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ORIGINAL ARTICLE

Brazilian research network on tuberculosis: scientific development Mission to eliminate tuberculosis

Rede Brasileira de Pesquisas em Tuberculose (REDE-TB): missão de desenvolvimento científico para eliminar a tuberculose

Red brasileña de investigación en tuberculosis: misión de desarrollo científico para eliminar la tuberculosis

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ABSTRACT

Background and Objectives: Since its inception, the Brazilian Tuberculosis Research Network (REDE-TB) has contributed significantly to scientific and technological advances in Brazil. This study analyzes this contribution in the strategic areas of tuberculosis prevention, diagnosis, and treatment, which are relevant for achieving the 2030 Agenda to End Tuberculosis**. Methods:** This research is based on a survey of the Lilacs and Embase/MEDLINE databases, focusing on primary and secondary studies on tuberculosis published by members of REDE-TB between 2018 and 2023. Data on identification, scope, study location, design, area, and population studied were extracted. Descriptive statistics and georeferencing were used for the analysis**. Results:** A total of 670 publications were identified, of which 447 were included in the review. Of these, 315 (70.5%) were published in international journals. Most studies in Brazil were conducted in Rio de Janeiro (29.0%), followed by São Paulo (19.2%), Rio Grande do Sul (13.8%), Paraná (11.6%) and Amazonas (10.7%). After Brazil, 24 (8.0%) studies were conducted in India, followed by South Africa (16 - 5.3%)

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and Uganda (10 - 3.3%). The studies had different designs, including literature reviews and epidemiologic studies, and focused primarily on tuberculosis disease (56.4%) and, to a lesser extent, tuberculosis infection (12.6%). **Conclusions:** The study highlights the importance of the Brazilian Research Network on Tuberculosis (REDE-TB) in the scientific production related to tuberculosis, contributing to policies and actions aimed at combating the disease in Brazil and around the world**.**

Keywords: *Tuberculosis. Latent Tuberculosis. Technology.*

RESUMO

Justificativa e Objetivos: Desde seu lançamento, a Rede Brasileira de Pesquisas em Tuberculose (REDE-TB) tem contribuído significativamente para a produção científico-tecnológica no Brasil. Este estudo teve como objetivo buscar essa contribuição nas áreas estratégicas de prevenção, diagnóstico e tratamento da tuberculose, relevantes para o cumprimento da Agenda 2030 para o Fim da Tuberculose. **Métodos:** A pesquisa foi baseada em um levantamento nas bases de dados *Lilacs* e *Embase/MEDLINE*, focando em estudos primários e secundários sobre tuberculose publicados entre 2018 e 2023 vinculados à REDE-TB. Foram extraídos dados de identificação, abrangência, local de estudo, delineamento, área e população estudada. A análise utilizou estatística descritiva e georreferenciamento. **Resultados:** Identificou-se 670 publicações, com 447 incluídas na revisão. Dentre estas, 315 (70,5%) foram publicadas em periódicos internacionais. A maioria dos estudos no Brasil ocorreu no Rio de Janeiro (29,0%), seguido por São Paulo (19,2%), Rio Grande do Sul (13,8%), Paraná (11,6%) e Amazonas (10,7%). Após o Brasil, 24 (8,0%) estudos foram realizados na Índia, seguidos pela África do Sul (16 - 5,3%) e Uganda (10 - 3,3%). Os estudos apresentaram delineamentos variados, incluindo revisões de literatura e estudos epidemiológicos, com foco principal em tuberculose doença (56,4%) e, em menor proporção, em tuberculose infecção (12,6%). **Conclusão:** O estudo evidencia a importância da Rede Brasileira de Pesquisas em Tuberculose (REDE-TB) na produção científica e tecnológica sobre TB, contribuindo no desenvolvimento de estratégias de enfrentamento à doença no Brasil e no mundo.

Descritores: *Tuberculose. Tuberculose Latente. Tecnologia.*

RESUMEN

Justificación y Objetivos: Desde su lanzamiento, la Red Brasileña de Investigaciones en Tuberculosis (REDE-TB) ha contribuido significativamente a la producción científico-tecnológica en Brasil. Este estudio tuvo como objetivo analizar dicha contribución en áreas estratégicas de prevención, diagnóstico y tratamiento de la tuberculosis, relevantes para el cumplimiento de la Agenda 2030 para el Fin de la Tuberculosis. **Métodos:** Esta investigación se basó en un levantamiento en las bases de datos *Lilacs* y *Embase/MEDLINE*, centrándose en estudios primarios y secundarios sobre tuberculosis publicados entre 2018 y 2023 por miembros de la REDE-TB. Se extrajeron datos de identificación, alcance, lugar de estudio, diseño, área y población estudiada. El análisis utilizó estadística descriptiva y georreferenciación. **Resultados:** Se identificaron 670 publicaciones, de las cuales 447 fueron incluidas en la revisión. Entre estas, 315 (70,5%) fueron publicadas en revistas internacionales. La mayoría de los estudios en Brasil se realizaron en Río de Janeiro (29,0%), seguido de São Paulo (19,2%), Río Grande do Sul (13,8%), Paraná (11,6%) y Amazonas (10,7%). Después de Brasil, 24 (8,0%) estudios se realizaron en India, seguidos por Sudáfrica (16 - 5,3%) y Uganda (10 - 3,3%). Los estudios presentaron diseños variados, incluyendo revisiones de literatura y estudios epidemiológicos, con un enfoque principal en la enfermedad por tuberculosis (56,4%) y, en menor proporción, en la infección por tuberculosis (12,6%). **Conclusión:** El estudio evidencia la importancia de la Red Brasileña de Investigaciones en Tuberculosis (REDE-TB) en la producción científica sobre tuberculosis, contribuyendo a políticas y acciones para enfrentar la enfermedad en Brasil y en el mundo.

Palabras Clave*:* *Tuberculosis. Tuberculosis Latente. Tecnología.*

INTRODUCTION

Tuberculosis (TB) is the deadliest infectious disease in the world, mainly affecting people living in poor and/or developing countries. Brazil is among those countries that face many challenges in eliminating TB, with 11 states having a TB incidence rate higher than the national average in 2023 (37.0/100,000 inhabitants) and a mortality rate of 2.2/100,000 inhabitants.[1, 2]

National efforts are being made to end TB as an epidemic by 2030, and eliminate the disease by 2050 (< 10 cases per 100,000 inhabitants). The End TB Strategy, launched in 2015, is based on three fundamental pillars for achieving the goals: user-centered care, bold social policies that impact the life course of people with TB and their families, and intensified research and innovation.[3]

Research and innovation are essential aspects for achieving the goal of eliminating TB and, today, the current priorities on a global scientific agenda include a TB vaccine with greater efficacy than the current one (BCG); shorter treatments for sensitive TB (up to 4 months of treatment) and resistant TB (up to 6 months and 100% by mouth), point-of-care diagnostics, and monitoring and surveillance of resistant TB, with molecular biology tech-

nologies; and person-centered care and social support, with a reduction in catastrophic costs.[3]

Among the care paradigms, the proposal is to move away from the curative, disease-centered model towards prevention, with a focus on TB preventive treatment (TPT) for priority groups and the elimination of barriers to access to TB diagnosis and treatment, especially among vulnerable populations. In addition, the use of new digital technologies and Artificial Intelligence (AI) could be of great help in the active search for cases, in increasing diagnostic accuracy and in carrying out educational activities on TB.[4]

Among the various initiatives to leverage science and technology in the field of TB, research cooperation networks stand out. Through the integration of strategic areas, interfacing basic and applied sciences, speed is promoted in the production of inputs and strategic and technological incorporation into the Unified Health System (SUS), thus bringing sustainable and creative solutions to health services.[5]

On the national scene, we would highlight the Brazilian Tuberculosis Research Network (REDE-TB), which was launched to compete for CNPq's Millennium Institutes Call for Proposals in 2002. Its epistemological matrix was systemic thinking, cooperation and solidarity among peers, and its operational strategy was to identify potential leaders to contribute to shaping a National TB Research Agenda. Civil society and government representatives were included in REDE-TB's organizational structure. Since its launch, there have been important developments at the national level, when TB began to occupy the health agenda, and REDE-TB members took over the National Technical Advisory Committee (CTA) of the Ministry of Health's now-defunct National TB Program (PNCT). [6-8]

At the international level, the World Health Organization (WHO) invited REDE-TB to take part in the Task Force for Movement Research in 2009, as it is a very innovative and peculiar way of producing science and technology. There is evidence that REDE-TB can act as one of the major locomotives and promoters of science and technology around TB in Latin America, making it important to verify this hypothesis through a literature review. With this in mind, this review sought to analyze REDE-TB's contribution to the technical-scientific development of TB over the last five years, with the aim of demarcating its contributions to the advancement of the End TB strategy.[9]

METHODS

Study design

A bibliographic review was carried out to construct the state of the art with the aim of exploring a wide and diverse range of studies that have been published by REDE-TB researchers, as well as their capacity to include both empirical and theoretical literature.[10]

This type of review aims to provide fundamental information on the institutional and social basis of the research field, the strategies for communicating and disseminating knowledge and the thematic, theoretical, methodological and epistemological trends. Its importance lies in describing, mapping, monitoring and evaluating the development and consolidation of the field.

The study was carried out in three stages: identification of REDE-TB members and their publications; data extraction; and synthesis of the literature results,

REDE-TB, created in 2002, currently covers eighteen areas of research related to TB, divided into thematic axes: drug development; health technologies and innovation; human resources; tuberculosis and HIV; clinical trials; tuberculosis in indigenous people; pediatric tuberculosis; tuberculosis in prisons; operational research; multidrug-resistant tuberculosis; epidemiology: information and informatics; quality management, knowledge and information management; biosafety and infection control; social mobilization; non-tuberculous microbacteria; international relations; interaction with government and social protection. These axes are made up of specialized researchers, distributed according to their expertise and contribution.

Identification of REDE-TB members and their publications

The process of identifying REDE-TB members took place by consulting the minutes of its extraordinary and ordinary assemblies held between 2018 and 2023. REDE-TB assemblies involve the participation of area coordinators and vice-coordinators, as well as associate members.

For access to these minutes, authorization was requested from the REDE-TB board. All the names of the people taking part in the meetings were taken into account when searching for publications in the LILACS and Embase/MEDLINE databases, together with the descriptors 'Tuberculosis', 'Tuberculosis' and 'TB'.

The searches were conducted in September 2023 and there were no restrictions on the language of publication. However, it was restricted to studies published after 2018, since that year saw the launch of the Global Plan to End TB (2018-2022) and the United Nations High-Level Meeting on TB, which was an important milestone in defining policies for TB research priorities and funding for United Nations Member States.[10]

Screening and selection of publications

The data obtained from the databases was exported and compiled on the Rayyan platform, which made it possible to detect and eliminate duplicate publications.[11,12]

Once the duplicate publications had been eliminated, the full articles were searched for, seeking to include in the review those that directly addressed TB and that had been published in the last five years by researchers linked to REDE-TB, regardless of the order of authorship. Excluded from the study were letters, editorials, commentaries, study protocols, conference abstracts, case reports, studies related to Mycobacterium Non-Tuberculosis or whose main focus was another infection/disease (HIV, dengue, COVID-19) without focusing on TB, as well as articles whose authors were not part of REDE-TB.

Data extraction

At this stage, data was extracted from the studies included in the review. The variables of interest were previously defined and included the following items: authors; title; year of publication; journal; language of publication; funding agency; scope of the study; state where the study was carried out; country where the study was carried out; study design; study area; study population. Articles published in various journals were collected, identifying their impact factor. Data extraction was carried out by five researchers and then checked in its entirety by a reviewer.

Summary of results

The data extracted was analyzed using descriptive statistics (absolute and relative frequency distribution). Subsequently, for the georeferencing stage of the studies published in Brazil and worldwide according to study site, we used the meshes in .shp format made freely available by the IBGE (states of Brazil) and the Environmental Systems Research Institute (world map). These sites were exported to QGIS software v. 3.32.3, georeferenced according to the geographical coordinates in their respective territorial meshes and thematic maps of the Brazilian states and countries were then generated.

Ethical aspects

In this study, due to the nature of the research, approval by the Research Ethics Committee (REC) was not required. The legislation that waives the need for approval by the REC generally applies to studies that do not directly involve human beings, such as literature reviews. Article 1 of Resolution 510/2016 mentions that research which does not directly involve human beings or which uses information in the public domain or anonymized data can be exempt from ethical evaluation.

RESULTS

By consulting the minutes of the REDE-TB meetings, 77 members were identified, with at least one researcher in each research area.

After identifying the researchers linked to REDE-TB, a review was carried out. A total of 670 publications were identified, of which 117 were excluded for being duplicates and another 106 for not having REDE-TB members as authors, 447 publications were included in this review (Figure 1).

Among the studies included in this review, the data on the impact factor of the publications analyzed stands out: 59 (12.53%) articles were published in journals with no impact factor; 279 (62.39%) in journals with an impact factor between 0.2 and 3; 73 (16.34) in journals with an impact factor between 4 and 10; 26 (5.16%) in journals with an impact factor between 11 and 20; and 13 (3.58%) in journals with an impact factor greater than 21. In addition, 78 (17.4%) were published in 2018; 78 (17.4%) in 2019; 96 (21.5%) in 2020; 90 (20.1%) in 2021; 80 (17.9%) in 2022; and 25 (5.6%) in 2023, up to the time of data analysis. As for the journals of publication, 315 (70.5%) were international, 426 (95.3%) were published in English.

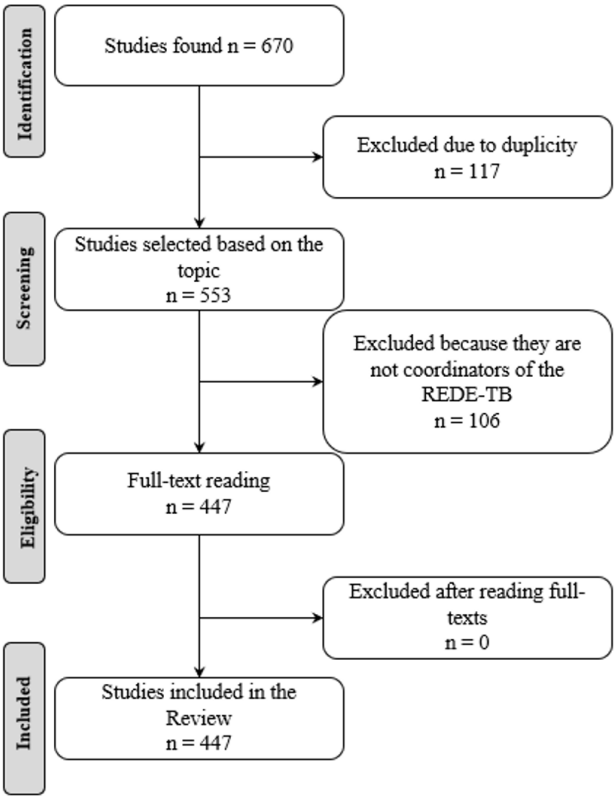

Figure 1. Flowchart illustrating the process of identification, screening and inclusion/exclusion of studies, 2018 to 2023.

Of the 447 studies included, 72 (16.1%) did not mention any funding agency and 20 (4.5%) reported that there was no funding. Of the 355 studies that received funding, 195 (54.9%) were funded by CNPq, 158 (44.5%) by international agencies, 154 (43.4%) by state foundations, 148 (41.7%) by CAPES, 49 (13.8%) by the Oswaldo Cruz Foundation, 33 (9.3%) by the federal government and 63 (17.7%) by various other bodies. Some studies received support from more than one funding agency.

Of the studies carried out, 224 (50.11%) were conducted in some Brazilian state. Rio de Janeiro was the state where most of the studies were carried out (65 - 29.0%), followed by São Paulo (43 - 19.2%), Rio Grande do Sul (31 - 13.8%), Paraná (26 - 11.6%) and Amazonas (24 - 10.7%), (Figure 2). It is important to note that some of the studies analyzed were carried out in more than one location within the states. For this reason, the number of 308 shown on the map (Figure 2) refers to the specific locations within the states where these studies were carried out. With this, it was possible to verify the scope of studies at a national level.

It was possible to identify the country in 301 (67.25%) studies. After Brazil, with 224 (89.0%) studies developed, India was the country with the largest number of studies, totaling 24 (8.0%) studies developed in partnership with REDE-TB researchers, followed by South Africa with 16 (5.3%) and Uganda with 10 (3.3%) (Figure 3). It is im-

portant to note that the total of 463 shown on the map (Figure 3) refers to the locations of the studies carried out, and not the total number of studies, since some of them were conducted in more than one country. It is therefore possible to see the scope of the studies worldwide.

As for the design of the studies conducted by REDE-TB researchers, 56 (12.5%) were literature reviews; 56 (12.5%) were cross-sectional studies; 55 (12.3%) were in vitro studies; 49 (11.0%) were prospective cohorts; and 43 (9.6%) were ecological studies (Table 1).

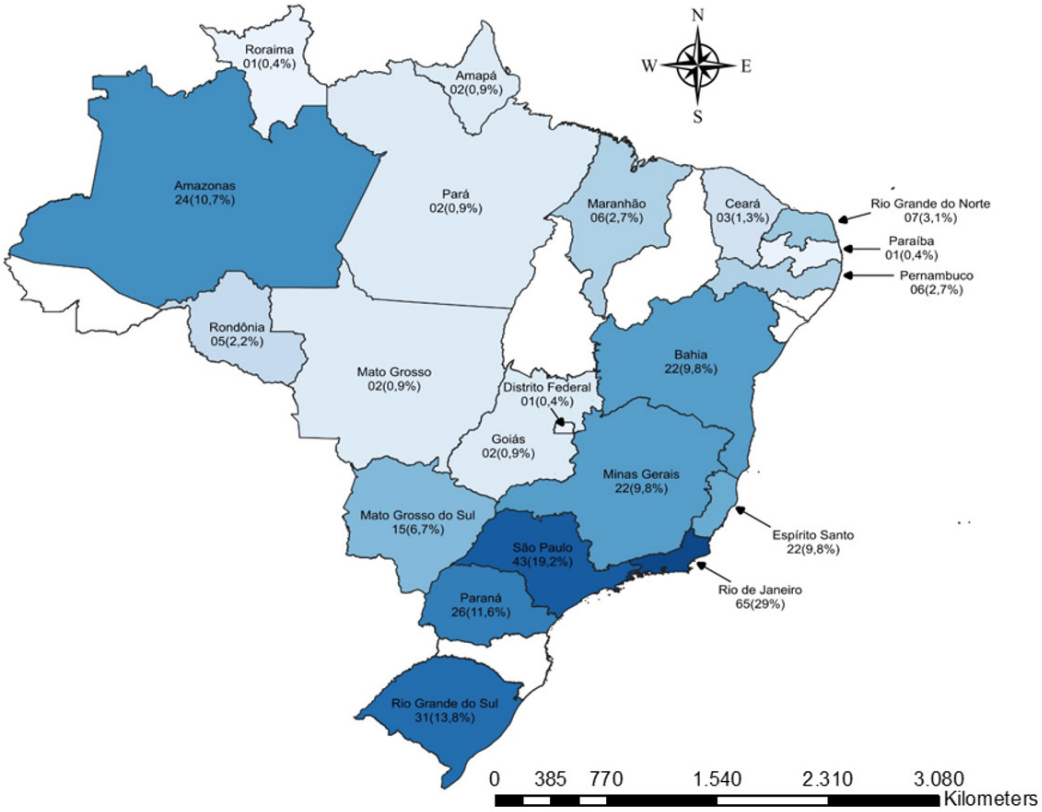

Figure 2. Distribution of studies conducted by REDE-TB researchers, by federation unit, Brazil, 2018 to 2023.

*Caption: *More than one unit of the federation was addressed in some studies, so the cumulative percentage exceeds 100%; in addition, 223 studies were not considered in this analysis because they did not cite this variable or because this variable did not apply to the study in question. The high frequency of studies per state is represented by dark shades, while light shades indicate a lower number of studies in that state."*

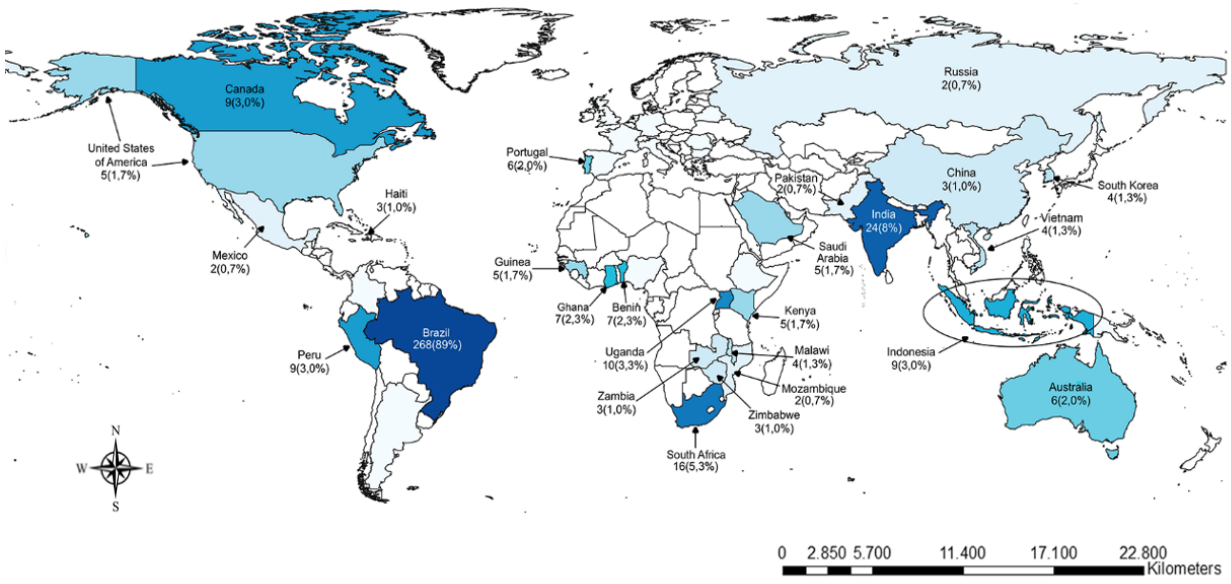

Figure 3. Distribution of studies conducted by REDE-TB researchers, by country of study, Brazil, 2018 to 2023*

*Caption: *Countries with one study each have not been marked on the map. They are: Argentina, Belarus, Bulgaria, Colombia, Ethiopia, France, Gambia, Georgia, Guinea-Bissau, Germany, Italy, Nigeria, Papua New Guinea, Romania, Sierra Leone, Singapore, Spain. More than one country was covered in some studies, which is why the cumulative percentage exceeds 100%; 146 studies were not considered in this analysis because they did not mention this variable or because this variable did not apply to the study in question.*

Table 1. Distribution of studies conducted by REDE-TB researchers, by design, Brazil, 2018 to 2023.

Category	Study Design	N (%)*
PRIMARY		
Observational	Cross-sectional	56 (12.5)
Quantitative	Prospective cohort	49 (11.0)
	Ecological	43 (9.6)
	Retrospective cohort	38 (8.5)
	Case-control	21 (4.7)
	Descriptive	26 (5.8)
Qualitative	Qualitative	9 (2.0)
Mixed	Mixed methods	1 (0.2)
Measurement/Evaluation	Accuracy of diagnostic tests	19 (4.3)
	Cost/cost-effectiveness	15 (3.4)
	Others	27 (6.1)
EXPERIMENTAL		
	in vitro	55 (12.3)
	Intervention study	3 (0.7)
	in vivo	30 (3.7)
	in silico	3 (0.7)
	Clinical trial	15 (3.4)
SECUNDARY	Literature Review	56 (12.5)

*Caption: *Some studies had more than one design, so the cumulative percentage exceeds 100%.*

As for the area of approach of the studies, 145 (32.4%) were focused on epidemiology, of which 32 were spatio-temporal studies. Other areas of study that were widely covered were: development and/or evaluation of drugs/treatment regimens (20.4%); clinical studies (16.1%) on pathogenesis, immunology and genetic markers; and development and/or evaluation of diagnostic methods (10.1%). Other areas of study can be identified in Table 2.

Table 2. Distribution of studies conducted by REDE-TB researchers, by area of study, Brazil, 2018 to 2023.

Areas of study	N (%)*
Epidemiology	145 (32.4)
Development and/or evaluation of drugs/treatment regimens	91 (20.4)
Clinical studies (pathogenesis/immunology/prognosis/ genetic markers)	72 (16.1)
Development and/or evaluation of diagnostic methods	45 (10.1)
Operational studies	39 (8.7)
Genetics and distribution of MTB	23 (5.1)
Evaluation and interoperability of information systems/ research data or artificial intelligence or digital health	18 (4.0)
Social perceptions and representations	6 (1.3)
Economic evaluation (catastrophic expenditure study)	6 (1.3)
Development and/or evaluation of medicinal plants	6 (1.3)
Knowledge, attitudes and practices in tuberculosis	4 (0.9)
Creation and/or development of vaccines	2 (0.4)
Validation of data collection instruments	2 (0.4)
Health care/ Access	1 (0.2)
Social network/social protection	1 (0.2)
Quality of life for people affected by TB	1 (0.2)

Caption: MTB: Mycobacterium tuberculosis; TB: tuberculosis
**Some studies covered more than one area, so the cumulative percentage exceeds 100%.*

The studies covered a variety of populations, with the most frequent being people with TB "disease" (56.4%). People with TB infection were addressed in 55 (12.6%) studies and co-infection with HIV was the subject of 38 (8.7%) studies. Other populations addressed by the studies can be identified in (Table 3).

Table 3. Distribution of studies conducted by REDE-TB researchers, according to study population, Brazil, 2018 to 2023.

Study population	N (%)*
TB disease	246 (56,4)
TB infection	55 (12,6)
TB/HIV co-infection	38 (8,7)
Children and adolescents	28 (6,4)
Healthcare or prison staff/managers/students	25 (5,7)
MTB strains/clinical isolates	25 (5,7)
Contacts	24 (5,5)
People deprived of their liberty	21 (4,8)
Respiratory symptomatic patients	19 (4,4)
People with diabetes mellitus/dysglycemia	18 (4,1)
Operational Studies of Treatment Outcomes	17 (3,9)
Animals (zoonotic TB)	14 (3,2)
Indigenous people	7 (1,6)
Homeless population	6 (1,4)
Operational studies of health services	6 (1,4)
International Migrants, Refugees and Stateless Persons	6 (1,4)
People who use psychoactive substances	5 (1,1)
People living with HIV	5 (1,1)
COVID-19	4 (0,9)
Suspected extrapulmonary TB	4 (0,9)
People with post-TB	4 (0,9)
Mental disorders	3 (0,7)
Transgender people	2 (0,5)
Pregnant women	2 (0,5)
People vaccinated with BCG	1 (0,2)
Renal insufficiency	1 (0,2)
Rheumatological diseases	1 (0,2)
Riverside population	1(0,2)

*Caption: *Some studies had more than one type of population, so the cumulative percentage exceeds 100%.*

DISCUSSION

With this investigation, we sought to analyze REDE-TB's contribution to the technical-scientific development of TB over the last five years, describing its contributions to the advancement of the strategy to end TB. A significant amount of scientific production can be observed, covering the 18 areas of knowledge that currently make up the network.

The results show a significant concentration of studies in some states and regions of Brazil, such as Rio de Janeiro and São Paulo, while others have no studies affiliated to REDE-TB. This suggests the need for strategies to expand the Network's activities, such as encouraging the inclusion of new researchers from these regions or

promoting collaborative studies involving local professionals and civil society. These initiatives could increase the representativeness and equity in the distribution of TB research efforts in the country (https://doi.org/10.6084/m9.figshare.27170853.v1).

Among the scientific-technological productions, we can see REDE-TB's contribution to the development of new treatment regimens, shortened treatments, vaccines, diagnostic tests, as well as studies evaluating diagnostic accuracy, cost-effectiveness and economic evaluations, especially with regard to catastrophic costs, which impact on the quality of life of patients and families. Artificial intelligence was also a technology evaluated by our researcher.[13-16]

We also noticed that the studies go beyond the national scenario, taking place in partnership with India and South Africa to a greater extent. This finding may have been due to the launch of the BRICS-TB NETWORK in 2017, the aim of which was technical-scientific cooperation between the countries that make up this bloc. In order to promote scientific collaboration in TB between the BRICS countries. In 2019, there was a specific call for proposals from the Department of Science and Technology (DECIT), together with the National Council for Scientific and Technological Development (CNPq), which included the participation of several REDE-TB members (Call MS-SCTIE-Decit / CNPq No. 33/2019 - Research on Tuberculosis within the BRICS).[17]

Another important finding is that the studies interface with many countries, which shows the capillarity of REDE-TB and its interconnections. In Latin America, on the other hand, there is still a gap to be filled, as has already been shown by studies on TB that point to low cooperation between Brazil and Latin American countries. A meeting was held in Chile in mid-August 2024, with representatives of civil society from Argentina and/or Mexico, Peru, Colombia, Uruguay, Paraguay, El Salvador, the United States, Guatemala, Panama, Brazil and Chile, where the creation of a Latin American TB-NET was envisioned, with the expectation of more cooperation between the countries and, therefore, to advance the Elimination of TB on the continent.[18]

When we look at the temporal distribution of scientific publications on TB produced by REDE-TB, we notice a relatively uniform distribution over the years, with a slight increase in the years 2020 and 2021, these being the most critical years of the COVID-19 pandemic. This increase can be attributed to the growing awareness of the interconnection between infectious diseases, the urgency of generating evidence to inform health policies and the impact of COVID-19 on tuberculosis prevention and control. Studies show that the pandemic has highlighted the need to investigate how COVID-19 affects the management of diseases such as tuberculosis, influencing both access to treatment and transmission. In addition, researchers have adapted their approaches to deal with these new realities, demonstrating resilience and an ongoing commitment to public health.[19-21]

It can also be seen that the majority of articles were published in international journals, with a selective editorial policy and arbitration, and this is probably due to the weight and penetration of REDE-TB, including its recognition by the WHO and Stop-TB. We also found that the results reveal a solid relationship between publications and research funding agencies.

As for the sources of funding, the diversity pursued by the researchers is remarkable, encompassing international agencies such as the Stop TB Partnership, the National Institute of Health (NIH), the United States, among others, and state foundations and government bodies such as CNPq and CAPES. A relevant finding is that 20.6% of the studies listed did not mention a funding agency, which can be attributed to the fact that the studies did not have their own funding, indicating that the research was conducted voluntarily and/or with resources from the researchers' own institutions. We would like to highlight the difficulties faced by researchers in obtaining funding, especially in the area of TB, which since 2019 has had a blackout, with no thematic funding, which has probably contributed to maintaining the situation.[22]

From the content analysis of the studies, it can be seen that many operational studies took place in hospital environments, outpatient units and basic health units. A significant proportion of the studies had a municipal scope, reflecting the interest of REDE-TB researchers in public health issues at a local level. We also observed a small proportion of studies in indigenous territories and universities, showing a diversity of interests in the fields of TB study, with approaches in different geographical and cultural contexts.[23,24]

With regard to the national scope of the studies, states such as Rio de Janeiro and São Paulo, which have large research and development centers, contributed almost half of the projects carried out with the participation of REDE-TB. However, Rio Grande do Sul, Paraná and Amazonas also contributed, together accounting for 36.1% of the studies. The fact that the studies were carried out in different states can be attributed to various factors, including the availability of resources, the focus of the research and the presence of universities and research institutes focused on the study of TB.[25-27]

It is also worth highlighting the plurality of types of research being carried out by REDE-TB members, with a predominance of literature reviews, experimental studies (involving pre-clinical studies, vaccines and treatment regimens and clinical trials, with a majority of diagnostic tests) and quasi-experimental, epidemiological studies (being descriptive, cross-sectional, cohort, case-control and ecological, the latter consisting of geospatial studies and including time series analysis). It is important to note that genetic studies are being carried out to map and monitor resistance, such as whole genome sequencing (WGS), mutation analysis associated with resistance and phenotypic virulence tests.

As far as the approach of the studies is concerned, there was a predominance of epidemiological studies. Analyzing the distribution of TB, especially in the Brazilian scenario, contributes to discussions about the health-disea-

se process and the determining factors for the involvement and outcomes of the disease in the different regions of the country, as well as contributing to the implementation of social and health policies for universal access to early diagnosis and treatment, control of transmissibility and an increase in favorable outcomes.[27-29]

In addition, studies aimed at the development and/or evaluation of drugs/treatments, as well as clinical studies and the development/evaluation of diagnostic methods made up an important sample of this review. This scientific evidence, together with epidemiological studies, can have an impact on improving health actions with a view to early diagnosis and treatment, as well as the quality of life of people affected by TB.[30]

With regard to the distribution of the studies conducted by REDE-TB researchers, there was a significant diversity in the populations studied in relation to TB and its various forms, including disease and infection. Most of the studies focused on people with pulmonary TB, the most prevalent clinical form and of greatest epidemiological importance, due to the potential for transmission. The literature shows that pulmonary TB is also one of the leading causes of death worldwide, accounting for the largest number of deaths caused by a single infectious agent, making its elimination a priority compared to other infectious diseases due to its impact on global health.[31]

It is also notable that a significant percentage of studies deal with people with TB infection, since it is important to understand and discuss not only manifest cases of the disease, but also those in which the infection is present without obvious clinical symptoms. It is estimated that approximately 25% of the world's population is infected with MTB (Mycobacterium tuberculosis), and the disease develops in 5-10% of these cases over the course of their lives, with a higher risk in immunocompromised groups. Therefore, latent TB can represent a significant challenge for TB control programs, since these people may develop active disease in the future.[32]

Although the number of studies on TB with HIV/AIDS co-infection has been substantially low compared to the others, this does not diminish its importance due to its impact on the prognosis of cases, as well as the challenges encountered in concomitant treatment and control of the infection/disease. This is because, in 2016, 57% of people reported with TB were infected with HIV and also because, in Brazil, there are signs of a re-emergence of the AIDS epidemic, with the worst indicators in 30 years, including an increase in cases among homosexuals and concentration in urban centers. Thus, TB/HIV co-infection requires an integrated and coordinated approach between control programs, highlighting strategies such as early diagnosis and timely treatment.[33,34]

Mathematical models have come up with estimates that analyze strategies and trends for achieving the targets set, allowing managers and authorities around the world to check whether their countries will succeed in achieving them[3]. According to these models, if we continue as we are, with no progress in terms of social protection policies and no incentives for research and innovation in TB, the expectation is that we will reach the target beyond 2050. However, if combined with the two pillars mentioned above, we can expect to achieve it in good time.[35-37]

Finally, it should be noted that the studies were part of diverse areas of study and addressed different population groups not covered in this discussion, but which can be identified in the results, showing the diversity and potential for action by REDE-TB researchers on the subject of TB.

It is worth noting that between 2012 and 2021, there was a significant increase in new cases of pulmonary tuberculosis (TB) among self-declared black or brown people, from 61.9% to 69.0%, while cases among whites fell from 35.9% to 28.9%. The percentage of cases among yellow or indigenous people remained constant at around 2.1%. This shows that it is essential to expand the active search and strengthen collaboration between the health services of the Unified Health System (SUS) and other institutions, taking into account the specificities of the most vulnerable populations, such as people deprived of their liberty, homeless people, immigrants and indigenous people.[38]

As for the limitations of this study, it is worth noting that studies carried out by REDE-TB researchers who were absent from the assemblies were not included. It is also important to recognize as a limitation the fact that the search was carried out in only three databases and with a time frame which, for the most part, included the period of the COVID-19 pandemic, which may have resulted in an atypical production of studies involving TB. Despite these limitations, this review has the potential to show a picture of what REDE-TB has been contributing to scientific research on TB in Brazil and around the world.

The study shows the importance of REDE-TB's work in scientific production on TB around the world, which is recognized by national and international funding agencies and materialized in the production of studies with different methodological designs and in different study sites, areas of knowledge and population groups. It is also worth highlighting the internationalization of the knowledge produced by its members, in response to the requirements for obtaining research grants and the classification of Graduate Programs, as well as in policies and actions to combat TB

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Rander Junior Rosa contributed to the bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of the results, drawing up tables, conclusions, review and statistics**. Ana Beatriz Marques Valença** contributed to the bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of the results, drawing up tables, conclusions, review and statistics**. Letícia Perticarrara Ferezin** contributed to project management, bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review**. Natacha Martins Ribeiro** contributed to project management, bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review**. Paula Daniella de Abreu** contributed to the writing of the abstract, methodology, interpretation of results, conclusions, review**. Rubia Laine de Paula Andrade** contributed to project management, bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review and statistics**. Willie Otávio Bueno Bernardi** contributed to project management, bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review**. Diogo Henrique Mendes da Silva** contributed to the writing of the abstract, methodology, interpretation of results, conclusions, review**. Aline Aparecida Monroe** contributed to project management, bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review**. Erica Chimara Silva** contributed to the writing of the abstract, methodology, interpretation of results, conclusions, review**. Vânia Maria Silva Araújo** contributed to project administration, fund acquisition, bibliographic research, review and statistics**. Anna Cristina Calçada Carvalho** contributed to writing the abstract, revision. **Ethel Leonor Noia Maciel** contributed to project management, bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review and statistics. **Ana Paula Junqueira-Kipnis** contributed to project management, literature research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review and statistics**. Jose Roberto Lapa e Silva** contributed to project administration, fund acquisition, bibliographic research, review and statistics**. Lia Gonçalves Possuelo** contributed to project management, bibliographic research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review and statistics**. Ricardo Alexandre Arcêncio** contributed to project administration, bibliographical research, writing the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, review and statistics**.**

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