

Research Article

Analysis of Tuberculosis Data in the Niono Health District in Mali from 2016 to 2024

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Abstract

Introduction: Tuberculosis is a chronic infectious disease caused by *Mycobacterium tuberculosis* (Koch's bacillus) and remains a major public health problem in many developing countries. This study aimed to analyze tuberculosis data from the Niono health district in Mali from 2016 to 2024. **Methodology:** This was a cross-sectional study conducted using routine data collected from Referral Health Centers (CSRef) and selected Community Health Centers (CSCoM) in the Niono district. The study covered data from 2016 to 2024. We analyzed annual incidence rates, the proportions of new cases and relapses, and mortality rates. Data confidentiality was maintained through coding throughout the study. **Results:** A total of 6,711 suspected TB cases, of which 718 were confirmed (a positivity rate of 10.7%), were recorded in the Niono health district database from 2016 to 2024. Tuberculosis incidence increased from 22.1 cases per 100,000 people in the Niono district in 2021 to 26.7 in 2024. The district saw a high proportion of incident cases in 2024 (19.3%). Notification to community health centers was the most common method, at 35.6%. The district experienced frequent relapses in 2019 and 2024 (18.8% and 18%, respectively). 99% of tuberculosis cases were treated at referral health centers. The mortality rate was estimated at 1.3%. **Conclusion:** Tuberculosis persists in the Niono health district, with the number of cases fluctuating and rising. The implementation of national strategies is necessary to achieve the objectives of a significant reduction.

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Keywords

Tuberculosis, Incidence, Niono District

1. Introduction

Tuberculosis (TB) is an infectious, contagious disease, primarily transmitted from person to person, caused mainly by *Mycobacterium tuberculosis* or Koch's bacillus [1]. For several decades, TB was the leading cause of death from a single infectious agent. [2] It remains a major scourge with more than 8 million new cases and 3 million deaths annually worldwide [3].

The World Health Organization (WHO) has recorded 10.8 million new tuberculosis infections worldwide, including 6 million men, 3.6 million women, and 1.3 million children, with an estimated mortality of 1.25 million deaths directly attributable to the disease in 2023 [4].

Africa has seen a decline in tuberculosis deaths and cases, from 2.5 million cases and 424,000 tuberculosis deaths in 2022 to 1.9 million cases in 2023 [5]. It bears a significant share of the global tuberculosis burden, with 1.6 million new cases and over 600,000 deaths each year [5]. For example, in Côte d'Ivoire, 20,000 cases of tuberculosis (125 cases per 100,000 inhabitants) are recorded annually [6].

In developing countries, the situation is exacerbated by structural factors such as limited access to care, inadequate health infrastructure, and socioeconomic inequalities [7]. These obstacles compromise the effectiveness of control policies, despite the improvement in the detection rate in the African Region, which increased from 60% to 70% between 2020 and 2022 [7].

In Mali, data show that tuberculosis persists despite progress in control and research, remaining a major public health problem [8, 9]. WHO estimates indicate that in 2018, the incidence rate was 53 cases per 100,000 inhabitants [9]. A downward trend is observed, with 48 cases per 100,000 inhabitants in 2023 and 37 cases per 100,000 inhabitants in 2024 [10, 11].

The Ségou region has a tuberculosis incidence of 55 cases per 100,000 inhabitants [12]. The Niono health district in the region recorded 4,168 suspected and 811 confirmed cases of tuberculosis from 2016 to 2024 [13]. These data have not been analyzed to assess the implementation of TB control strategies. The main objective of our work was to analyze these data. More specifically, it allowed us to:

- 1) Calculate the frequency of tuberculosis in the Niono health district.
- 2) Determine the number of new cases and relapses in the Niono health district,
- 3) Determine the number of systematic tuberculosis screenings in people living with human immunodeficiency virus (HIV),

- 4) Determine the tuberculosis death rate in the Niono health district.

This study will provide a better understanding of the evolution of TB in the Niono health district from 2016 to 2024, thereby strengthening targeted interventions by health authorities.

2. Materials and Methods

2.1. Study Framework

The current study took place in the Niono health district, located in the Ségou region, the fourth administrative region of Mali. The district covers an area of 23,063 km² with a population of approximately 575,123 inhabitants in 2024 and a density of 22 inhabitants/km² [14]. It is structured into two levels of care: the first, represented by twenty-six (26) community health centers (CSCoM), and the second, the referral health center (CSRef).

2.2. Type and Period of Study

This was a cross-sectional study conducted from February to July 2025. It focused on tuberculosis data from the Niono health district in Mali from 2016 to 2024.

2.3. Study Population

(DHIS 2) database from 2016 to 2024.

Suspected case: Pulmonary tuberculosis is often suspected based on one of the following criteria: A chest X-ray taken to look for respiratory symptoms (cough lasting > 3 weeks, hemoptysis, chest pain, dyspnea), unexplained illness, fever of unknown origin, or a positive tuberculin skin test [3].

A confirmed case of tuberculosis is a patient in whom the presence of the responsible bacterium, *Mycobacterium tuberculosis*, has been proven by laboratory tests [3].

A case of relapse is defined as a patient who has already taken antituberculosis drugs for one month or more and whose final result of the last antituberculosis treatment was "cured" or "treatment completed" and who presents with a recurrent episode of TB (true relapse or reinfection) [3, 15].

2.4. Data Collectio

We extracted the data from the Mali District Health Information Software (DHIS2) database.

Data processing was performed using Microsoft Excel 2016.

We analyzed the tuberculosis database by time, place, and person.

3. Results

A total of 6711 suspected TB cases, of which 718 were confirmed, representing a positivity rate of 10.7%, were recorded in the Niono health district database from 2016 to 2024 (Tables 1 and 2).

Table 1. Distribution of suspected TB cases in the Niono health district from 2016 to 2024.

Year	Health facilities				Total	
	CSCom		CSRef			
	n	%	n	%	n	%
2016	191	26.7	159	5.2	350	5.2
2017	45	6.3	352	11.6	397	5.9
2018	79	11.0	461	15.2	540	8.0
2019	36	5.0	378	12.4	414	6.2
2020	26	3.6	159	5.2	185	2.8
2021	29	4.1	193	6.3	222	3.1
2022	45	6.3	301	9.9	346	5.2
2023	103	14.4	399	13.1	502	7.5
2024	161	22.5	638	21.0	3755	55.6
Total	715	100.0	3040	100.0	6711	100.0

n= number of suspected tuberculosis cases

Table 2. Distribution of confirmed TB cases in the Niono health district from 2016 to 2024.

Year	Health facility				Total	
	CSCCom (n)		CSRef (n)			
	n	%	n	%	n	%
2016	6	10.2	40	5.6	46	5.9
2017	8	13.6	69	9.6	77	9.9
2018	7	11.9	71	9.9	78	10.0

Year	Health facility				Total	
	CSCCom (n)		CSRef (n)			
	n	%	n	%	n	%
2019	3	5.1	58	8.1	61	7.8
2020	7	11.9	33	4.6	40	5.1
2021	4	6.8	113	15.7	117	15.0
2022	3	5.1	84	11.7	87	11.2
2023	0	0.0	122	17.0	122	15.7
2024	21	35.6	129	17.9	150	19.3
Total	59	100.0	719	100.0	778	1000

n = number of confirmed cases of tuberculosis.

The district experienced a high proportion of incident cases in 2024 at 19.3%. Notification in community health centers was the most represented at 35.6%.

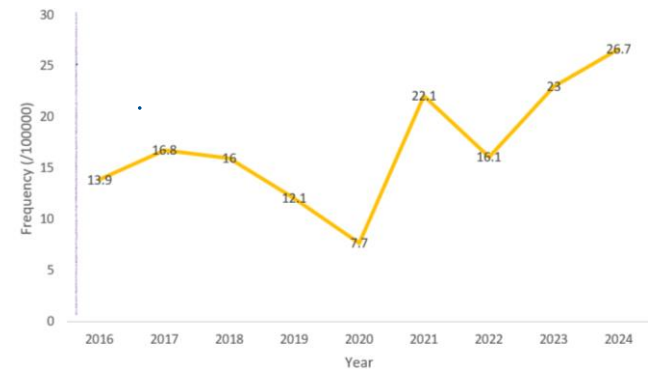


Figure 1. TB trend in the Niono health district from 2016 to 2024.

Since 2020 we have seen an increase in the trend of TB cases.

Table 3. TB relapse cases in the Niono health district from 2016 to 2024.

Year	Health facility				Total	
	CSCCom (n)		CSRef (n)			
	n	%	n	%	n	%
2016	0	0.0	0	0.0	0	0.0
2017	0	0.0	0	0.0	0	0.0
2018	0	0.0	0	0.0	0	0.0
2019	0	0.0	138	18.9	138	18.8

Year	Health facility				Total	
	CSCom (n)		CSRef (n)			
	n	%	n	%	n	%
2020	0	0.0	121	16.6	121	16.5
2021	0	0.0	116	15.9	116	15.8
2022	0	0.0	108	14.8	108	14.7
2023	0	0.0	119	16.3	119	16.2
2024	5	100.0	127	17.4	132	18.0
Total	5	100.0	729	100.0	734	100.0

The district experienced frequent cases of relapse in 2019 and 2024 with 18.8% and 18% respectively.

4. Discussion

4.1. Boundaries

Our study was limited by the quality of the data in the care facilities, due to its incompleteness (several items were not completed). We also noted inconsistencies that limited comparisons between care facilities of the same level.

4.2. Frequency of TB in the Niono Health District

The incidence of tuberculosis cases in the Niono health district is trending upward, peaking at 26.7 cases per 100,000 inhabitants in 2024. Although this rate is lower than the national average of 50 cases per 100,000 inhabitants according to the Global Tuberculosis Report 2023, this district warrants particular attention. This trend was observed only in 2021, according to our results (Table 2). This could be explained by the proper implementation of strategies recommended by the Ministry of Health, through intensified screening activities by community teams [11]. Our results are consistent with those of the study by Sanogo et al in the Mopti region in 2020 [16]. A survey conducted in Kayes by Boubacar Niaré et al in 2023, with screening in 12 mosques in Bamako, indicates a detection rate of 1.64% (≈1,640 per 100,000), thus confirming a potentially underestimated incidence in rural areas [17].

4.3. Relapse and New Cases of TB in the Niono District

The Niono district recorded a considerable proportion of tuberculosis cases, at 19% and 18% respectively, including both first diagnoses and relapses in 2019 and 2024. Recent tuberculosis exposure was found in 37% of cases in the study by S. Majdoub Fehri et al. in Tunisia [18]. The lack of distinction

between new cases and relapses in the Niono district database could explain this difference in proportion. Relapses are associated with an increased risk of developing drug-resistant forms of tuberculosis. [19] Ansa et al in Ghana in 2012 observed that the integration of TB/HIV services significantly reduced relapse rates by improving follow-up and support for vulnerable patients [20].

4.4. TB Trends in the Niono Health District

From 2016 to 2024, we witnessed a fluctuation in TB cases, expressed between 2016 to 2019 and 2020 to 2024. The specific lethality was estimated at 1.3% (10/778) from 2016 to 2024, exclusively within the Reference Health Centers (CSRéf). This rate remains lower than the national average reported in the 2023 national annual report, which estimates the tuberculosis case fatality rate at around 6% [21]. This difference is explained by the fact that our study considers confirmed cases, whereas the national average includes notified cases, which may encompass all suspected and confirmed cases. This situation illustrates that, despite a relatively lower mortality rate in Niono, each death reveals classic risk factors: late diagnosis, poorly managed HIV co-infection, and treatment interruptions, consistent with the findings of the national program. In the same region as Niono, Coulibaly et al. observed a case fatality rate of 8.3% in Konobougou, in the Baroueli district, in 2020, significantly higher than that of our study [22]. Similarly, the study conducted by Ousmane Sy et al. in the Djenné health district in 2024 reported a case fatality rate of 11.7% [23]. In the two previous studies, the differences could also be explained by the methods (study designs, data collection methods) and the study populations.

5. Conclusion and Recommendations

Tuberculosis remains prevalent in the Niono district. The number of relapses remains significant in our context, highlighting the need for regular patient follow-up. We recommend rigorous data collection in the district health database to support the implementation of national strategies, such as prompt case reporting and treatment initiation.

6. Ethical Considerations

Access to sensitive information contained in the database was subject to prior authorization in accordance with applicable regulations for scientific research. Furthermore, the confidentiality of the information collected was a top priority. The data collected were used exclusively within the scientific framework of this tuberculosis research, with enhanced safeguards against unauthorized disclosure. Data processing complied with applicable international and national standards in medical and scientific research, while contributing to improved knowledge of tuberculosis and public health strategies.

Abbreviations

CSCoM	Community Health Centers
CSRef	Referral Health Centers
DERSP	Department of Teaching and Research in Public Health and Specialties
DHIS2	District Health Information Software
HIV	Human Immunodeficiency Virus
INSP	National Institute of Public Health
TB	Tuberculosis
UCRC	University Clinical Research Center
USTTB	University of Sciences, Techniques and Technologies of Bamako
WHO	World Health Organization

Author Contributions

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Conflicts of Interest

The authors declare that they have no conflict of interest in this work.

References

- [1] Global Tuberculosis Reports [Internet]. [cited 10 Nov 2025]. Available from: <https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports>
- [2] Storla DG, Yimer S, Bjune GA. A systematic review of delay in the diagnosis and treatment of tuberculosis. BMC Public Health [Internet]. 14 Jan 2008 [cited 10 Nov 2025]; 8(1): 15. Available at: <https://doi.org/10.1186/1471-2458-8-15>
- [3] Ministry of Health and Social Development of Mali. Technical Guide for Integrated Disease Surveillance and Response in Mali. 2022.
- [4] World Health Organization. Tuberculosis [Internet]. [cited 10 Nov 2025]. Available from: <https://www.who.int/fr/news-room/fact-sheets/detail/tuberculosis>
- [5] World Health Organization. African Region records further decline in tuberculosis deaths and cases [Internet]. 2025 [cited 10 Nov 2025]. Available from: <https://www.afro.who.int/fr/news/la-region-africaine-enregistre-une-nouvelle-baisse-des-deces-et-des-cas-de-tuberculose>
- [6] World Health Organization. Biennial Report 2022-2023: Main Results [Internet]. [cited 1 Dec 2025]. Available from: <https://www.afro.who.int/fr/countries/cote-divoire/publication/rapport-biennal-2022-2023-principaux-resultats>
- [7] WHO, Regional Office for Africa. Africa is making progress in the diagnosis and treatment of tuberculosis [Internet]. 2025 [cited 10 Nov 2025]. Available from: <https://www.afro.who.int/fr/news/lafrique-fait-des-progres-en-matiere-de-diagnostic-et-de-traitement-de-la-tuberculose>
- [8] MEASURE Evaluation. Support for Health Programs [Internet]. [cited 10 Nov 2025]. Available from: <https://www.measureevaluation.org/countries/mali.html>
- [9] WHO Mali Annual Report 2018.pdf [Internet]. [cited 10 Nov 2025]. Available from: <https://www.afro.who.int/sites/default/files/2019-01/OMS%20MALI%20Rapport%20annuel%202018.pdf>
- [10] World Health Organization. Mali celebrates World Tuberculosis Day 2012 [Internet]. 2012 [cited 10 Nov 2025]. Available from: <https://www.afro.who.int/fr/countries/mali/news/le-mali-celebre-la-journee-mondiale-de-lutte-contre-la-tuberculose-2012>
- [11] Revised Integrated National Strategic Plan 2023-2026 for the fight against HIV/AIDS, Tuberculosis and Viral Hepatitis in Mali.
- [12] Sectoral Unit for the Fight against HIV/AIDS, Tuberculosis and Viral Hepatitis, Mali. Annual Report 2024.
- [13] Niono Health District. Tuberculosis database 2016 to 2024.
- [14] Directorate General of Health and Public Hygiene. National Statistical Health Yearbook, Mali. 2023.

- [15] World Health Organization. 1.3 Drug-resistant TB [Internet]. [cited 1 Dec 2025]. Available from: <https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2023/tb-disease-burden/1-3-drug-resistant-tb>
- [16] Sanogo M, Kone B, Diarra B, Maiga M, Baya B, Somboro AM, Sarro YS, Togo ACG, Dembele BPP, Goita D, Kone A, M'Baye O, Coulibaly N, Diabate S, Traore B, Diallo MH, Coulibaly YI, Saleeb P, Belson M, Orsega S, Siddiqui S, Polis MA, Dao S, Murphy RL, Diallo S. Performance of microscopic observation drug susceptibility for the rapid diagnosis of tuberculosis and detection of drug resistance in Bamako, Mali. *Clin Microbiol Infect Off Publ Eur Soc Clin Microbiol Infect Dis*. June 2017; 23(6): 408. e1-408. e6. <https://doi.org/10.1016/j.cmi.2017.01.004>
- [17] Niaré B, Traoré Y, Keita C, Diallo O, Diarra S, Ba K, Touré S, Keita M, Coulibaly O, Traoré A, Diarra B, Traoré M, Coulibaly MB, Konake MS, Coulibaly AB. Active Screening for Tuberculosis in Sub-Saharan Africa: The Case of Mosques in the District of Bamako (Mali). *SAS J Med* [Internet]. 23 June 2023 [cited 1 Dec 2025]; 9(06): 704-8. Available from: https://saspublishers.com/media/articles/SASJM_96_704-708_FT.pdf
- [18] Majdoub Fehri S, Daghfous H, Ben Saad S, Tritar F. Predictive factors for relapse of pulmonary tuberculosis. *Rev Mal Respir* [Internet]. 1 Jan 2017 [cited 1 Dec 2025]; 34: A234. Available from: <https://doi.org/10.1016/j.pneumo.2018.01.002>
- [19] Mjid M, Hedhli A, Zakhma M, Zribi M, Ouahchi Y, Toujani S, Cherif J. Clinical and microbiological profile of patients with relapsed tuberculosis in Tunisia. *Rev Pneumol Clin* [Internet]. 1 Apr 2018 [cited 1 Dec 2025]; 74(2): 76-80. Available from: <https://www.sciencedirect.com/science/article/pii/S0761841717301475>
- [20] Ansa GA, Walley JD, Siddiqi K, Wei X. Assessing the impact of TB/HIV services integration on TB treatment outcomes and their relevance in TB/HIV monitoring in Ghana. *Infect Say Poverty*. 24 Dec 2012; 1(1): 13. <https://doi.org/10.1186/2049-9957-1-13>
- [21] Ministry of Health and Public Hygiene. Mali NCD Strategic Plan 2019-2023, Non-communicable disease [Internet]. [cited 1 Dec 2025]. Available from: <https://fr.scribd.com/document/822242867/MLI-B3-s21-Plan-Strategique-MNT-VF-230319>
- [22] Coulibaly MB, Niangaly AA, Keita Z, Sylla O. Epidemiological, diagnostic, and evolutionary profile of tuberculosis in the community setting at the Konobougou diagnostic and treatment center, Mali. *Rev Malienne Infect Microbiol* [Internet]. 27 Nov 2020 [cited 1 Dec 2025]; 15(2): 43-7. Available from: <https://doi.org/10.53597/remim.v15i2.1731>
- [23] Ousmane SY, Karamoko Djiguiba, Cheickne Hamala Kome, Sidy Sangare, Fanta Niare, Lamine Doumbia. Epidemiological aspects of pulmonary tuberculosis in the Djenné health district, Mali. *Journal of Epidemiology and Public Health*, 2(4), 1-5 [Internet]. 2024 [cited 1 Dec 2025]. <https://doi.org/10.64030/3065-9078>