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Prevalence and risk factors associated with pulmonary tuberculosis in a prison in Cali Colombia

Prevalencia y factores de riesgo asociados a tuberculosis pulmonar en un centro carcelario de Cali, Colombia

Sirley Muegues[1,2], Constanza Núñez[3], Luci Luna[4], Robinson Pacheco[1,5]

[1] Grupo de Investigación en Epidemiología y Servicios, Universidad Libre, Cali, Colombia.
[2] Fundación Universitaria los Libertadores, Bogotá D. C, Colombia
[3] Institución Universitaria Antonio José Camacho, Cali, Colombia.
[4] Secretaría de Salud Pública Municipal, Cali, Colombia.
[5] Departamento de Salud Pública y Medicina Comunitaria, Universidad ICESI, Cali, Colombia.

Correspondence: Sirley Muegues. Email: simuvi1980@hotmail.com

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Abstract

Background: Pulmonary Tuberculosis (PT) is a public health problem in the world and is exacerbated in prison centers.

Objective: to determine the prevalence and risk factors of PT transmission in a prison center in Cali, Colombia, 2013 - 2014.

Methods: Study of cases and controls. By institutional registry of the Villahermosa prison, reported 5,815 persons deprived of liberty during the study period; Of these 98 were cases and 98 controls.

Results: The prevalence of PT was 1.68%. The median age was 29.8 years (RIQ 23-33.5), the predominant ethnic group was mestizo with 55% (108/196), single marital status 57% (112/196), secondary education level 75% (129/196), socioeconomic level two, 71% (138/196), subsidized insurance 99% (194/196) and construction employment 71% (123/196). The probability of developing PT in this prison is explained by malnutrition (OR= 17.53 95% CI 4.06-76.78, p= 0.01), and HIV infection (OR= 8.93 IC 95 % 1.07-74.18 p= 0.04)

Conclusions: The dynamics of the transmission of PT is determined not only by the health conditions of individuals, but also by the characteristics of the environment where they interact as social beings. TB control programs should conduct indicator analysis in prison centers independently of the general population in order to implement prevention and control strategies focused on risk management.

Resumen

Antecedentes: La Tuberculosis Pulmonar (TBp) es un problema de salud pública en el mundo y se exacerba en los centros carcelarios.

Objetivo: Determinar prevalencia y factores de riesgo de la trasmisión de TBp en un centro carcelario de Cali, Colombia, 2013 - 2014.

Métodos: Estudio de casos y controles. El registro institucional de la cárcel de Villahermosa, reportó 5.815 personas privadas de la libertad en el periodo del estudio; de estos 98 fueron casos y 98 controles.

Resultados: La prevalencia de TBp fue de 1.7%. La mediana de edad 29.8 años (RIQ 23.0-33.5), la etnia predominante fue la mestiza con 55% (108/196), estado civil soltero 57% (112/196), nivel educativo secundaria 75% (129/196), nivel socioeconómico dos, 71% (138/196), aseguramiento subsidiado 99% (194/196) y ocupación en construcción 71% (123/196). La probabilidad de desarrollar TBp en la cárcel de Villahermosa es explicada por desnutrición (OR = 17.5 IC 95% 4.06-76.8,), y la infección con VIH (OR= 8.9 IC 95% 1.07-74.2).

Conclusiones: La dinámica de la trasmisión de la TBp está determinada no solo por las condiciones de salud de los individuos, sino, además, por las características del entorno donde estos se interactúan como seres sociales. Los programas de control de TB deben realizar análisis de indicadores en los centros carcelarios de manera independiente al de la población general a fin de implementar estrategias de prevención y control enfocadas en la gestión del riesgo.

Key contribution of the study

Objective	Determine the prevalence and risk factors of TB transmission in a prison in Cali, Colombia, 2013 - 2014.
Study design	Case control
Source of information	Medical records, treatment card and databases of the TB program.
Population/sample	5,815 PDL of the Villahermosa prison. The cases were 98 persons deprived of liberty with a clinical and microbiological diagnosis for TBp and 98 controls with similar risk factors and characteristics but with negative sputum Bk.
Statistical analysis	Descriptive statistics. Prevalence and ORs with their 95% CIs were determined. Cases and controls were compared with chi square and multivariate analysis with binomial logistic regression was performed.
Principle findings	The probability of developing TBp in PDL is explained by malnutrition (OR = 17.5 95% CI 4.06-76.8), and HIV infection (OR = 8.9 CI 95% 1.07-74.2).

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Introduction

According to the global tuberculosis report, during 2017, 10 million new cases were reported, with an estimated mortality of 1.3 million, with TB being the main cause of death from an infectious disease caused by a single etiological agent and the ninth highest cause of death from all causes (1). Although the disease can affect people of any age or social condition, it is maintained and perpetuated, via transmission, in the poorest, socially excluded communities, where people generally have higher rates of immune-debilitating comorbidities and access barriers to health services (2, 3).

The population deprived of liberty (PDL) represents one of the most vulnerable population groups for the transmission and development of the disease. Reporting up to 2,213 cases per 100,000 PDL in prisons in Peru and, together with other countries such as El Salvador, these populations have reached between 25-50 times the incidence with respect to the general population (4-6). In Colombia, during 2017, 985 cases of tuberculosis (all forms) in PDL were notified to the TB Surveillance System, with an incidence of 800 cases per 100,000 PDL. 92% of these cases were TBp (7).

In a prison study in Tolima, Colombia, a high prevalence of TBp was demonstrated in PDL (1.5%; 17/1,129; 95% CI: 0.8-2.2%) likewise, in Latin American countries such as Chile, Brazil, Bolivia, Ecuador and Paraguay have a higher prevalence of TBp in PDL than in the general population (8). The high transmission of TBp in prisons is explained by the combination of various social factors, such as barriers to access to health services (OR: 7.38; 95% CI: 2.3-23.4) (9), low level of education (OR: 10.7; 95% CI: 7.6- 13.6) (10), drug abuse (OR: 4.6; 95% CI: 1.7-12.4, p: 0.006) (11), alcohol (OR: 11.5; 95 CI %: 2.0–67.0) (9), and long sentences; environmental such as the high rates of overcrowding 88.2%; OR: 9.8; 95% CI: 3.1–31.6, p <0.001) (12); biological, related to immunosuppression such as HIV / AIDS (OR: 3.1; 95% CI: 1.02-9.40) (13,14), malnutrition (body mass index less than 18.5 kg / m2) (OR: 2.1; 95% CI: 1.3–3.0) (12) and depression. Likewise, in prisons in Colombia, overcrowding has been reported as the main risk factor for developing TBp (11,15,16).

Some authors note that prisons are a constant source of dissemination of the etiological agent Mycobacterium tuberculosis to the non-prison population; it is estimated that around 6% of cases originate from prison contacts (8). To reduce the vulnerability of PDL to TBp, the WHO urges TB control programs to implement, in prisons, strategies to capture, diagnose and treat the population with active TB in a timely manner (17). The limitations of access to prisons, by the TB control programs, and the high turnover rate of the PDL, limit the success in recruiting, diagnosing, treating and monitoring these patients (15,18-20). The understanding of the dynamics of TB transmission in prisons is achieved through constant evaluation of the burden of the disease and the presence of risk factors. This research aimed to determine the prevalence of TBp, and identify risk factors in PDL of a prison in Cali, Colombia 2013-2014.

Methods

Study design
An analytical observational study of cases and controls was carried out. Defining as "Case" all inmates with a clinical or microbiological diagnosis of TBp, and as "Control", all inmates with a time of confinement greater than six months, with no history of TB and with no respiratory symptoms related to TBp.

Study population
This investigation took place in the Villahermosa prison in the city of Cali, with a capacity of 1,667 inmates. During 2013-2014, 5,815 inmates were declared, giving an overcrowding rate of 248.8%.

From the records of patients with TB, 98 incident cases of TBp and 98 controls were selected through simple random sampling using as a sampling frame from the list of inmates from each yard and year where cases of TB were reported. A sample size calculation was performed using OpenEpi online software (http:// www.Openepi.com/SampleSize/SSCC.htm) to determine the power of the study: since the census resulted in 98 cases, and the calculated sample size yielded a value of 96 cases, a power of 80% is estimated.

All those who agreed to participate in the study filled out a questionnaire aimed at determining the variables that could be considered exposure factors associated with TBp in this population of PDL. The clinical information was recovered from three sources of information: the medical records of the Villahermosa prison health center; official databases of patients from the TB Control Program in prison and the individual card for treating TB cases.

Variables
The following information was collected in this PDL population with or without TBp. Sociodemographic variables, such as age, ethnicity, marital status, socioeconomic status, occupation, educational level and health regime, as well as clinical and social variables such as malnutrition, HIV, were analyzed. Diabetes, pneumonia, hypertension, asthma, scabies, syphilis, gastritis and drug dependence were also considered, to determine the risk factors for TBp in this sample of PDL of the Villahermosa prison in Cali, Colombia.

Data management and statistical analysis
All the information was collected in Microsoft Office Excel® and analyzed using the Stata 12™ statistical package (Stata Corp, College Station, TX, USA). Once all the information had been collected, a probability sampling of 10% of the records was carried out and they were compared against the source documents. The information was verified and no discrepancies were found between what was entered and the information sources. Through a univariate analysis, the distribution of quantitative variables was evaluated using the Shapiro-Wilk statistical test, taking a value of $p \leq 0.05$ as significance. The variables were summarized through medians and interquartile ranges. The qualitative variables were summarized as percentages and are presented in frequency tables.

Through a bivariate analysis using contingency tables and taking the Odds Ratio (OR) with their respective 95% confidence

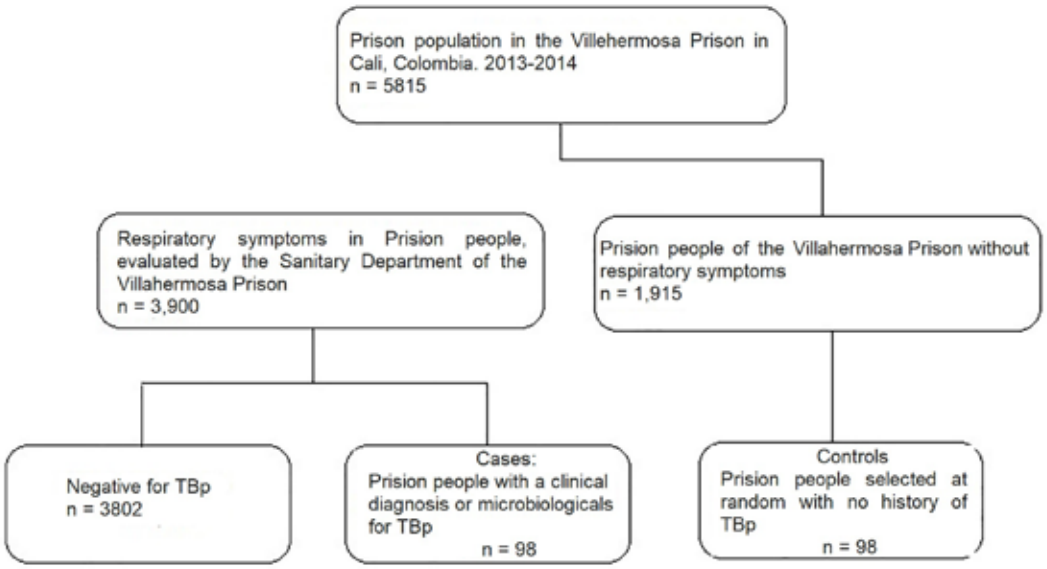

Figure 1. Study population flow diagram: Prision people with Pulmonary Tuberculosis.

intervals as an association measure, the associations between the exposure variables and the result variables "has or does not have TBp". The comparison of the categorical variables between cases and controls was done through the Ji^2 or Fisher statistical test and the quantitative variables via the T Student or Mann-Whitney test, as appropriate. To control for possible confounding variables and to evaluate the weight of each variable in the development of TBp in this population of PDL, a multivariate analysis was performed through a logistic regression, incorporating those variables that in the bivariate analysis had p-values ≤0.20. The model was built with the Backward strategy and the most parsimonious model was selected through the likelihood ratio.

Ethical Statement

The Ethics Committee of the Universidad Libre in Cali, Valle, endorsed the study, as detailed in Act 02-2 of April 27, 2015. Ethical approval from the INPEC and the Municipal Health Secretariat of Cali was also obtained. All information relating to the identity of the participants was masked with numerical codes to prevent any possible traceability of the identity of the participants; no one outside the research or the ethics committee had access to this information.

Results

Between January 1, 2013 and December 31, 2014, the Health Department of the Villahermosa prison in Cali evaluated 3,900 respiratory symptoms in the 11 prison yards and reported 98 incident cases of TBp to the municipal program of TB control in Cali (Figure 1). The cumulative incidence during the study period was 1,685 cases of TBp per 100,000 PDL, rising from 447 cases of TBp per

Table 1. Demographic factors determining TBp in PDL en Cali, 2013-2014.

Characteristics	Description	Cases (n= 98)	Controls (n= 98)	OR	IC LI-LS	p
Age	years	28.0 (22-33)	28.5 (25-37)	0.96	0.92-0.99	0.02
Ethnicity	Mixed	49	59	1.51	0.82-2.77	0.15
	Afrocolombian	49	39			
Marital status	Partner	46	38	1.39	0.79-2.56	0.24
	No partner	52	60			
Socioeconomic status	Class 1	35	22	0.51	0.27-0.96	0.03
	Class 2	62	76			
Occupation	Construction	57	66	0.81	0.39-1.64	0.53
	Other occupation	21	30			
Level of education	Primary	18	25	1.06	0.50-2.29	0.85
	Secondary	56	73			
Type of health insurance	Subsidized	97	97	1.00	0.01-79.29	1.00
	Contibutes	1	1			

100,000 PDL in 2013 to 1,238 cases of TBp per 100,000 PDL in 2014. Regarding the proportion of respiratory symptoms in individuals in which TBp had been diagnosed, this was 2.5% (98/3,900) in both years of the study, and 1.7% (26/1,566) and 3.1% (72/2,334) for 2013 and 2014 respectively. The temporal behavior of incident cases showed an increase of almost double in 2014 compared to 2013. The months with the highest number of new cases were June with 12 cases, and May and November with 9 (Figure 2).

Demographic and clinical information from 196 PDL records (98 incident cases and 98 controls) was analyzed. The median age was 29.8 years (IQR: 23.0-33.5), the predominant race was mestizo [mixed] at 55.0% (108/196) and the most frequently reported marital status was single at 57% (112/196). 75% (129/196) of the participants reported having completed basic secondary education and only the two lowest socio-economic strata were reported, of which 71% (138/196) belonged to Class 2. With regard to insurance, 99% (194/196) had a subsidized regime and 71% (123/196) declared that they worked in the construction sector.

When comparing cases and controls through bivariate analysis of their demographic characteristics, it was found that age (OR: 0.96; 95% CI: 0.92-0.99, p: 0.02), and socioeconomic level (OR: 0.51; 95% CI: 0.27-0.96, p: 0.03), were significant at p: <0.05 (Table 1). Regarding the clinical characteristics, the bivariate analysis showed a statistically significant association between TBp, with malnutrition (OR: 17.53 95% CI: 4.06-76.78, p: 0.01), and HIV infection (OR: 8.93; 95% CI: 1.07-74.18 p: 0.04) being statistically significant (Table 2).

According to the findings of the multivariate logistic regression, and after adjusting for the other demographic and clinical characteristics and habits of consumption of psychoactive substances and alcohol (Drug Dependence), the presence of TBp in this population of PDL in Cali is explained by their state of malnutrition and their HIV status, which reveals that subjects with TBp had 16.7 (95% CI: 3.7-74.1 p: 0.000) and 8.95 (95% CI: 1.02-77.86, p: 0.04) times more chance of acquiring this infectious disease (Table 3).

Discussion

This is the first study to evaluate the frequency and determinants associated with the presence of TBp in PDL incarcerated in the Villahermosa prison in the city of Cali, Colombia. Demographic, clinical and alcohol and psychoactive substance use (drug dependence) information was analyzed from 98 incident cases and 98 controls between 2013 and 2014.

During the study period, the prevalence of TBp in PDL in the Villahermosa prison was 1.68%: 0.44% (2013) and 1.23% (2014), while the positivity of TBp in respiratory symptomatic patients was 67.0% and 1.7 and 3.1% respectively. Other studies in PDL in Colombia confirm the high frequency of TBp positivity in this vulnerable population. In 2013, it was reported that 16.2% (1,129/6,961) of the total PDL in 10 prisons in the department of Tolima, were respiratory symptoms, while the prevalence of TBp was 1.5% (17/1129) in this population (8).

Table 2. Clinical and social determinants of TBp in the PDL population in Cali, 2013-2014.

Characteristics	Description	cases (n=98)	controls (n=98)	OR	IC LI-lS	p
Malnutrition (BMI <18.5)	Yes	24	2	1.75	4.06-76.78	0.01*
	No	65	95			
HIV	Yes	7	1	8.93	1.07-74.18	0.04*
	No	76	97			
Diabetes	Yes	2	3	0.78	0.12-4.79	0.79
	No	81	95			
Pneumonia	Yes	1	2	0.58	0.05-6.57	0.66
	No	82	96			
Hypertension	Yes	2	5	0.45	0.08-2.43	0.36
	No	81	93			
Asthma	Yes	3	9	0.37	0.09-1.41	0.14
	No	80	89			
Scabies	Yes	3	2	1.79	0.29-11.03	0.52
	No	80	96			
Syphilis	Yes	1	1	1.18	0.07-19.20	0.9
	No	82	97			
Gastritis	Yes	2	7	0.32	0.06-1.58	0.16
	No	81	91			
Drug dependent	Yes	61	61	1	0.56-1.78	1.0
	No	37	37			

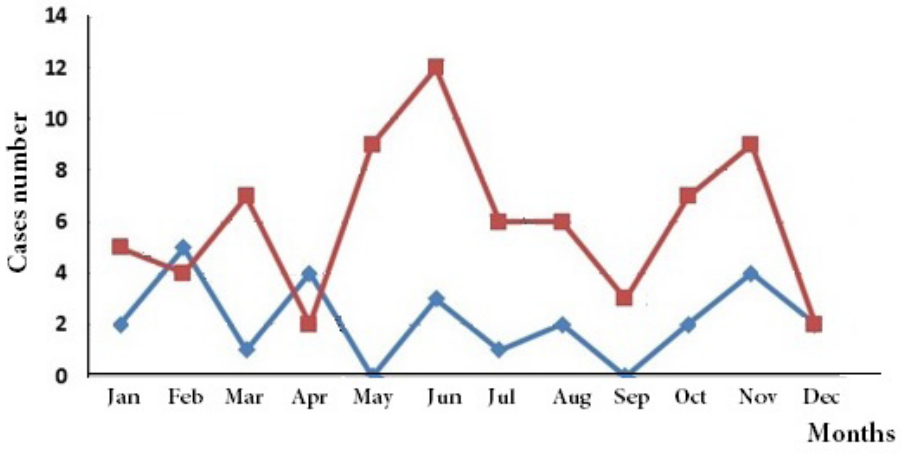

Figure 2. Temporal behavior of incident cases of pulmonary TB in PDL of the Villahermosa Prison in Cali-Colombia 2013-2014.

The prevalence reported in prisons in other countries such as Brazil and Peru, can reach 12.9% (36/279) and 79.5% (245/308) respectively (21,22). With respect to reports from prisons in Africa, Nigeria reports a prevalence of 54.2% (91/168) (23) and in Ethiopia the prevalence ranges from 4.9% (765/15,495) and 19.4% (24/124) (24), with incidences of 211 per 100,000 inhabitants, this being more than double that reported in the general population (25). In Zambia, the prevalence is up to 18 times higher (6.4) (26). The above data are within the estimate given by the WHO, of up to 100 times higher prevalence in prisons compared to the general population (27).

The main findings regarding the risk factors for developing TBp in PDL at the Villahermosa prison were malnutrition and HIV infection, as described in the literature. Scientific research shows a greater susceptibility of the host to TB in patients with compromised immune system, including HIV infection and malnutrition states (28-30). In our study, the state of malnutrition was evaluated through the BMI considering scores equal to or less than 18.5 kg/m^2 as low nutritional status.

Other studies carried out in prisons in Latin American countries reported BMI lower than 18.5 kg/m^2 in patients with TBp (OR: 12.7; 95% CI: 9.6-15.7) (31) and two cross-sectional studies in prisons, Central de Mbuji-Mayi, Democratic Republic of Congo (BMI <18.5 kg/m^2, OR: 2.1; 95% CI: 1.3- 3.0 PAF: 35.6%), and Tajikistan (BMI <18.5 kg / m2, OR: 5.79; 95% CI: 3.07-10.91), indicate that PDLs, being in a state of malnutrition, are more likely to develop TBp (12,32).

Regarding our finding that HIV is a risk factor for developing TB in the PDL of the Villahermosa Prison, this is in line with reports from prisons in the North of Gondar, northwestern Ethiopia, Southeastern Iran and cities such as Bucaramanga and Medellín in Colombia, where HIV prevalence was significantly associated with TBp among prisoners (OR_{adj}: 7.26; 95% CI: 1.10-33.30; p: 0.024), (OR: 2.4; 95% CI. 1.1-5.0, p: 0.25), and 4.2% respectively, confirming that HIV infection presents a great opportunity to pass from infection to TB disease (11,33,34).

The main weaknesses of this research are that the variables regarding habits and behavior recognized as risk factors were self-reported by the subjects, meaning that there may be underreporting or information bias due to socially accepted responses. Additionally, malnutrition was only measured with the BMI and not with other methods, such as the measurement of the thickness of the skinfolds (with gauges), underwater weighing, bioelectrical impedance, dual X-ray absorptiometry (DXA) and isotope dilution, as outlined by the Center for Disease Control and Prevention (CDC). These methods are not always available, as they are highly expensive and also require highly qualified personnel (31). Given that the dynamics and conditions of prisons may vary in each prison institution, these data only represent the Villahermosa prison and penitentiary for the period analyzed.

Table 3. Multivariate analysis. Risk factors for TBp in PPL in Cali, Colombia 2013-2014.

Characteristics	Description	Cases (n=98)	Controls (n=98)	OR Adjusted	IC 95%	p
Malnutrition	Yes	24	2	16.76	3.7-74.5	0.000
	No	65	95			
HIV	Yes	7	1	8.95	1.0-77.9	0.040
	No	76	97			

Conclusions

The dynamics of TBp transmission is determined not only by the health conditions of the individuals, but also by the characteristics of the environment where they interact as social beings. In prisons, the risk factors for developing TBp are magnified by the extreme conditions of overcrowding, high rates of consumption of psychoactive substances, violence, and limitations in access to health services. The control of TBp in Villahermosa must be approached from the perspective of health determinants, improving the environmental and nutritional conditions of the PDL and their access to health services, evaluating the presence of physical, environmental and psychosocial risk factors at the time of admission to the prison. It is also important to ensure timely diagnosis and treatment and comprehensiveness in the provision of health services.

The concentration and perpetuation of TBp in prisons acts as a focus for other geographic areas of the cities. TB control programs must, therefore, carry out indicator analysis in prisons independently of the general population in order to implement prevention and control strategies focused on risk management.

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Conflicts of interest
All authors declare that they have no conflicts of interest that may influence the results or conclusions of the article.

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