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Original Article

The complexity of TB/HIV coinfection: an analysis of the social and health services context in the state of São Paulo, Brazil

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Abstract

Introduction: Brazil is in the 19th position of priority countries for the control of TB/HIV coinfection, so we aimed to analyze the social and health services contexts that are associated with TB/HIV coinfection in São Paulo state.

Methodology: Ecological study conducted in 645 cities of the state. The study population consisted of 10,389 new cases of TB/HIV coinfection in state residents between 2010 and 2015. The variables and indicators used in the study were collected from secondary sources. To identify the factors associated with the occurrence of TB/HIV coinfection cases, generalized additive models for location, scale and shape were used. The best distribution model was defined from the lowest Akaike information criterion value.

Results: There was an association between the occurrence of coinfection and the diagnosis of TB after death and greater treatment default. There was also an association with greater coverage of nurses and Family Health Strategy, which comprises Primary Care settings focused on families. Regarding the social context, the Gini Coefficient of inequality was identified as a determinant of coinfection.

Conclusions: The study presents the complexity of TB/HIV coinfection, proposing critical points in the health services and social context. Despite the high coverage of nurses and Family Health Strategy in some cities, this did not affect the reduction of the incidence of coinfection. These findings may be attributed to a fragmented care and focused on acute conditions. Furthermore, this model of care holds few prospects for care integration or prioritization of prevention and health promotion actions.

Key words: Tuberculosis; HIV; coinfection; health services research, social determinants of health.

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Introduction

The World Health Organization (WHO) recommends ending tuberculosis (TB), Human Immunodeficiency Virus (HIV) infection and Acquired Immunodeficiency Syndrome (AIDS) using strategies such as End TB, eliminating TB by 2035 [1] and goal 90-90-90 to end the AIDS epidemic by 2030 [2]. Coinfection from TB/HIV compromises compliance with the strategies mentioned due to the greater vulnerability and complexity of the cases, the difficulty in establishing a timely diagnosis and the problems in monitoring both treatments. In 2015, there were an estimated 1.1 million people with TB/HIV coinfection worldwide, and in Brazil, this number was 6.8 thousand people, placing the country in 19th position of priority countries for TB/HIV coinfection control [1].

In addition, the complexity of TB/HIV coinfection care involves structural aspects, such as macro health and social protection policies; aspects related to the culture of a society, such as discrimination and stigma; aspects related to individuals, such as behaviors, lifestyle, psychological disorders and stress [3]; and aspects related to the organization of health services, which may favor or hinder the access of affected populations to actions and the health system [4,5]. The challenges of TB/HIV co-infection care also lie in the fact that treatment involves prescribing medications for both conditions, predisposing the patient to drug

interactions, treatment default, and the acquisition of severe forms of the disease, such as resistant TB [1,6].

Among other difficulties for the control of TB in patients coinfected with HIV, the higher occurrence of false-negative results to the smear, molecular rapid test and culture tests; the higher prevalence of extrapulmonary cases; atypical pulmonary radiological images; and the difficulty in regulating cases in urgent and emergency situations can be highlighted. These aspects require skill and qualification of health teams for early diagnosis and appropriate treatment, systematic assessment of the quality of the health services and permanent surveillance of areas, with active case finding for TB cases among people with HIV and vice versa [7]. Furthermore, TB/HIV patients present lower quality of life and less social support [8] and are subjected to greater stigma [9] when compared to those with only one infection. This context, characterized by deprivation and social inequality [10], may place individuals at greater risk of unfavorable outcomes [11].

In a literature search, it was found that the majority of the studies have analyzed TB and HIV conditions separately, always focusing on health services or epidemiological indicators, verifying the lack of investigations that incorporate the quality of services and the social context. It can be observed that although there are theoretical essays [12] on the importance of this type of approach, its application with empirical data is still restricted. Considering the complexity of TB/HIV coinfection, this study aimed to analyze the social and health services contexts that are associated with TB/HIV coinfection in the state of São Paulo, which is the most populous in Brazil, housing about 45.5 million inhabitants, 21.8% of the country.

Methodology

This ecological study was conducted in 645 cities of the state of São Paulo, Brazil.

The country has a Unique Health System (SUS), which is public and universal to the entire Brazilian population, offering promotion, prevention and rehabilitation actions. Regarding TB and HIV, care for both conditions is done exclusively by SUS, from prevention and diagnosis to treatment, a fact that can help their control.

The study population consisted of new cases (incidents) of TB/HIV coinfection among residents of the state reported in the TB-WEB (TB Case Reporting and Monitoring System) between 2010 and 2015. Prisoners and people that presented change of diagnosis and/or transfer to another state were excluded. The

Table 1. Social and service variables and indicators that affect TB/HIV coinfection in the state of São Paulo.

Variables/indicators	Source
Number of TB/HIV co-infection cases (according to covariates) Proportion of treatment defaults (according to covariates) Proportion of deaths (according to covariates) Proportion of cases diagnosed by active case finding (according to covariates) Proportion of cases diagnosed by outpatient demand (according to covariates) Proportion of cases diagnosed after death (according to covariates) Proportion of cases diagnosed during hospitalization or in urgency and emergency units (according to covariates) Proportion of sputum smear microscopy tests performed (according to covariates) Proportion of sputum culture tests performed (according to covariates) Proportion of sensitivity tests performed (according to covariates) Proportion of cases with directly observed treatment (according to covariates)	TB-WEB (2010-2015)
Presence of prison units in the cities	SAP (2019)
Degree of urbanization of the cities Demographic density of the cities Municipal Human Development Index Service Level by Water Supply Service Service Level by Sewerage Treatment Service Service Level by Garbage Collection Gross Domestic Product (GDP) Percentage of population with monthly nominal per capita income of ¼ to ½ minimum wage Percentage of population with monthly nominal per capita income of up to ¼ minimum wage Gini Index	IBGE (2010)
Mean coverage of the *Bolsa Família* welfare program by city	CADÚNICO / IBGE (2010-2015)
Mean coverage of primary care by city Mean coverage of the Family Health Strategy by city	SIAB / IBGE (2010-2015)
Mean health expenditure per inhabitant Mean number of nurses per thousand inhabitants Mean number of doctors per thousand inhabitants Mean number of nursing technicians and nursing aides per thousand inhabitants	SEADE / IBGE (2010-2013)

TB-WEB – São Paulo state information system for TB notification; SAP – Penitentiary Administration Office; IBGE – Brazilian Institute of Geography and Statistics; CADÚNICO – Federal Government Unique Register; SIAB – Primary Health Care Information System; SEADE - Statewise System for Data Analysis.

variables and indicators used in the study were collected from secondary sources, as presented in Table 1, and organized in databases according to the number of TB/HIV coinfection cases by city and considering the covariates gender, age (≤ 14 years; 15 to 59 years; ≥ 60 years) and year of diagnosis (2010 to 2015).

To identify the factors associated with the occurrence of TB/HIV coinfection cases, the Generalized additive models for location, scale and shape were used. The GAMLSS approach is especially suited for statistical modeling of response variables that are over dispersed or exhibit heterogeneity, such as the large number of distribution families available for modeling [13].

These analyses considered only the cities of São Paulo state that had at least one case of the disease, with those presenting absence of the event being excluded. In order to identify which distribution family would best fit the TB/HIV coinfection occurrence data, the "fitDistr" function of the GAMLSS package was used [14]. Additionally, the corresponding zero-truncated count distributions were included, given the absence of these values in the sample data. The best distribution model, which was the truncated Waring, was defined from the lowest Akaike information criterion (AIC) value [15].

The study was approved by the Research Ethics Committee (CEP) of the University of São Paulo at Ribeirão Preto College of Nursing (CAAE Process: 54341216.9.0000.5393).

Results

A total of 10,389 TB/HIV coinfection cases were found between 2010 and 2015 in the state, with 7,479 (72%) males and 9,980 (96.1%) aged 14 to 59 years.

The age groups of 60 years and over and 14 years and under presented a negative association with coinfection. In contrast, a positive association was identified between coinfection and the male gender; percentage of TB diagnoses after death; percentage of treatment default; Gini Coefficient; Municipal Human Development Index (MHDI); mean number of nurses per thousand inhabitants; greater coverage of the Family Health Strategy (FHS) and having a prison unit in the city. The final model presented an AIC of 5573.291, that is, a value lower than that identified in the null model with truncated Waring, indicating that the variables included allowed a better explanation of the mean and variance of the dependent variable (Table 2).

We performed the diagnosis of the final model, which showed a good fitness to the data, explaining the occurrence of coinfection cases in an ecological spectrum of analyzes.

Discussion

The results of the study corroborate the literature, which shows the prevalence of TB/HIV coinfection cases in male individuals. Males are more likely to develop TB as that they are often less concerned with their own health than women [16] and present higher indices of alcohol and drug abuse [17]. With the exception of sex workers, the people that make up the

Table 2. Explanatory model for the social and service indicators that affect TB/HIV coinfection in the state of São Paulo, Brazil (2010-2015).

Variable	Coefficient	*P* value
Mean (μ)		
Age ≥ 60 years	-1.78	< 0.01*
Age ≤ 14 years	-2.66	< 0.01*
Male	0.53	< 0.01*
Percentage of cases diagnosed after death	10.11	< 0.01*
Percentage of supervised treatment	-0.08	0.48
Percentage of dropouts	8.86	< 0.01*
Gini Index	10.15	< 0.01*
Mean number of nurses (per thousand inhabitants)	0.27	< 0.01*
Municipal Human Development Index	9.76	< 0.01*
Family Health Strategy coverage	0.01	< 0.01*
Municipality with prison unit (categorical)	0.19	0.04*
Primary Care Coverage	-0.01	0.09
Mean number of nursing technicians and nursing aides (per thousand inhabitants)	0.01	0.65
Variance (σ)		
Percentage of dropouts	18.96	< 0.01*
Percentage of cases diagnosed after death	18.99	< 0.01*

*Statistically significant ($p < 0.05$); Akaike Information Criterion value: 5,573.29.

largest contingent of key populations for HIV infection, include: men who have sex with men; transgender people; people who use injecting drugs; and prisoners [18]. Therefore, as males are predominant in these groups, they are often more vulnerable to both TB and HIV.

Coinfection has been found to predominantly affect young adults, the age group with the highest exposure and vulnerability to both conditions [19,20]. Groups of individuals older than 60 years and younger than 15 years presented a protective association for coinfection, which may be related to the lower frequency of these diseases in these age groups.

Regarding operational indicators, there was an association between TB/HIV and the diagnosis of TB after death, demonstrating that health services may not be diagnosing TB cases in a timely manner and possibly are not active case finding for respiratory symptoms among individuals with HIV. These difficulties have also been reported in previous studies [21,22], demonstrating the need for efforts by local health systems and policy makers to place the control of both diseases on the priority agenda of the services and cities.

In this study, it was also found that the higher the treatment default rate in the city, the higher the occurrence of TB/HIV coinfection cases. Treatment default increases the risk of disease transmission, morbidity and mortality [23], as well as the cost of monitoring for these patients, decreasing the chances of cure and acting as a predictor for the development of resistant bacilli [24,25]. The reasons that lead TB/HIV coinfected patients to default TB treatment are based on unfavorable socioeconomic situations, adverse medication effects, drug use and low personal motivation, as well as factors related to health services such as poor infrastructure, limitations in the work process organizing and lack of access [26]. Accordingly, the need to perform actions aimed at promoting treatment adherence focused on directly observed therapy (DOT), reducing the side effects of medications and strengthening the search for missing patients is recognized [26].

Operational studies evaluating TB and HIV programs show the importance of identifying the challenges that underlie the provision of health services to treat both diseases. Proposing strategies for the timely diagnosis of cases as well as for monitoring and effective treatment are imperative [27-30]. Family Health Strategy coverage is considered a primary resource for improving the health of individuals in cities, as it can improve the access to health services for the population. With the decentralization of health actions and service restructuring, the FHS assumes an essential role in TB control, as it acts in the prevention, diagnosis and treatment of the disease [31,32]. As a result, it is believed that TB/HIV coinfection cases will be better detected in those municipalities with higher FHS coverage, which is also justified by the higher mean number of nurses. Studies indicate that the FHS nurses perform active case finding, contacts tracing, notification of cases, and DOT, among other actions [32-35].

The present study found an association between TB/HIV coinfection and higher MHDI, which was also found in another study [36]. In addition to better conditions of longevity, education and income, expressed in high levels of human development, it is believed that these cities have more structured networks of health services. Greater health service capacity may lead to higher numbers of diagnosed cases for both diseases studied. Furthermore, they are monitoring centers, attracting people from cities with lower MHDI for treatment [37].

These findings indicate a higher occurrence of TB/HIV coinfection among the cities with greater social inequality, which leads to situations of vulnerability in the population. This results in marginalization of the population in relation to the place of residence, difficulty in accessing health services and lack of social representation, which are aggravated by the precarious socioeconomic situation of the individual and the community [10]. Tuberculosis is known to reflect the precariousness of local social development policies and its permanence leads to the exhaustion of the productive capacity of the community. Cyclically, TB arises in poor communities and contributes to worsening the state of poverty, precisely because it affects its productive economic class [38]. These conditions, when associated with HIV, potentiate and make the individual even more vulnerable.

Coinfection with TB/HIV is a socially complex disease and its elimination is not restricted to the health sector, but also depends on intersectoral management, improved quality of life, socioeconomic development, social inclusion policies, labor market qualification, improved housing conditions and greater access to health services [10,38]. Therefore, to achieve better outcomes, intervention structures that address TB and HIV should not only focus on the clinical aspects of the diseases, but should also integrate and improve the social determinants of the populations affected [39].

Another variable associated with the occurrence of TB/HIV coinfection was related to the presence of a

prison unit in the cities. In these settings TB is known to have serious implications for the general health of the population [40], since transmission of the disease can occur through the contact of the prisoners with the community when released or in open or semi-open regimes, as well as when they come into contact with prison staff and visitors [41]. This situation will only change when prisoners are offered decent conditions of incarceration and access to health, as provided for in international and national laws [42].

The main limitations of this study relate to a possible information bias, since data from secondary sources were used. Although the ecological approach was an adequate method for the study, it has limitations due to its design, not allowing generalizations for other populations and contexts.

Conclusion

The study advances the knowledge regarding the occurrence of TB/HIV coinfection and its associated factors in cities of São Paulo state, since we consider their social and health services context. It was possible to identify the main obstacles that the cities of the state face to control both diseases, supporting the recommendations that health services needs to focus the care on people with the characteristics considered more vulnerable to the coinfection and on measures to improve the timely diagnosis and the treatment adherence. The study also highlights the importance of intersectoral actions to address social inequalities and ensure protection policies for the vulnerable population. Finally, this study can serve as a reference for the evaluation and monitoring processes of TB and HIV/AIDS Control Programs, providing evidence to support their management according to the complexity of their practices.

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