Original

RESP

Determinants of tuberculosis in the prison population in Catalonia

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ABSTRACT

Objective: Describe the characteristics of inmates who have or have had tuberculosis (TB) and identify associated factors.
Material and method: An observational, prospective, multicenter, population-based study was carried out on patients admitted to the nine prisons in Catalonia between March 1 and June 30, 2023. The patient's history of TB was assessed, and the presence of current TB was confirmed/ruled out. In TB cases, predictor variables were studied using bivariate and multivariate logistic regression analysis, calculating the risk ratio (RR) and its 95% confidence interval (CI).
Results: There were 1,679 admissions, 2.3% with previous TB and 1 with TB detected at screening. TB cases were older (45.1 *vs*. 33.7 years) and more frequently intravenous drug users (6.9% vs. 1.7% in non-users), Asian (9.1% vs. 1.4% in non-Asian), HIV-infected (10.3% vs. 1.9% in non-infected) and homeless (3.4% *vs*. 1.9% in those with a home). Multivariate analysis confirmed the association with: a) be older (RR: 2.9 in >30 years of age and RR=5.8 in >60 years of age, P =0.001); b) Asian origin (RR: 8.81; P <0.001); and c) not having a home (RR: 3.07; P = 0.005).
Discussion: 2.3% had or had previously had tuberculosis. Therefore, it is essential to carry out tuberculosis screening upon admission to detect new cases or exacerbations and prevent TB transmission in an enclosed environment. Previous tuberculosis was more common in older adults, Asians, and those without shelter or housing; such groups require special follow-up.

Key words: prisons; tuberculosis; mass screening; diagnostic screening programs.

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INTRODUCTION

TB is an infectious disease with the highest levels of morbidity and mortality in the world. There were 10.8 million incident cases in 2023, making it a serious public health issue, especially amongst vulnerable populations. The incidence of the disease has increased in Spain[1] and other countries[2] since 2021 as a result of the COVID epidemic, which reduced controls of TB and other diseases. Cases of TB and deaths caused by the disease take place mostly in countries with low or medium economic resources or amongst socially disadvantaged persons in wealthy countries. Such persons are more likely to be incarcerated.

TB and prison have long been a synonym because of frequent overcrowding in prisons, poor hygiene and ventilation in some centres and the characteristics of the inmates themselves, who are more frequently infected by *Mycobacterium tuberculosis*[3].

The overcrowding and deficiencies in hygiene found in some prisons are a breach of international regulations on inmates' human rights; they create a hazardous environment for both inmates and prison professionals and also imply a risk to inmates' physical and mental health[4]. Furthermore, the characteristics of many inmates (many of whom are irregular migrants, homeless persons, intravenous drug users, etc.) mean that there is a higher incidence of TB in this group[5,6], which some studies estimate to be between 6 and 30 times higher than it is amongst the general public[5].

Prisons are also enclosed or semi-enclosed centres where there is a higher risk of infection from diseases that, like TB, are mainly transmitted through the air. For all the reasons mentioned above, many of the persons who enter prison may have or continue to TB. It is therefore essential to quickly detect the disease, isolate smear-positive patients to break the chain of infection, prevent infection of third parties (inmates, professionals and visitors) and commence treatment for TB. The objective of this study is to determine how many of the persons who enter prison present or have presented TB and identify possible determining factors of the disease that might enable preventive strategies to be designed and TB detection to be optimised.

MATERIALS AND METHODS

Study design and population

Prospective, multi-centre and observational study of the prevalence of TB and the population base. A study was carried out of all the persons who entered any of the nine prisons in Catalonia: five in Barcelona province (CP Brians 1, CP Brians 2, CP Lledoners, CP Quatre Camins, CP de Joves, and CP de Dones), one in Girona (CP Puig de les Basses), one in Lleida (CP Ponent) and one in Tarragona (CP Mas d'Enric) in the period between 01/03/2023 and 30/06/2023.

Process and variables

All the inmates were checked to see if they had presented with TB, using the interview conducted in the prison committal phase and the shared clinical history used in Catalonia[7] as information sources. The history offers a set of web services that enable healthcare professionals to publish and consult medical information generated by centres about patients.

The TB screening program was applied to all recent admissions: anamnesis, tuberculin test and/or interferon gamma release assays if there were no previous records of a positive result and no background of TB, radiological study of infected persons or suspected cases and, if relevant, a microbiological study.

To check possible factors associated with TB, the following data was gathered: a) sociodemographic variables: age, sex, origins and social situation; b) variables associated with legal (tobacco and alcohol) and illegal drug use (type of substance and route of administration); and c) clinical-therapeutic variables: diabetes *mellitus*, HIV infection, transplant, other immunodeficiencies and treatment with biologic drugs and/or immunomodulators. Alcohol consumption was evaluated according to the level of risk associated with consumption, as per the update issued by the Ministry of Health[8] and recommendations of the Health Department of the Regional Government of Catalonia[9].

Statistical analysis

A background of TB was used as the dependent variable, while the other variables were utilised as independent ones. The prevalence of previous TB was calculated, along with any possible associated factors. The statistical analysis was carried out with the Statistical Package for the Social Sciences-Personal Computer (SPSS-PC), and the mean, standard deviation and percentages were used to quantify the distribution of the variables. Finally, to determine the predictive variables associated with the background of TB, a bivariant logistical regression analysis was carried out, while the variables that showed a statistical association (P <0.1) were included in a multivariant

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model, with the relative risk being calculated with the corresponding CI at 95%.

Ethical considerations

The study was carried out in accordance with international ethical recommendations (Helsinki Declaration and Oviedo Convention) and the best clinical practices of the Spanish government, enshrined in the Law of quality and cohesion of the National Health System of 2023. The data was processed in accordance with Regulation 2016/679 of the European Parliament and Council, concerning the protection of data of 27 April 2016 and Organic Law 3/20181 on data protection and guarantees of digital rights. All the participants signed an informed consent document and the project was evaluated by the Jordi Gol Clinical Research Ethics Committee (CEIC) of the University Institute of Primary Care Research (IDIAP), which approved the project under code number CEIC: 23/110P.

RESULTS

1,679 recently admitted inmates with an average age of 38.1 years were studied (SD: +/- 11). 93% of the inmates were men, 62.1% were foreigners and 10.4% were IDUs. 22.8% had no home or place of residence and 3.5% were HIV positive. Other descriptive characteristics of the population can be seen in Table 1.

The data for TB showed that 38 (2.3%) of the inmates had already presented with the disease, according to comments made in the anamnesis or information taken from the clinical record. The screening carried out during admission also found another case of TB that had not previously been diagnosed (Figure 1).

The prevalence of TB was found to be higher than the total average prevalence (2.3%) in the following groups (Figure 2): a) older patients (2.9% in ≥30 years, and 5.8% in ≥60 years); b) in IDUs (6.9%); c) in smokers (2.5%); d) in high-risk alcohol users (3.1%); e) in the homeless (3.4%) and f) in HIV positive persons (10.3%). However, three of these groups: a) smokers (2.5% of TB in smokers against 1.5% in non-smokers); b) high-risk alcohol users (3.1% of TB in high-risk alcohol users against 2% who were not) and c) foreigners (2.3% of TB in foreigners against 2.1% in Spaniards) did not present a statistically significant association: $P = 0.20$, $P = 0.19$ and $P = 0.91$, respectively). However, when the foreign patients were categorised into geographical areas, the prevalence of TB amongst Asian persons was found to be much higher (9.1% compared to 1.4% of those who were not) and statistically significant ($P < 0.001$).

Finally, the multivariant analysis confirmed the association between TB and older ages, being of Asian origins and being homeless, while associations with being an IDU and being HIV positive were ruled out. Table 2 shows the results of the bivariant and multivariant analyses, along with the OR and corresponding CI when the variables were found to be statistically significant.

DISCUSSION

This study showed that persons entering prison have a very high probability (2.3%) of having or having had TB. The yearly risk of infection from TB amongst the Spanish general public was 0.12% in the early 21st century[10] and it is estimated that the 1% yearly risk of infection is expressed as 50 to 100 cases of TB per 100,000 inhabitants[11]. This implies that in the last 20 years the risk amongst the Spanish population of presenting TB has been approximately 0.09-0.12%; i.e., a risk between 10 and 25 times less than that of persons who are convicted to prison sentences. This difference between the general public and the prison population matches the observations made in the meta-analysis of the prison population by Cords *et al.*[5].

Active TB was detected in the 1,679 subjects who entered Catalonian prisons during the months of the study, matching the origin and characteristics of the population, and therefore the risk of presenting TB. Indeed, in 2023, 17 cases of TB were reported[12] in Catalonian prisons, equivalent to an incidence of 211 cases per 100,000 inhabitants, 20 times higher than the incidence outside prison (8.3 per 100,000)[1], but 30 times lower than it was 30 years ago, when it was approximately 6,000 cases per 100,000[13].

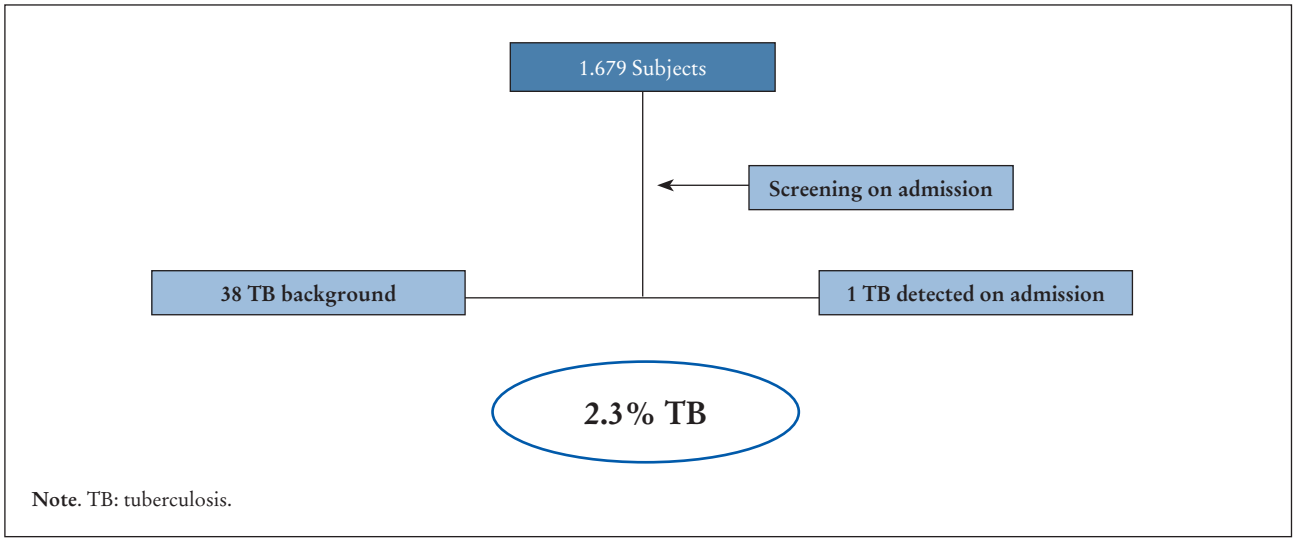
The current incidence of TB amongst inmates in Catalonia is comparable to the ones found in Mediterranean European countries[5] and well below the incidence observed in South American[14], African[15] and Thai[16] prisons, As for the detected case of TB, it is important to point out that this incident prevented the transmission of TB inside the prison, which has happened on other occasions and been observed from molecular epidemiology carried out at prisons in Catalonia[17] and the Madrid region[18].

The results of this study showed that the likelihood of having TB increased with age. This may be due to

Table 1. Sociodemographic characteristics of the population in the study.

Variable		n (%)
Age group	<21	88 (5.2)
	21-29	461 (27.5)
	30-59	1,078 (64.2)
	≥60	52 (3.1)
Sex	Male	1,561 (93.0)
	Female	118 (7.0)
Origin	Spanish	636 (37.9)
	Foreign	1,043 (62.1)
IDU	IDU at some time	174 (10.4)
	Non-IDU	1,505 (89.6)
Tobacco	Current smoker	1,343 (80.0)
	Ex-smoker/non-smoker	336 (20.0)
Alcohol	Non-drinker or low-risk drinker	1,323 (78.8)
	High-risk drinker	356 (21.2)
Social situation	Homeless	382 (22.8)
	With home	1,297 (77.2)
HIV infection	Yes	58 (3.5)
	No	1,570 (93.5)
	Unknown	51 (3.0)
Diabetes *mellitus*	Yes	50 (3.1)
	No	1,629 (96.9)
Biologic treatments or immunomodulators	Yes	5 (0.3)
	No	1,674 (99.7)
Transplant	Yes	1 (0.05)
	No	1,678 (99.95)

Note. IDU: intravenous drug user; HIV: human immunodeficiency virus.



Note. TB: tuberculosis.

Figure 1. Distribution of admissions to prison with a background of TB or who were detected with the disease.

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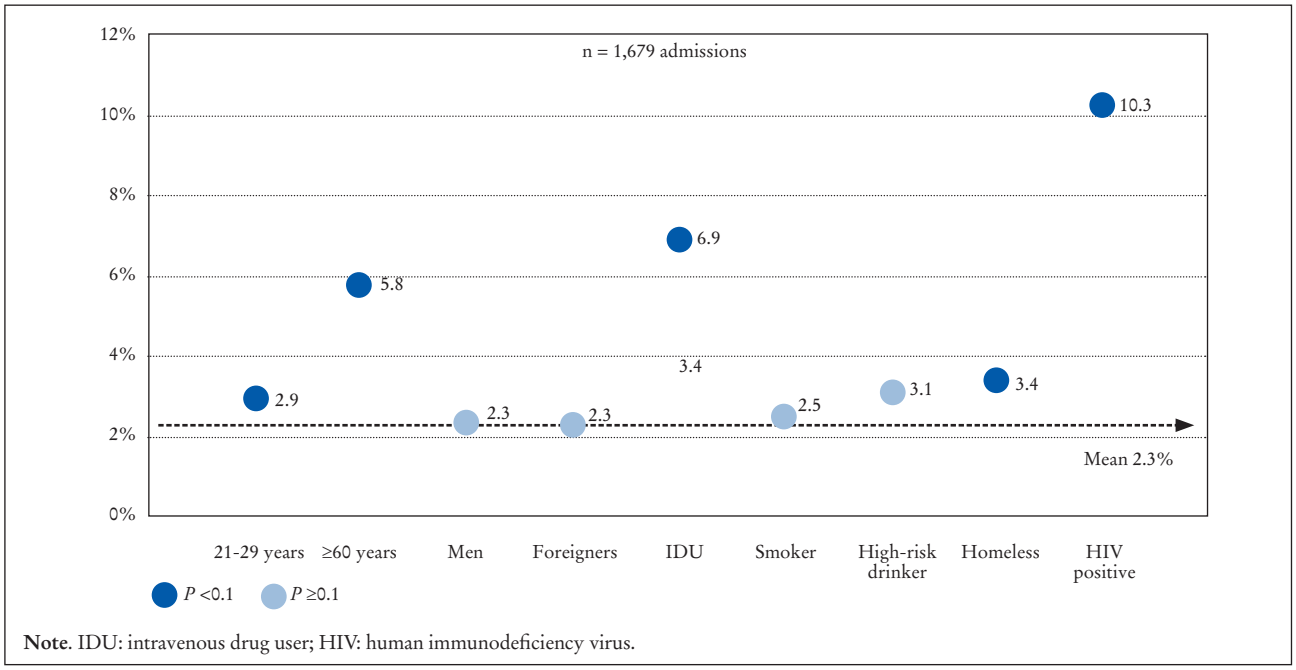
Table 2. Variables associated with presenting tuberculosis and level of statistical significance. Bivariant and multivariant analysis.

	Bivariant analysis		Multivariant analysis	
Variable	Background of TB	Value *P*	RR CI (95%)	Value *P*
Age	Less at lower ages (0% at <21; 0.9% from 21 to 29; 2.9% from 30 to 59; 5.8% >60	*P* = 0.01	0.95 (0.92-0.98)	0.001
Sex	2.3% in men and 1.7% in women	*P* = 0.49		
Geographical area	9.1% in Asians compared to 1.4% in non-Asians	*P* = 0.015	8.81 (4.10-18.93)	<0.001
IDU (at some point)	6.9% if IDU and 1.7% if non-IDU	*P* <0.001	NS	
Smoker	2.5% if smoker or ex-smoker and 1.5% if non-smoker	*P* = 0.19		
Alcohol	2.6% in non-drinkers. 1.4% if low-risk drinker and 3.1% if high-risk drinker	*P* = 0.18		
Homeless	3.4% if homeless and 1.9% if they have a home	*P* = 0.07	3.07 (1.39-6.77)	0.005
HIV infection	10.3% in HIV positive and 1.9% if HIV negative	*P* = 0.001	NS	

Note. CI: confidence interval; IDU: intravenous drug users; RR: relative risk; TB: tuberculosis; HIV: human immunodeficiency virus; NS: not significant.



Note. IDU: intravenous drug user; HIV: human immunodeficiency virus.

Figure 2. Distribution of previous or current rate of tuberculosis amongst inmates entering prison, according to categories subject to analysis. Bivariant analysis.

the fact that many inmates are infected with TB[19-22], especially older ones, and many of them also possess factors that indicate a risk of progression. Although the classical view of TB as a disease of children and young adults still persists, there is evidence that the incidence of the disease in more developed countries is shifting towards older populations, associated with greater comorbidity and immunosenescence[23].

A statistically significant association was observed between being of Asian origin and TB diagnoses. It is worth mentioning that 58.2 of the cases reported in Catalonia in 2022 were from other countries, which is a rate of incidence of 36.2 cases per 100,000 inhabitants, five times higher than the one established for Spanish inmates, while 22.4% of these cases were found amongst persons of Asian origin[24].

The association between being Asian and presenting TB was also highlighted by the Centres for Disease Control and Prevention (CDC), since the diagnosis of TB amongst Asian stands at 30% in the USA, with an incidence 32 times higher than the one for non-Hispanic whites[25].

Finally, it was found that being homeless was also a predictive factor for TB. The latest epidemiological report in Catalonia[24] showed that 31% of TB cases were diagnosed in persons in situations of social vulnerability, and it has already been mentioned that lack of housing and overcrowding in hostels for the homeless is related to a higher prevalence of TB and more limited access to medical care[26], which may lead to epidemics if prevention and control measures are not taken. The consequence may in fact be even more serious: a study carried out in London concluded that homeless patients not only have TB more frequently, but are also more likely to not complete treatment and so present resistance to antituberculosis drugs[27].

This study has some limitations and strengths. The weaknesses include the design, which provides data at a specific moment and therefore does not enable a time sequence between variables to be established. Another is the issues arising from the use of clinical records as a source of information, which always implies the risk of potential underreporting. It does however have some positive aspects. For example, it is a multicentre study that includes all the patients that entered Catalonian prisons, and this prevents selection biases, quantifies and analyses the real situation, and therefore enables future measures to be coherently designed. Another noteworthy point is that the analysis used information gathered from habitual clinical practice (anamnesis on admission and electronic clinical records), which means that economic costs and the workload are not increased, which are very important factors when working large populations like the one considered in this study. Finally, it should be pointed out that this research was probably feasible because prison healthcare in Catalonia is managed by the Department of Health and not by other departments such as Home Affairs or Justice. As some authors have pointed out[14], this has made it possible to avoid working with a hierarchical structure with rules, codes, cultures and objective that are different from those used in the health system, and facilitates research like the one presented here, ethically and clinically supervised by healthcare agencies.

To sum up, screening for diseases when entering prison is tremendously important, inasmuch as it enables the study of a population that often has little access to healthcare resources and which often presents infections and/or diseases. Screening has some obvious advantages for inmates' health, for that of the persons who work in prisons and for society as a whole, since it enables the early detection of infections and diseases and prevents transmission inside prison and after release. For example, this study showed that 2.3% of recently admitted inmates had or had had TB. The patients most likely to suffer from this condition were mainly older inmates, Asians and homeless persons. Groups such as these should therefore be considered to be of special interest in screening.

The control of TB in prisons as part of the international fight against the disease. It may be true that putting an end to the TB epidemic by 2030, as the UN suggests in its objectives related to health in the UN Sustainable Development Goals[28], is unattainable and probably utopian in scope, but a utopian vision should and often is the starting point of any progress, as is the design of a better future to which prison institutions also have the obligation to contribute.

Ethical committee

The project underwent evaluation by the Jordi Gol Clinical Research Ethics Committee (CEIC) of the University Institute of Primary Care Research (IDIAP).

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