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Prevalence of Tuberculosis and Evolution in Diagnostic Methods over the Last 10 Years in Burkina Faso

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Abstract

Introduction: Burkina Faso, a West African country, has also seen a resurgence in new cases of tuberculosis. It would be useful to have an overview of how prevalence and diagnostic methods have changed in recent years. The aim of this study was to estimate the prevalence of tuberculosis in Burkina Faso over the past 10 years and to summarize the diagnostic methods used. **Material and Methods**: A review of studies published between 2014 and 2024 on the prevalence of tuberculosis in Burkina Faso and the diagnostic methods used were carried out using the "Preferred Reporting Items for Systematic Reviews and Meta-Analysis" (PRISMA). Relevant publications were selected from the PubMed/Medline, Embase, Google Scholar, and ScienceDirect databases. **Results**: Most of the studies on the prevalence of pulmonary tuberculosis in Burkina Faso found in this review were generally hospital-based and included both child and adult populations. Prevalence rates ranged from 15% to 63.36%, with a calculated overall prevalence of 31.58% [(n = 348; 95% CI (26.86 - 36.30)] in the studies examined. The majority of authors used microscopy, which is the standard diagnostic method. Molecular techniques such as GeneXpert were associated with microscopy in over 70% of studies, compared with less than 30% for culture. **Conclusion**: At the end of this study, the number of reported cases fluctuated over the years. In terms of diagnostic methods, in the last 10 years, more specific molecular techniques have been introduced, along with the use of alternative samples to sputum for the detection of *Mycobacterium tuberculosis*.

Keywords

Tuberculosis, Prevalence, Diagnostic Methods, Review

1. Introduction

Tuberculosis is a disease caused by a *Mycobacterium tuberculosis complex*, the most common of which is *Mycobacterium tuberculosis* or Koch's bacillus [1]. In 1882, Robert Koch isolated the tuberculosis bacillus for the first time [2]. The causative agent of tuberculosis is thought to have two different evolutionary lineages, the first of which affects only humans [3]. The second lineage, which is thought to be of animal origin, also infects humans but mainly affects mammals such as cattle, goats, and rodents. Transmission of tuberculosis is primarily through the air for the first lineage and through food for the second lineage. Tuberculosis can manifest itself clinically as pulmonary tuberculosis and extrapulmonary tuberculosis. Extrapulmonary tuberculosis affects other organs in the body, in addition to the lungs. Tuberculosis remains a major public health problem, with a high incidence worldwide and in sub-Saharan Africa. Over the last decade, there has been an increase in the number of cases of tuberculosis worldwide, with variations depending on the region and the population. The reported global number of people newly diagnosed with TB was 7.5 million in 2022. This is the highest number since the WHO began monitoring tuberculosis on a global scale [1]. Burkina Faso is a West African country with a National Tuberculosis Control Program and a health information system that appear to be similar to those in other sub-Saharan African countries. In order to detect, treat, and prevent tuberculosis in as many people as possible, a better control strategy is needed. A better control strategy requires the development of better diagnostic techniques. Initially, tuberculosis was diagnosed by culture before the development of more specific techniques, particularly molecular techniques. The country has seen a resurgence in new cases of tuberculosis in recent years despite the implementation of strategies to combat and prevent the disease [4]. Given this situation, it would be useful to have an overview of changes in prevalence and diagnostic methods in recent years. The aim of this study was, therefore, to estimate the prevalence of tuberculosis in Burkina Faso over the last 10 years and to summarize the diagnostic methods used.

2. Methods

2.1. Study Design

A review of various studies published between 2014 and 2024 on the prevalence of tuberculosis in Burkina Faso and the diagnostic methods used were carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). All primary studies conducted in Burkina Faso that mentioned the prevalence of tuberculosis, regardless of the diagnostic methods used and the

nature of the sample, were included. Only articles dealing with human tuberculosis were considered. Reviews, case reports, letters to the editor, opinion articles, study protocols, conference abstracts, posters, theses, and reports were excluded.

2.2. Research Strategy

We conducted a systematic literature review to identify relevant publications concerning prevalence and diagnostic methods used in work published from 2014 to 2024 in Burkina Faso. Searches in French and/or English were conducted in PubMed/Medline, Embase, Google Scholar, and ScienceDirect databases. The documents identified were downloaded in the appropriate format and linked to the Zotero software. The boolean operators "AND" and "OR" were used to link MeSH terms and keywords and to retrieve publications from the PubMed/Medline (NCBI) databases. The keywords used were "tuberculosis", "diagnosis", "prevalence" + "Burkina Faso".

2.3. Eligibility Criteria and Study Selection Procedure

After consulting the databases, the studies were selected based on the following criteria:

1) Data published in a peer-reviewed scientific journal;
2) Full articles with related data available;
3) Date of publication of the article;
4) Place of data collection in the article.

The search and selection of relevant articles were carried out by two independent reviewers to reduce the risk of information, selection, and analysis bias. In the event of a disagreement over the eligibility of a study, the issue was resolved through discussion and/or consensus with a third reviewer. The quality of the studies was examined to exclude those of low quality. Data from the remaining studies were presented in tabular form for independent assessment of the methodological quality of each study.

2.4. Data Extraction and Analysis

The variables extracted from the articles included in this study were the first author, the year of publication of the data, the period of sample collection, the population studied, the age of the participants, the type of sample, the diagnostic methods used, the type of study (cross-sectional, longitudinal cohort or other observational) and the prevalence of tuberculosis. An overall prevalence was calculated, and a 95% confidence interval was determined. Articles dealing solely with diagnostic methods without mention of prevalence were used for a qualitative analysis.

2.5. Risk of Bias and Quality Assessment of the Studies

The risk of bias and quality of the studies included in this systematic review

was assessed using the Joanna Briggs Institute (JBI) critical appraisal for the methodological quality of articles in accordance with the study design. The aim of this evaluation is to assess the methodological quality of a study and to determine the extent to which it took into account the possibility of bias in its design, implementation, and analysis [5].

3. Results

3.1. Characteristics of Studies Included

For this study, 9821 articles were found in the databases examined, plus 5 other documents. First, duplicates and then irrelevant articles based on the title were eliminated. Next, the exclusion of reviews and case reports permitted the selection of 28 articles for review. In the end, 11 articles were selected for review, dealing with methods of diagnosis and/or prevalence of tuberculosis. The results of the article search, and the number of articles included and excluded are shown in **Figure 1**.

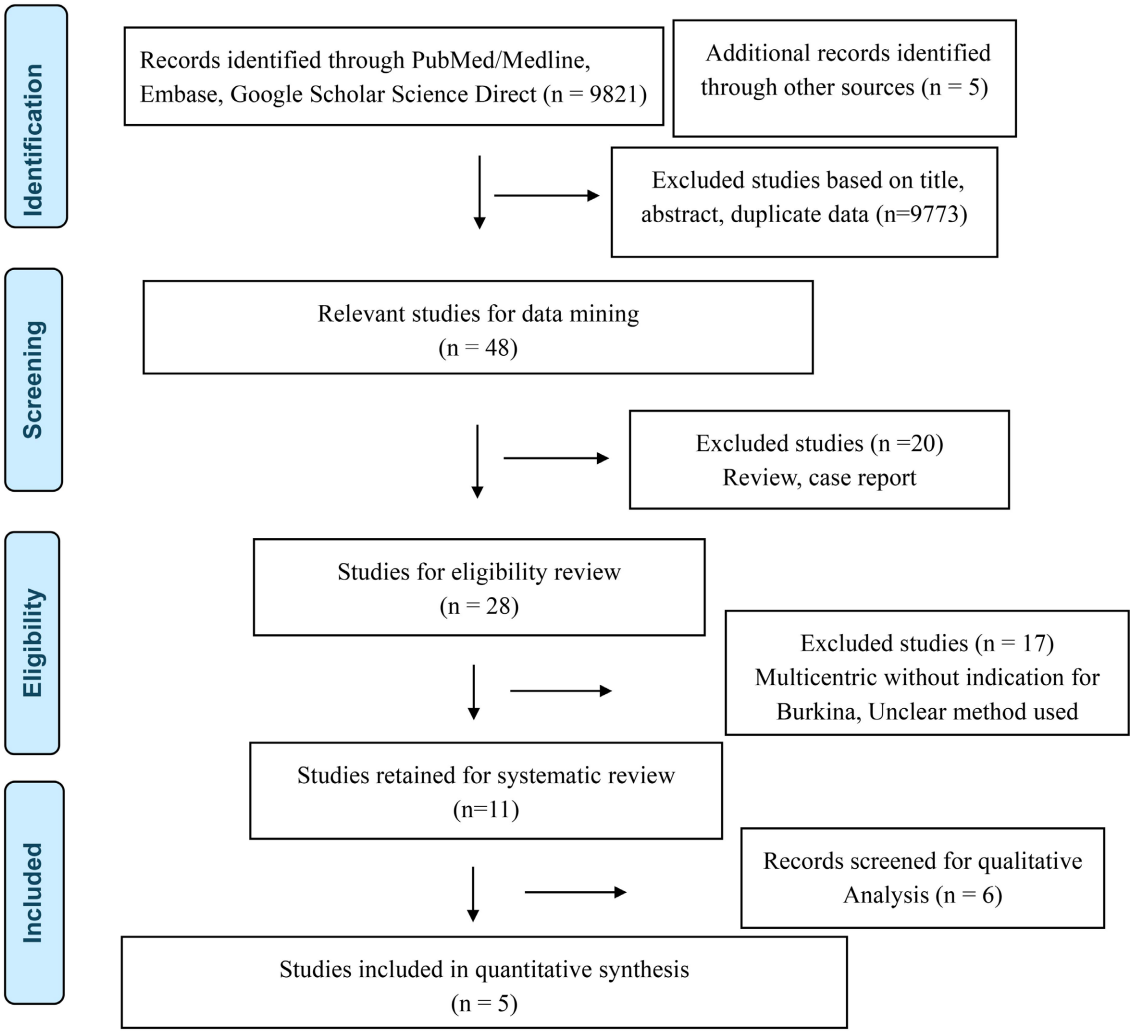

Figure 1. PRISMA flowchart of the search strategy for inclusion of published studies.

Data were extracted from articles published between 2014 and 2024 on tuberculosis in Burkina Faso that met our eligibility criteria. Of the articles selected, 7 reported the prevalence of tuberculosis in samples collected in Burkina Faso and presented the diagnostic methods used. Two articles tested the use of alternative samples to sputum, which is the standard sample used to diagnose tuberculosis, while two other articles assessed the performance of tests for diagnosing tuberculosis.

3.2. Tuberculosis Prevalence in Burkina Faso

Most of the studies on the prevalence of tuberculosis in Burkina Faso found in the context of this study were generally conducted in hospitals and involved both children and adults. The age of the youngest patient reported was 7 months, compared with 78 years for the oldest [6]. Prevalence rates ranged from 15% to 63.36% [7] [8] (**Table 1**). The calculated overall prevalence was 31.58% [(n = 348; 95% CI (26.86 - 36.30)], representing the proportion of positive TB diagnoses among the samples in the studies examined. Two data sets were not included in this estimate because the authors targeted only cases of meningitis or contact cases. The data available from some authors indicated numbers of notified TB cases per year instead of a prevalence value. The trend remained relatively constant, fluctuating slightly between 2014 and 2020. However, from 2020 to the present year, 2024, there is a clear increase. The lowest number of cases was 5792 in 2014, compared with 8613 in 2023 (**Figure 2**).

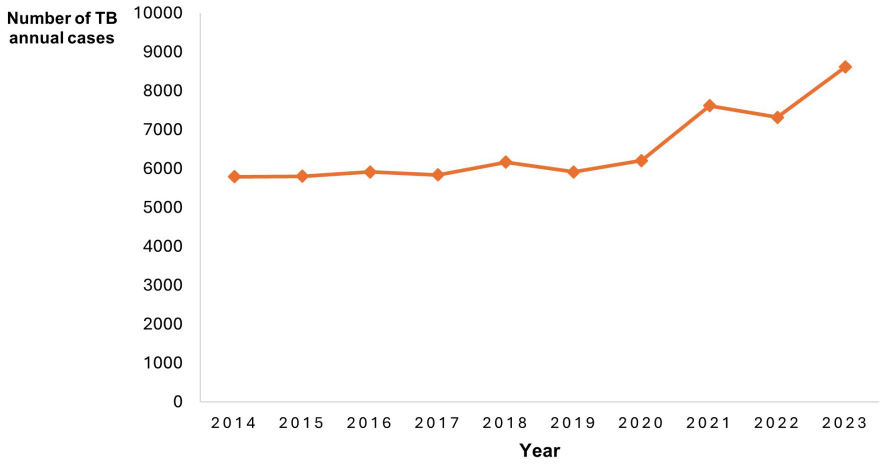

Figure 2. Trend in the annual number of tuberculosis cases in Burkina Faso [4] [9].

3.3. Diagnostic Methods Used

One or more diagnostic methods were used to test for *Mycobacterium tuberculosis*. The majority of authors used microscopy, which is the standard diagnostic method. Molecular techniques such as GeneXpert were associated with microscopy in over 70% of studies, compared with less than 30% for culture. As for the type of samples used, saliva was used in 42.8% of the studies found (**Table 1**).

Table 1. Characteristics of articles dealing with the prevalence of tuberculosis.

Author	Study period	Type of study	Population	Age range	Sample size	Type of sample	Diagnostic methods	Type of TB	TB prevalence
Djibougou *et al.*, 2022	March to July 2020	Cross-sectional	Contact cases	38.52 ± 12.01 years 15 - 68 years	101	Blood	QFT-Plus TST	Latent	63.36%*
Ilboudo *et al.*, 2015	2014	Cross-sectional	Any patient	38.52 ± 14.02 years	59	Sputum	Microscopy Real-time PCR (7500)	Pulmonary	44.1%
Kabore *et al.*, 2023	January to July 2016	Cross-sectional	Any suspected TB patient	31 ± 18 years 7 months to 78 years	119	RTS stools	Microscopy Xpert	Pulmonary	23.59%
Marcy *et al.*, 2022	27 April 2011-December 2014	Observational cohort	Children with HIV	<13 years	50	Blood sputum	Microscopy Xpert culture	Intra-thoracic	15.0%
Ouedraogo *et al.*, 2016	1 February to 30 April 2014	Cross-sectional	Suspected patients	-	57	Sputum stool	Culture Microscopy		26.0%
Sanogo *et al.*, 2020	December 2012 to November 2014	Longitudinal cohort	Children with HIV	<13 years	63	Sputum, nasopharyngeal	Microscopy Xpert culture	Pulmonary	49.2%
Zida *et al.*, 2018	2014 to 2015	Cross-sectional	Patients with meningitis symptoms	-	202	Cerebrospinal fluids	PCR	-	1.48%*

*Value not included in calculated overall prevalence. TB: tuberculosis. QFT-Plus: QuantiFERON-TB Gold Plus test; TST: Tuberculin skin test; RTS: Respiratory Tract Sample.

The others used blood or tested alternative samples such as stools and nasopharyngeal swabs. It was found that stool was sometimes less contributory than sputum (Table 2), unlike nasopharyngeal swabs. Nasopharyngeal swabs could be an alternative for children, for example.

Table 2. Characteristics of articles that evaluated the use of alternative samples or diagnostic methods.

Author	Comparison standard sample	Alternative samples	Diagnostic method or test used	Results
Sanogo *et al.*, 2020*	Gastric tubing sputum	Nasopharyngeal string test stool	Microscopy Xpert MTB/RIF	Identical contribution from standard and alternative samples
Ouedraogo *et al.*, 2016*	Sputum	Stool	Microscopy culture	Stools were less contributory than sputum. Cause: may be due to the stool pre-treatment stage.
Sanogo *et al.*, 2021**	-	-	QuantiFERON®-TB Gold In-Tube test (QFT-GIT)	Sensitivity: 20.69% Specificity: 96.55%
Diabouga *et al.***	-	-	VIDAS® TB-IGRA (Interferon-γ release assays)	Sensitivity: 90.4 - 95.0% Specificity: 94.9%

*Studies evaluating the use of alternative samples; **Studies evaluating the performance of test in diagnostic of tuberculosis.

4. Discussion

This study assessed the available data on the prevalence of tuberculosis and the diagnostic methods used over the last 10 years in Burkina Faso. The overall prevalence of all types of patients combined was 31.58% among the studies considered. When we look at the data for the years targeted by the study, we find a prevalence of 49.2% for 2014 reported at the Sourô Sanou University Hospital (CHUSS) in Bobo-Dioulasso [10] then a value of 44.1% at collection sites such as the district of Bogodogo and the Saint Camille medical centre in Ouagadougou [11]. Sanogo *et al.* carried out their sample collection from 2012 to 2014, compared with the authors of the Ouagadougou study, for whom the study only covered 2014. This could explain the higher prevalence found by the first authors cited. Two other studies, whose sample collection period included 2014 found lower prevalence rates of 26% [12] and 15% [13], respectively. These values could be due to the short sample collection period (3 months) for the study by Ouedraogo *et al.* Regarding the study by Marcy *et al.* in 2016, the patients recruited were children under 13 years of age living with HIV. In 2015, the prevalence mentioned by the data found was 1.48% [14]. This low prevalence could be explained by the fact that the authors had looked for *Mycobacterium tuberculosis* in suspected cases of meningitis rather than tuberculosis, but also by the type of sample used (Cerebrospinal fluid). From January to July 2016, a prevalence of 23.6% was observed in patients suspected of having tuberculosis [6]. This value is comparable to the prevalence of 26.8% obtained by authors in Ethiopia among the same types of participants who were suspected of having tuberculosis [15]. In 2020, the tuberculosis prevalence rate obtained by Djibougou and colleagues was 63.36% [7]. This high prevalence came from case contact patients in whom latent tuberculosis had been detected by Tuberculin skin test (TST) and Interferon Gamma Release Assays (IGRAs). Authors have found a lower prevalence among contact cases of 38.10% and 43.6% respectively in Indonesia among children under 5 years of age [16] and India in older participants [17].

In parallel with these prevalence values obtained by the various studies, from 2014 to 2023, tuberculosis is notified each year in Burkina Faso in terms of the number of cases. In 2014, the number of tuberculosis cases was 5792; in 2015, it had risen to 5808. Between 2016 and 2020, the number of tuberculosis cases rose from 5918 to 6207. The number of tuberculosis cases fluctuated, reaching 7619 in 2021, 7320 in 2022 and 8613 in 2023. National data for 2024 are not yet available. In 2023, the number of new cases and relapses was 8613, compared with 7320 in 2022, an increase of 17.7%. One reason for this is the application of directives, the implementation by the Burkinabe government of the Active case-finding (ACF), and the increase in the number of GeneXpert devices in health centers across the country [4].

In Burkina Faso, tuberculosis is a notifiable disease that can be diagnosed using various types of samples. In the analyzed studies, some authors used conventional samples for the detection of *Mycobacterium tuberculosis*, such as sputum, gastric

tubes, blood, etc. [7]. Other authors have explored alternatives such as the use of stools, nasopharyngeal swabs, and cerebrospinal fluid. While the study by Ouedraogo *et al.* in 2016 found that stools were less contributory than sputum, probably due to the pre-treatment stage; in the study by Sanogo and colleagues, the comparison between the two types of samples gave the same detection rate [10]. These alternative samples would, therefore, detect *Mycobacterium tuberculosis* just as well as standard samples and could be used for children, in whom it is often complicated to obtain a good sputum [18].

Tuberculosis can be diagnosed clinically and bacteriologically. Bacteriological diagnosis is made from sputum samples and other biological fluids such as gastric tube fluid, ascites puncture, and pleural puncture. [19]. Clinical diagnosis is made on the basis of clinical signs and additional examinations such as the X-ray used in the study of Berteloot *et al.* [20].

A review of the different methods used by authors in studies from 2014 to the present day for the bacteriological diagnosis of tuberculosis showed that the use of microscopy and molecular techniques ranked equally at over 70% compared with less than 30% for culture. For a long time, microscopy and culture were the only techniques used before the introduction of GeneXpert in 2013 in Burkina Faso [21]. The use of microscopy was common to all authors [6] [11] [12] [22] [23] followed by culture [8] [10] [12] and Tuberculin Skin Test (TST) [24]. Gene amplification techniques were also mentioned [11] [14], including GeneXpert [6] [9] [13] [23] as well as QuantiFERON®-TB Gold test [23] [24] and Vidas TB-IGRA which are automated methods for quantifying gamma interferon compared with the classic Elisa method [25]. Although microscopy remains the standard, recent tests have made a significant contribution to the diagnosis of tuberculosis in Burkina Faso.

Study Limitations

This study was limited by the paucity of studies available on the prevalence of tuberculosis in Burkina Faso. The vast majority of the data was found to concern regions of the country, and the results could not be generalized.

5. Conclusion

The results of this study show that there is heterogeneity in the reported prevalence of tuberculosis in Burkina Faso. There are very few studies on the subject, probably due to the fact that there is a national tuberculosis control program that compiles information on cases and publishes an annual report on incidence. There has been a downward trend in the number of cases reported over the years. As for diagnostic methods, the last 10 years have seen the introduction of more specific molecular techniques, as well as the use of alternative samples to sputum for the detection of *Mycobacterium tuberculosis.* The Burkinabè health system needed to step up its prevention efforts through awareness campaigns and mass screening using the new diagnostic methods, and by providing all screening centres

with GeneXpert equipment.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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