REVISTA O MUNDO DA SAÚDE

Evaluation of the Tuberculosis Control Program in a state of the Brazilian Amazon Region

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Abstract

The evaluation of the Tuberculosis Control Program contributes to identifying the difficulties that permeate the implementation of public policies defined for the control of the disease. Thus, this study aimed to evaluate the performance of Municipal Tuberculosis Control Programs in Rondônia and identify aspects associated with such performance. An ecological study was carried out in 39 municipalities in the state in 2018. Performance indicators of municipal programs were calculated for further cluster analyses, which grouped them according to performance. The multiple correspondence analysis was used to identify variables (demographic, social, epidemiological, and those related to the health system) associated with the formed groups. The results showed that cluster 1, with 25 municipalities, displayed a regular performance and was associated with a small and large population, high incidence of tuberculosis and AIDS, and a low coverage of the Community Health Agents Program and the Family Health Strategy. Cluster 2, with 10 municipalities, presented an unsatisfactory performance and was associated with medium population size, low incidence of tuberculosis and AIDS, high coverage of the Community Health Agents Program and the Family Health Strategy, absence of indigenous areas, and worse social indicators. Cluster 3, with four municipalities, demonstrated a satisfactory performance and was associated with the presence of indigenous areas and better social indicators. It is possible to conclude the need for more attention given to social inequalities in the municipalities with the worst performance as well as to a greater role of Primary Health Care in facing the disease.

Keywords: Tuberculosis. Program Evaluation. Quality Indicators in Health Care. Health Management. Primary Health Care.

INTRODUCTION

Tuberculosis (TB) persists as a global public health problem of high magnitude, having been responsible, in 2020, for about 9.9 million new cases and 1.3 million deaths from the disease. Until 2019, before the pandemic caused by COVID-19, TB was responsible for the highest number of deaths in the world from a single infectious agent, surpassing HIV/AIDS and malaria combined[1].

In underdeveloped or developing countries, with low and middle income, the scenario becomes even more worrisome. In Brazil, in 2020, there were an estimated 66,819 new cases and 4,543 deaths from the disease, composing an incidence and mortality coefficient of 31.6 cases/100,000

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inhabitants and 2.1 deaths/100,000 inhabitants, respectively. In the state of Rondônia, located in the northern region of the country, in the same year, 441 new cases of TB were reported (incidence coefficient of 24.5 cases/100 thousand inhabitants) and 19 deaths from the disease (mortality coefficient of 1.1 deaths /100 thousand inhabitants)[2,3].

This epidemiological situation represents challenges for the control of the disease in terms of reaching the goals of the Strategy to End TB proposed by the World Health Organization, which recommends, by 2035, the reduction of the disease incidence coefficient to <10 cases/100 thousand inhabitants and <1 death/100 thousand inhabitants[4].

The programmatic actions that integrate TB care in Brazil are organized through the conformation of TB Control Programs at the national, state, and municipal levels, which must consider the local contexts for planning and implementing strategies that aim to overcome the challenges involved in TB prevention and care. In addition, they need intersectoral action and articulation between the different spheres of management of the Unified Health System (UHS)[2].

The evaluation of health programs has been considered an important tool for identifying the health needs of the population, contributing to the planning and implementation of public health actions. However, this evaluation becomes complex, since it involves multiple activities and different actors, indicating the need to integrate epidemiological and operational factors for the interpretation of data related to the performance of the Programs[5].

In healthcare and, above all, in public health, evaluating the implementation of the TB Control Program, its impact, its efficiency in the use of resources and the effectiveness of the actions carried out, is considered fundamental for decision-making[6]. Thus, it is possible to define successes and failures, point out deficiencies in operational indicators, monitor risk situations and problems, compare results, plan new actions, and seek satisfactory results, aiming at improving services and gains for the population[7,8].

A literature review on the performance of TB Control Programs described the results of 23 studies that showed the effects of introducing the program in different national and international scenarios, the evaluation of programs through operational indicators, through the evaluation of satisfaction users, the community, and health professionals, as well as the analysis of strategies incorporated into programs and factors that affect their performance[9]. Therefore, this study is original for the purpose of discussing the performance of a health program for the first time in the state of Rondônia and its relationships with demographic, social, epidemiological, and health system-related variables.

There is growing recognition that operations research should be incorporated into national disease control programs to establish an evidence-based program[10]. In relation to TB, this is no different, since this type of research is encouraged in order to contribute to the improvement and introduction of new practices, and the development and reinforcement of new policies and current actions of the TB Control Program[11].

Therefore, considering that operational research is important for the evaluation of health programs and constitutes one of the pillars of the global strategy for TB control[11], this study aims to contribute to the identification of the difficulties that still permeate the implementation of public policy actions for health programs aimed at controlling TB, which persists as a public health problem. This study also intends to provide

information in order to optimize intersectoral strategies aimed at local needs according to loco-regional characteristics and to provide evidence to support the management of the TB Control Program.

Thus, targeting such contributions, this study aimed to evaluate the performance of Municipal Tuberculosis Control Programs in the state of Rondônia, Brazil, and to identify the aspects associated with such performance.

METHODS

This is an ecological study, which allows for the recognition and knowledge that the collective community has a different purpose and social dynamics from that observed in individuals[12] and, for public health, it is an advantageous element due to the ease of execution, low cost, and possibility of generating hypotheses.

The study was carried out in the state of Rondônia, which borders the states of Amazonas, Acre, and Mato Grosso, in addition to the Republic of Bolivia. It had an estimated population, in 2018[13], of 1,757,589 inhabitants, spread over 237,765,240 km^2, with a population density of 6.58 inhabitants/km^2. The choice of this state is justified by the operational complexity of health care that emerges due to its territorial extension and the diversity of geographic, social, and epidemiological indicators affected by the realities of urban, rural, riverside, and indigenous areas.

It consists of 52 municipalities distributed into seven Health Regions, which are linked to the State Health Department of Rondônia (SESAU/RO). For the development of TB control actions, TB care in all municipalities in the state is decentralized to the Primary Health Care (PHC) program, which is responsible for diagnosis, treatment, monthly monitoring, Directly Observed Treatment (DOT), investigation of contacts, and discharge of TB cases. As a support network, two municipalities centralize care for cases of TB/HIV co-infection at the outpatient level. At the tertiary level, the state has the support of a large hospital, located in the capital Porto Velho, which is a reference for infectious diseases, and is responsible for the treatment of drug-resistant TB (DR-TB), nontuberculous mycobacteria, and worsening TB cases.

For the diagnosis of cases, it has a state laboratory for performing sputum culture and sensitivity testing, as well as some municipal and/or contracted laboratories for performing sputum smear microscopy. As for the Rapid Molecular Test for TB (RMT-TB), Rondônia has seven machines, two of which are located in the capital.

Municipalities of residence of TB cases reported in Rondônia in 2018 and reported in the Disease Information Notifications System (SINAN) were considered as observation units. As an inclusion criterion, all municipalities that had at least one case of TB in the year in question were considered. Cases transferred to other states and with an unfilled start date of treatment were excluded.

Identification data (city of residence and disease notification), clinical variables (type of entry, clinical form, sputum smear, sputum culture, HIV test, and RMT-TB), treatment follow-up (DOT, monthly control smear, control of communicators (identified and examined)), and closure situation were collected using SINAN. These data were made available by the State Health Surveillance Agency of Rondônia.

Furthermore, data were collected from each municipality, referring to the year of

study, in national public databases, namely: Brazilian Institute of Geography and Statistics - IBGE - https://www.ibge.gov.br/ (Population estimate, indigenous and riverside areas, Gini index, Human Development Index (HDI), Gross Domestic Product (GDP), and urbanization rate); Department of Data Processing of the Unified Health System - DATASUS - https://datasus.saude.gov.br/ (Population coverage of the Community Health Agents Program (CHAP)); Secretariat of Primary Health Care of the Ministry of Health - SPHC/MH - https://aps.saude.gov.br/ (Population coverage of the Family Health Strategy (FHS) and SINAN (Number of new TB cases, number new cases of pulmonary TB, AIDS cases, and cases with a positive HIV test result).

Data analysis was performed in two stages: the first consisted of building operational indicators, using Microsoft Excel software. The calculation of operational indicators followed the suggestions of the Manual of Recommendations for the control of TB in Brazil[14,15] and the methods proposed by an evaluative survey of a health program[7]. They were as follows: Proportion of new TB cases notified by the municipality of residence; Proportion of new cases of pulmonary TB who underwent sputum smear and RMT-TB at the start of treatment; Proportion of new cases of pulmonary TB who underwent sputum culture at the beginning of treatment; Proportion of HIV testing among new TB cases; Proportion of ongoing HIV testing among new TB cases; Proportion of new cases of pulmonary TB diagnosed by sputum smear microscopy and RMT-TB; Proportion of new cases of pulmonary TB diagnosed by sputum culture; Proportion of DOT among new TB cases; Proportion of contacts examined among identified contacts of new TB cases; Proportion of new bacilliferous pulmonary cases with recommended number of monthly control smears performed; Cure ratio among new TB cases; Proportion of treatment dropout among new TB cases; Proportion of deaths among new TB cases; Proportion of TB retreatment cases; Proportion of TB retreatment cases who underwent culture examination; and Proportion of TB retreatment cases who abandoned of treatment.

Such indicators were used to carry out the Cluster Analysis (CA), through its two main methods: hierarchical - through the linkage distance of 12, a cut of three groups of municipalities was found according to the performance of the ALSO; non-hierarchical k-means - it was possible to identify the members of each cluster by analyzing the centroids and the average of the operational indicators for each cluster. The difference between the performance of the clusters was verified through the analysis of variance ANOVA and Tukey's test.

In the second stage, the Multiple Correspondence Analysis (MCA) was applied, which allowed investigating the association between the clusters (passive variable) and the characteristics of the municipalities (active variables), namely: demographics (population size, indigenous, and riverside areas), social (Gini index, HDI, GDP, and urbanization rate), health-related (CHAP and FHS population coverage), and epidemiological (TB incidence rates, bacilliferous pulmonary TB, AIDS, and TB/HIV co-infection ratio).

These variables, being quantitative, were transformed into qualitative variables: population size (≤10 thousand inhabitants - small, > 10 to ≤50 thousand inhabitants - medium size, and > 50 thousand inhabitants - large); the other variables were classified according to the calculation of their averages (cut-off point), as range 1 (values below the average) and range 2 (values above the average). It is noteworthy that for the

Gini index, the classification occurred in an inverted way - range 1 (values above average) and range 2 (values below average).

To justify and validate the choice of the number of dimensions (two) in the multidimensional space, the analysis of the decrease in eigenvalues was used[16]. Subsequently, the active variables that presented low quality in the sum of the dimensions (less than one) were excluded: "Presence of a riverside area", "Incidence rate of bacilliferous pulmonary TB", and "Proportion of TB/HIV coinfection".

For the interpretation of the factorial plan, the variables that belonged to each dimension were identified according to the highest absolute contribution (Cos^2) to the variability of the data set. Thus, it was possible to interpret the dimensions derived from the set of active variables and identify which of them were associated with the passive variable (clusters). To perform the CA, MCA, and other statistical tests, the TIBCO Statistica software, version 13.4, was used and a statistical significance level of 5% was adopted.

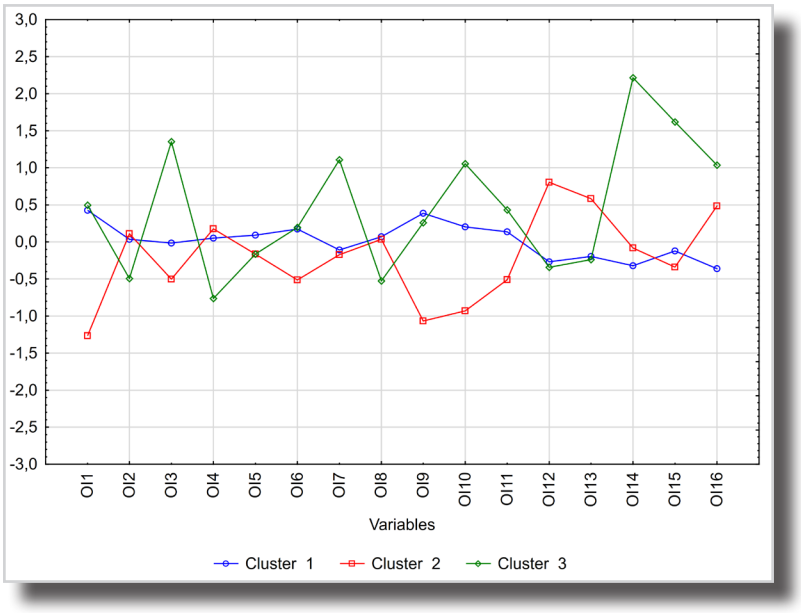
In view of the recommendations contained in Resolution No. 466, of December 12, 2012, of the National Health Council and the guidelines and regulatory standards for research involving human beings[17], this study was submitted and approved by the Research Ethics Committee (REC) of the University Federal de Rondônia, according to opinion number 3.939.112.

RESULTS

Of the 52 municipalities in Rondônia, 13 were excluded for not having reported TB cases. Thus, 39 municipalities were included in the study, which had 721 TB cases reported in SINAN in 2018.

Of these 721 cases, 38 were excluded from the data analysis stage of the study because they were diagnosed before 2018; five for not having a start date for treatment; five for residing in other states; four for having been transferred to other states; and one for having started treatment in 2019. Of the 668 cases considered for the study, 538 (80.5%) were new cases of TB and 109 (16.3%) were retreatments (of which 49 (45%) were relapses and 60 (55%) were re-entries after treatment abandonment) and 21 (3.2%) other types of entry.

Based on the CA, three groups of municipalities were formed according to the performance of the TB Control Program: Cluster 1, with 25 municipalities (64.1%); Cluster 2, with 10 municipalities (25.6%); and Cluster 3 with four municipalities (10.3%). When analyzing the centroids referring to the clusters formed by the CA (Figure 1) and the averages of the operational indicators for each cluster (Table 1), it was identified that cluster 1 was categorized as having a regular performance, cluster 2 with an unsatisfactory performance, and cluster 3 with a satisfactory performance.



Legend: (OI1) Proportion of new TB cases notified by the municipality of residence; (OI2) Proportion of new cases of pulmonary TB who underwent sputum smear and RMT-TB at the beginning of treatment; (OI3) Proportion of new cases of pulmonary TB who underwent sputum culture at the beginning of treatment; (OI4) Proportion of HIV testing among new TB cases; (IO5) Proportion of ongoing HIV testing among new TB cases; (IO6) Proportion of new cases of pulmonary TB diagnosed by sputum smear and RMT-TB; (IO7) Proportion of new cases of pulmonary TB diagnosed by sputum culture; (IO8) Proportion of DOT among new TB cases; (IO9) Proportion of contacts examined among identified contacts of new TB cases; (IO10) Proportion of new bacilliferous pulmonary cases with recommended number of monthly control smears performed; (IO11) Proportion of cure among new TB cases; (IO12) Proportion of treatment dropouts among new TB cases; (IO13) Proportion of deaths among new TB cases; (IO14) Proportion of TB retreatment cases; (IO15) Proportion of TB retreatment cases who underwent culture examination; and (IO16) Proportion of TB retreatment cases who abandoned treatment.

Figure 1 – Centroids referring to clusters of municipalities formed by cluster analysis regarding the performance of tuberculosis control programs, Rondônia, Brazil, 2018.

In the application of analysis of variance, eight indicators showed no statistically significant difference between the groups evaluated. The comparison of the averages of the performance indicators of the TB Control Programs in the municipalities of Rondônia identified a better performance of cluster 3 (satisfactory) than of cluster 2 (unsatisfactory) for the following indicators: Proportion of new TB cases notified by the municipality of residence; Proportion of new cases of pulmonary TB who underwent sputum culture at the beginning of treatment; Proportion of new bacilliferous pulmonary cases with recommended number of monthly control smears performed; Proportion of TB retreatment cases; and Proportion of TB retreatment cases who underwent culture examination (Table 1).

Cluster 1 (regular) showed an intermediate performance, but not statistically different from the other clusters in the analysis of the operational indicator "Proportion of new cases of pulmonary TB who underwent sputum culture at the beginning of treatment". Regarding this cluster and cluster 3 (satisfactory), both had a high proportion of new TB cases reported by the municipality of residence, a high proportion of contacts of new TB cases examined among those identified, and a low proportion of treatment abandonment among new TB cases, when compared to cluster 2 (unsatisfactory) (Table 1).

Table 1 – Average of operational indicators according to the clusters of municipalities formed, Rondônia, Brazil, 2018.

Operational indicators	Cluster 1 (n=25)	Cluster 2 (n=10)	Cluster 3 (n=04)	p-value*
	Mean(±sd)	Mean(±sd)	Mean(±sd)	
Proportion of new TB cases reported by the municipality of residence	94.2(17.1) a	37.7(34.9) b	96.4(7.1) a	**<0.0001***
Proportion of new pulmonary TB cases who underwent sputum smear and RMT-TB at the start of treatment	86.5(22.3)	88.3(19.3)	73.4(49.0)	0.5802
Proportion of new pulmonary TB cases who underwent sputum culture at the start of treatment	14.6(25.2) ab	1.4(4.5) a	51.8(42.2) b	**0.0045***
Proportion of HIV testing among new TB cases	88.9(16.4)	91.7(18.0)	71.4(48.1)	0.2631
Proportion of ongoing HIV testing among new TB cases	2.0(9.9)	0(0)	0(0)	0.7554
Proportion of new cases of pulmonary TB diagnosed by sputum smear and RMT-TB	61.4(32.8)	37.1(36.3)	62.2(43.2)	0.1732
Proportion of new cases of pulmonary TB diagnosed by sputum culture	4.2(11.6)	3.3(10.5)	20.8(25.0)	0.0603
Proportion of DOT among new TB cases	33.6(43.6)	32.2(42.8)	8.9(17.7)	0.5484
Proportion of contacts examined among identified contacts of new TB cases	91.4(13.5) a	48.8(39.1) b	87.7(20.6) ab	**0.0001***
Proportion of new bacilliferous pulmonary cases with recommended number of monthly control smears performed	53.2(35.8) a	9.7(17.8) b	85.6(19.3) a	**0.0002***
Cure ratio among new TB cases	78.9(28.3)	59.0(36.9)	88.0(14.3)	0.1485
Proportion of treatment dropout among new TB cases	4.7(8.0) a	26.2(33.4) b	3.2(6.4) ab	**0.0092***
Proportion of deaths among new TB cases	0.2(1.2)	4.7(10.9)	0(0)	0.0996
Proportion of TB retreatment cases	3.2(7.5) a	6.6(11.7) a	39.5(14.4) b	**<0.0001***
Proportion of TB retreatment cases who underwent culture examination	3.0(9.2) a	0(0) a	27.5(32.0) b	**0.0011***
Proportion of TB retreatment cases who abandoned treatment**	3.2(9.5)	30.0(48.3)	47.5(41,1)	**0.0044***

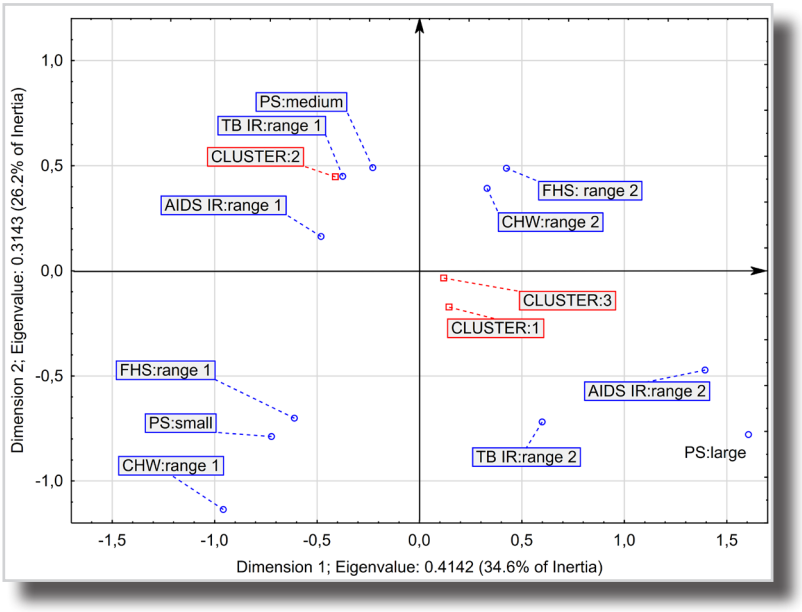
Legend: Tuberculosis (TB), Rapid Molecular Test for TB (RMT-TB), Directly Observed Treatment (DOT).
* p value for the F test <0.05; the letters (a and b) mean the statistical differences between the means by the Tukey test, considering p<0.05.
** ANOVA showed differences between groups, but multiple comparison analysis did not identify which groups were different.

In the first MCA, dimension 1 (highest absolute contribution - Cos^2) was composed of the variable referring to the demographic characteristic of the municipalities - "Population size" and the epidemiological data of the municipalities - "AIDS incidence rate". Dimension 2 was composed of variables related to the characteristics of the health system and the epidemiological data of the municipalities - "CHAP population coverage", "FHS population coverage", and "TB incidence rate".

In the perceptual map of the MCA, it is possible to identify the representation of the two dimensions, which were able to constitute 60.8% of the inertia contained in the original data. On the positive side of dimension 2, there is cluster 2 - unsatisfactory performance, associated with municipalities with high population coverage of the CHAP and FHS and low TB incidence rate. On the negative side of dimension 1, this same cluster

was associated with medium population size and low AIDS incidence rate (Figure 2).

On the negative side of dimension 2, cluster 1 was identified as having a regular performance, associated with municipalities with low population coverage of CHAP and FHS, and high TB incidence rate. On the negative side of dimension 1, this cluster was associated with municipalities with small and large population sizes and, on the positive side of dimension 1, it was associated with a high AIDS incidence rate. Cluster 3, with a satisfactory performance, was not associated with any categorical variable because it is close to the origin (point zero of dimensions 1 and 2) (Figure 2).



Legend: Population Size (PS): small, medium, large; Coverage of the Community Health Agents program (CHAP): range 1 (low), range 2 (high); Coverage of the Family Health Strategy (FHS): range 1 (low), range 2 (high); TB incidence rate (TB): range 1 (low), range 2 (high); AIDS incidence rate (AIDS): range 1 (low), range 2 (high).

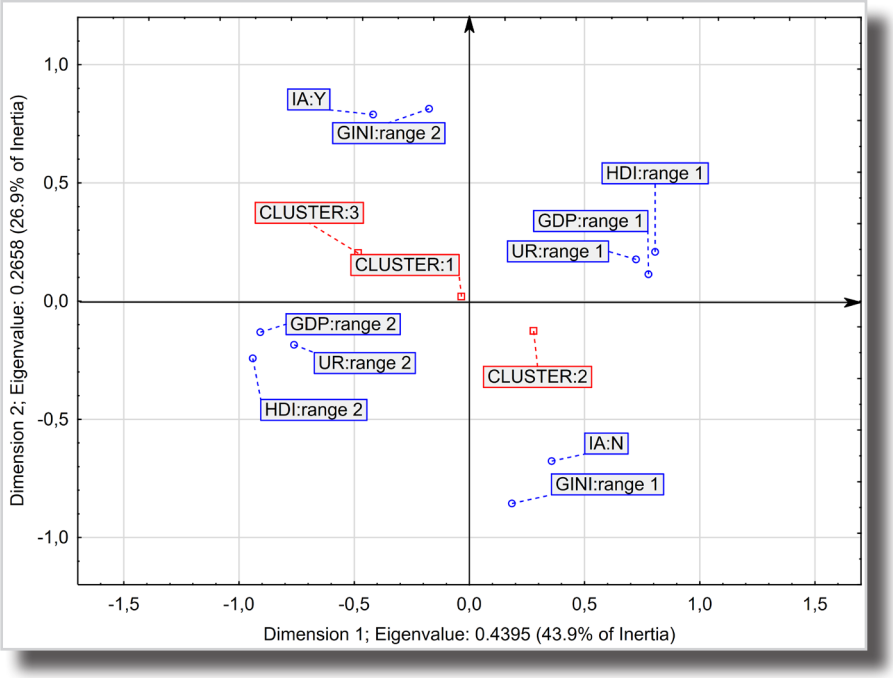
Figure 2 – Perceptual map of association between clusters and epidemiological indicators, demographic, and health system-related characteristics of the study municipalities, Rondônia, Brazil, 2018.

In the second MCA, dimension 1 (highest absolute contribution - Cos^2) was composed of variables related to the social characteristics of the municipalities - "HDI", "GDP", and "Urbanization rate". Dimension 2 was composed of variables referring to the demographic and social characteristics of the municipalities - "Indigenous Area" and "Gini Index".

In the perceptual map of the MCA, it was possible to identify the representation of the two dimensions, which constituted 70.8% of the inertia contained in the original data. On the negative side of dimension 1, there is cluster 3 – a satisfactory performance, associated with municipalities that presented high HDI, GDP, and urbanization rate. On the positive side of dimension 2, this same cluster was associated with the presence of an indigenous area and a low Gini index (Figure 3).

On the positive side of dimension 1, cluster 2 was identified – an unsatisfactory performance, associated with municipalities

that had low HDI, GDP, and urbanization rate. On the negative side of dimension 2, this cluster was associated with the absence of an indigenous area and a high Gini index. Cluster 1, with a regular performance, was not associated with any categorical variable because it is close to the origin (point zero of dimensions 1 and 2) (Figure 3).



Legend: Indigenous Area (IA): yes (Y), no (N); Gini index (GINI): range 1 (high), range 2 (low); Human Development Index (HDI): range 1 (low), range 2 (high); Gross Domestic Product (GDP): range 1 (low), range 2 (high); Urbanization rate (UR): range 1 (low), range 2 (high).

Figure 3 – Perceptual map of association between clusters and social indicators and demographic characteristics of the study municipalities, Rondônia, Brazil, 2018.

DISCUSSION

It is estimated that, for operational purposes, 1% of the general population has respiratory symptoms, which may vary between different Brazilian cities[15]. Therefore, the number of municipalities in the state of Rondônia that did not notify any TB case in 2018 requires attention and reflection on the (under)reporting and identification of TB cases which, as an infectious disease, disregards geographic limits, population size, and/or or turnover of people in certain locations.

In this study, heterogeneity was identified among the municipalities of Rondônia regarding the quality of TB care. Such performance was also observed in other states and was related to structural weaknesses and process deficiencies[18-20], partial implementation of the Directly Observed Treatment Short-Course (DOTS) strategy by the programs[21], and ineffectiveness in TB prevention and care actions, reflecting on unfavorable outcomes of the treatment[22-24].

Most municipalities with an unsatisfactory performance in cluster 2 were associated with a medium-sized population and high CHAP and FHS coverage, which leads to reflections on the concreteness of the decentralization of TB prevention and care actions for PHC, as recommended by the Ministry of Health. It is noteworthy that decentralization to PHC, if carried out in its entirety, is capable of allowing the expansion of access to such measures to the general population and to those at greater risk of contracting the disease, such as indigenous people, while respecting individual rights, in line with the principles and guidelines of the UHS[15].

In a study carried out in municipalities located in the interior of the state of Amazonas, a low performance of the programs was identified associated with deficient conditions for the diagnosis and treatment of TB, in addition to low levels of socioeconomic development[25]. Similar results were found in this study, since the cluster of poor performance was associated with low HDI, GDP, and urbanization rates and a high Gini index. In these scenarios, the persistence of social inequalities and inequities in health are still reflected in health actions and services that are not equally distributed and accessible to the entire community.

On the other hand, it was identified that the municipalities with a satisfactory performance (cluster 3) and were associated with better social indicators also had the presence of indigenous areas. It is known that the state of Rondônia is among the states with the highest incidence of TB among the indigenous population and, as the disease disproportionately affects these communities, the elaboration and strengthening of TB prevention and care actions must be covered by more specific and intersectoral guidelines, combined with social protection measures[26], since the difficulty of access to indigenous communities and the lack of infrastructure and local resources make it difficult to continue health actions aimed at this population.

This study also found that the municipalities with an unsatisfactory performance were the ones that least reported TB cases by the municipality of residence. This finding indicates that the TB Control Programs of the municipalities with unsatisfactory performance should make efforts to carry out an active search for cases and expand access to health services to enable the diagnosis and timely notification of the disease, since failures in this implementation can overwhelm other municipal programs.

Communication between the State Program and the municipalities becomes essential so that the measures recommended internationally and nationally are implemented and meet the needs of individuals with TB, their families, and the community[15]. Thus, it is necessary to strengthen the support systems for technological densification and increase the solvability of PHC in the diagnosis of the disease, with laboratory support for carrying out tests and communicating with the other points of the Health Care Network[27] to meet expectations regarding its role in detecting TB cases.

The performance of sputum smear microscopy for the monthly evolution of TB cases was lower in municipalities with a low performance (cluster 1), even with high CHAP and FHS coverage. This result is explained by the fact that these municipalities do not have laboratories responsible for analyzing the samples due to the lack of structure for this, which are dependent on the laboratory support network of other municipalities and on logistics for the transport of sputum samples for examinations. This type of organization can result in inadequate storage and transport of collected samples and difficulties in the communication and integration of information between laboratories and health services[28].

Although the Ministry of Health recommends

sputum culture for all new cases of TB or retreatment[14], it was found that the municipalities that least requested this test for both cases were those with an unsatisfactory performance (cluster 2). It is important to consider that culture is an exam with a high specificity and sensitivity and can increase the bacteriological diagnosis of the disease by up to 30%[15]. Moreover, because the state has high percentages of infections by nontuberculous mycobacteria[29], this can contribute to misunderstandings in diagnosis and in the implementation of treatment.

However, performing the culture requires more time to obtain the result, which may delay the diagnosis of TB and increase the transmission of the disease[30,31]. Considering the limitations pointed out, such municipalities could benefit from the expansion of the use of RMT-TB, since the sensitivity of this test is more significant when compared to sputum smear microscopy and is faster than a culture[32].

Another weakness regarding the unsatisfactory performance of the municipalities in cluster 2 is related to the incipient performance of contact tracing. In these municipalities, it appears that the development of a collective work articulated to the needs of the territory for the detection of TB cases is still guided by a curative and fragmented care model, since the actions are focused on people affected by TB, superficially covering the family and the community, contributing to the maintenance of TB as a public health problem of great magnitude[33,34]. These aspects reinforce the need to strengthen PHC through the CHAP and the FHS, in order to advance a TB care model that includes the territory and values the role of CHA as unique members of health teams and articulators between services, families, and community[35].

This study identified a high rate of anti-HIV testing among new TB cases in all groups of municipalities, which represents a potential for the state in terms of timely screening for TB/HIV co-infection, considered a risk factor for death, and an increased incidence of AIDS and adverse effects[22]. This finding reiterates the importance of communication, integration, and cooperation between TB and HIV/AIDS control programs, as well as these and other services in the health care network, aiming at the best quality of health care for people with both diseases[28,36].

It is noteworthy that the municipalities with a satisfactory performance (cluster 3) had a higher rate of retreatment for TB and treatment abandonment among them. These factors make the follow-up of cases even more complex and, therefore, justify the performance of DOT, aiming at increasing adherence and better results with the treatment[23,37]. However, low rates of performing DOT were identified in all groups of municipalities, suggesting that the DOT treatment regimen should be part of the list of actions to be offered in the treatment of TB by all municipalities in the study, especially among those with high CHAP and FHS coverage (unsatisfactory cluster) and high incidence of TB (regular cluster).

The group of municipalities with regular and satisfactory performances (clusters 1 and 3) had the lowest proportions of abandonment of TB treatment, which is considered one of the best result indicators of the actions of the TB Control Programs[19,24]. This index was close to the goal of a maximum of 5% recommended by the World Health Organization[4], showing the potential that most cities in the study have to reach it, in order to increase the number of cases with favorable treatment outcomes.

Therefore, some of the difficulties to be overcome are related to the fragmentation of practices, work overload, unpreparedness to deal with individuals with TB, especially in situations of vulnerability and risk, as well as to carry out actions for timely diagnosis, management, and prevention[38]. These obstacles impact the fulfillment of PHC attributes and functions, and studies carried out in the capital of the state of Rondônia also observed

weaknesses of TB care services in establishing a bond with users, focusing on the family and on community-oriented care[34,39].

Therefore, it becomes a challenge to think about organizational models that allow effective action on activities in the UHS and its decision-making microprocesses; especially in the area of management and planning of healthcare work and its interface with the production of care as a space for decision-making[40]. When focused on the TB care model, these decisions affect the performance evaluation of programs and the magnitude of the disease.

The main limitations of this study were related to the lack of knowledge of other context indicators that may interfere with the performance of municipalities; use of the 2010 census for some social variables; unidentified and controlled confounders; and a possible information bias due to the use of secondary data, which highlights the importance of adequate data recording, filling out notification forms and updating information systems, aiming to contribute with important evidence for the planning, monitoring, and evaluation of the operational performance of the TB Control Programs.

CONCLUSION

The findings of this study contribute to the management of TB Control Programs and raise reflections for public health, providing subsidies for the elaboration of public policies in heterogeneous contexts, such as the different municipalities in the state of Rondônia. Through this study, it was possible to identify that the best performance of the municipalities was not associated with greater coverage of CHAP and FHS and, thus, it is possible to see the need to carry out the implementation of disease control actions to increase access to diagnosis and treatment of TB, as well as for the satisfactory outcome of the cases, performing, giving credit to PHC, the realization of the search for respiratory symptoms, contact control, follow-up of cases, and operationalization of DOT.

Therefore, it is worth noting that, in order to improve the performance of municipalities, the decentralization of the actions proposed by the TB Control Programs must be accompanied by intersectoral actions that seek to overcome inequalities in healthcare and establish social protection measures, in particular, in the municipalities with the worst performance and who had a medium population size, low incidence of TB and AIDS, low economic development, and social inequality.

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