | | | |
| One§             | 1.181  | 16.3                 | 14.2-18.4     |     |        |
| Two or more      | 148    | 25.7                 | 18.6-32.7     | 1.6 | 1.2-2.1|

Note. *Ratio of prevalence and §benchmark categories.

CI: confidence interval; CC: chronic cough.

Table 3. Factors associated with PTB amongst Ecuadorian prisoners in 2016.

| Variable                        | N     | Positive PTB | Negative PTB | Crude OR* (CI 95%) | Adjusted OR* (CI 95%) |
|---------------------------------|-------|--------------|--------------|--------------------|-----------------------|
| Age (years)                     | 769   | -            | -            | -                  | 1.0 (0.9-1.0)         |
| Coastal prison                  | 737   | 186 (25.2)   | 551 (74.8)   | 4.10 (2.9-5.8)     | 3.8 (2.5-5.5)         |
| Diagnosis time of more than six days | 635   | 125 (19.7)   | 510 (80.3)   | 1.43 (1.1-1.9)     | 1.1 (0.8-1.6)         |
| Two or more visits              | 148   | 38 (25.7)    | 110 (74.3)   | 1.8 (1.2-2.8)      | 1.5 (0.9-2.3)         |

Note. *Benchmark categories: regional prison; diagnosis time of less than six days, number of medical consultations.

CI: confidence interval; OR: odds ratio; PTB: pulmonary tuberculosis.
come to light in prison studies in Brazil, Ethiopia and Spain\textsuperscript{12,22,23}. The largest number of inmates held in custody or serving a short sentence for a minor crime are also generally young men\textsuperscript{24}.

Incarceration in the coastal prison is associated with a higher risk of PTB. The prison is characterised by greater overcrowding, with young prisoners awaiting sentencing, most of whom are in custody for minor offences, and where the penal reforms had not yet been implemented in the year of the study\textsuperscript{7}. Although we have no data about the length of imprisonment, there are grounds to believe that prisoners serving shorter sentences are sent to this prison. A study of prisons in Ethiopia\textsuperscript{25} and another in South Africa\textsuperscript{17} found no association between the length of imprisonment and the likelihood of presenting PTB, although more cases were found amongst inmates incarcerated for less than two years in Ethiopia and for less than three in South Africa.

The lack of uniformity in detecting cases of CC and PTB over the period measured in epidemiological weeks was not found in other studies available in indexed journals or grey literature. This information means we can assume that most of the CCs are detected in the screening campaigns carried out approximately every three months, coinciding with the quarterly evaluation reports and never at the moment the inmates enter prison, when there would be an increase of CCs between week 1 and 22, which is the rainy season on the Ecuadorian coast. We can also infer from this that the diagnosis does not include the culture and therefore the drug sensitivity test. This is because only the samples of BK+++ were cultivated, which does not meet the recommendations of national and international regulatory bodies\textsuperscript{8,26}.

The PTB diagnosis time was 4-8 days for 75% of the CCs that were detected and more than six days in 20% of the PTB cases. This possible delay in diagnosis is attributed to: not having a nearby laboratory available, not carrying out an X-ray test, and not having enough staff and time to carry out exhaustive interviews with suspected cases and so comply with international recommendations\textsuperscript{26-29}.

Some researchers\textsuperscript{27} have found that inmates generally have limited access to medical care because of the stigmas and changes in medical care patterns for populations of this type. At the same time, it has also been acknowledged that there are more opportunities to take effective control measures amongst prison inmates, given that they are captive populations.

Such measures would be:
1. Regular and standardised medical evaluations for early CC detection when entering prison.
2. Including the culture and drug sensitivity tests in the PTB diagnosis.
3. Isolating positive cases.
4. Provision of directly supervised standardised treatment.
5. Coordination with external control programmes.
6. Methadone maintenance programmes for heroin addicts\textsuperscript{28}.

It has been shown that such measures are the most effective way to prevent TB cases, since they enable early diagnosis and timely treatment of the disease, and so reduce incidence\textsuperscript{3,4}.

This study has the following limitations. The information collected was cleaned, given that the data is collected per visit and not per case. It is impossible to determine with any precision if the first consultation coincides with the inmate's entry into prison, and the cultures to diagnose tuberculosis have not been made in line with national regulations.

These situations raise the following questions: did the prisoners enter with latent tuberculosis and later develop PTB inside prison? Were they entering the prisons with active PTB? Or did they fall ill inside prison? Whatever the answers may be, the determining factors that play a part in the circulation of \textit{Mycobacterium tuberculosis} should be major considerations for future studies.

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REFERENCES
1. Torres-Duque CA, Fuentes Alcalá ZM, Rendón A, Migliori GB. Hoja de ruta para la eliminación de la tuberculosis en Latinoamérica y el Caribe. Arch Bronconeumol. 2018;54(1):7-9.
2. González-Martín J, García-García JM, Anibarro L, Vidal R, Esteban J, Blanquer R, et al. Documento de consenso sobre diagnóstico, tratamiento y prevención de la tuberculosis. Arch Bronconeumol. 2010;46(5):255-74.
3. Lienhardt C, Lönnroth K, Menzies D, Balsegaram M, Chakaya J, Cobelens F, et al. Translational Research for Tuberculosis Elimination: Priorities, Challenges, and Actions. PLoS Med. 2016;13(3):e1001965.
4. Merid Y, Woldeamanuel Y, Abebe M, Datiko D, Hailu T, Habtamu G, et al. High utility of active tuberculosis case finding in an Ethiopian prison. Int J Tuberc Lung Dis. 2018;22(5):524-9.

5. World Prison Brief. Ecuador: World Prison Brief data. [Internet]. WPB; 2018. [Citado 27 May 2018]. Disponible en: http://www.prisonstudies.org/country/ecuador

6. Gallegos Rivera JA. Sistema penitenciario: el reto de la rehabilitación en Ecuador. Universidad Católica de Santiago de Guayaquil; 2018.

7. Puebla MV. Crisis del sistema penitenciario en Ecuador: más allá de una declaración de estado de excepción. [Internet]. En: inredh.org. INERDH. 27 May 2019. [Citado 28 Ago 2019]. Disponible en: https://inredh.org/crisis-del-sistema-penitenciario-en-ecuador-mas-alla-de-una-declaracion-de-estado-de-excepcion/

8. Dirección Nacional de Normatización. Manual de Procedimientos para la prevención y control de la tuberculosis. [Internet]. Ministerio de Salud Pública de Ecuador; 2017. [Citado 27 May 2018]. Disponible en: https://www.salud.gob.ec/wp-content/uploads/2017/07/MANUAL-DE-PROCEDIMIENTOS-DE-TB-FINAL.pdf

9. Reporte mensual de personas privadas de libertad-Ministerio de Justicia, Derechos Humanos y Cultos | Ecuador. [Internet]. [Citado 29 Jul 2019]. Disponible en: https://www.justicia.gob.ec/reporte-mensual-de-personas-privadas-de-libertad/

10. Granda J. Anuario de vigilancia epidemiológica 1994-2017. Enfermedades respiratorias agudas graves. [Internet]. En: public.tableau.com. Tableau Software; 2016. Disponible en: https://public.tableau.com/profile/vivicente80#!/vizhome/respiratorias2014/ANUARIO

11. Biaidlegne F, Rodloff A, Sack U. Review of the prevalence and drug resistance of tuberculosis in prisons: a hidden epidemic. Epidemiol Infect. 2015;143(5):887-900.

12. Valença MS, Scaini JLR, Abileira FS, Gonçalves CV, Von Groll A, Silva PEA. Prevalence of tuberculosis in prisons: risk factors and molecular epidemiology. Int J Tuberc Lung Dis. 2015;19(10):1182-7.

13. Schwitters A, Kaggwa M, Omiel P, Nagadya G, Kisa N, Dalal S. Tuberculosis incidence and treatment completion among Ugandan prison inmates. Int J Tuberc Lung Dis. 2014;18(7):781-6.

14. Sánchez AR, Massari V, Gerhardt G, Barreto AW, Cesconi V, Pires J, et al. Tuberculosis in Rio de Janeiro prisons, Brazil: an urgent public health problem. Cad Saúde Pública. 2007;23(3):545-52.

15. Assefzadeh M, Barghi RG, Shahidi SS. Tuberculosis case-finding and treatment in the central prison of Qazvin province, Islamic Republic of Iran. East Mediterr Health. 2009;15(2):258-63.

16. Moosazadeh M, Khajani N, Nasehi M, Bahrampour A. Predicting the incidence of smear positive tuberculosis cases in Iran using time series analysis. Iran J Public Health. 2015;44(11):1526-34.

17. Telisinghe L, Fielding KL, Malden JL, Hanifa Y, Churchyard GJ, Grant AD, et al. High tuberculosis prevalence in a South African prison: the need for routine tuberculosis screening. PLoS One. 2014;9(1):e87262.

18. Jittimanee SX, Ngamtrairai N, White MC, Jittimanee S. A prevalence survey for smear positive tuberculosis in Thai prisons. Int J Tuberc Lung Dis. 2007;11(5):556-61.

19. Séri B, Koffi A, Daniel C, Ouassa T, Blehoué M-A, Ouattara E, et al. Prevalence of pulmonary tuberculosis among prison inmates: A cross-sectional survey at the Correctional and Detention Facility of Abidjan, Côte d’Ivoire. PLoS One. 2017;12(7):e0181995.

20. Adane K, Spigt M, Dinant G-J. Tuberculosis treatment outcome and predictors in northern Ethiopian prisons: a five-year retrospective analysis. BMC Pulm Med. 2018;18(1):37.

21. Addis Z, Adem E, Alema W, Birhan W, Mathewos E, Tachelle B, et al. Prevalence of smear positive pulmonary tuberculosis in Gondar prisoners, North West Ethiopia. Asian Pac J Trop Med. 2015;8(2):127-31.

22. Adane K, Spigt M, Ferede S, Asmelash T, Abebe M, Dinant G-J. Half of Pulmonary Tuberculosis Cases Were Left Undiagnosed in Prisons of the Tigray Region of Ethiopia: Implications for Tuberculosis Control. PLoS One. 2016;11(2):e0149453.

23. López de Goicoechea-Saiz ME, Sternberg F, Portilla-Sogorb J. Prevalence and associated risk factors of latent tuberculosis infection in a Spanish prison. Rev Esp Sanid Penit. 2018;20(1):4-10.

24. Fazel S, Baillargeon J. The health of prisoners. Lancet. 2011;377(9769):956-65.

25. Adane K, Spigt M, Johanna L, Noortje D, Aberra SF, Dinant GJ. Tuberculosis knowledge, attitudes, and practices among northern Ethiopian prisoners: Implications for TB control efforts. PLoS One. 2017;12(3):e0174692.
26. Organización Panamericana de la Salud. Guía para el control de la tuberculosis en poblaciones privadas de libertad de América Latina y el Caribe. OPS; 2008.
27. Altet Gómez MN, Alcaide Megías J. Control y eliminación de la tuberculosis en España: las estrategias para el siglo XXI. An Pediatr. 2006;64(1):66-73.
28. De Vries SG, Cremers AL, Heuvelings CC, Greve PF, Visser BJ, Béland S, et al. Barriers and facilitators to the uptake of tuberculosis diagnostic and treatment services by hard-to-reach populations in countries of low and medium tuberculosis incidence: a systematic review of qualitative literature. Lancet Infect Dis. 2017;17(5):e128-43.
29. González E, Armas L, Baly A, Gálvez A, Álvarez M, Ferrer G, et al. Impacto económico-social del Programa Nacional de Control de la Tuberculosis (PNCT) en la población cubana. Cad Saúde Pública. 2000;16(3):687-99.