

EPIDEMIOLOGICAL AND EVOLUTIONARY PROFILE OF TUBERCULOSIS PATIENTS MONITORED AT THE DIAGNOSTIC CENTER FOR TUBERCULOSIS AND RESPIRATORY DISEASES OF THE CITY OF MEKNES, MOROCCO

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SUMMARY

Objective: The objective of this research is to evaluate the epidemiological and evolutionary profile of tuberculosis in the city of Meknes (Morocco). **Methods:** This is a retrospective and descriptive study of the subjects followed at the Diagnostic Center for Tuberculosis and Respiratory Diseases of the Prefecture of Meknes, over a period of six years (January 2010- December 2015). **Results:** 4424 cases were collected, for an average annual incidence of 91 cases per 100,000 inhabitants. The average annual incidence in urban areas was 103 cases per 100,000 inhabitants compared to 77 in rural settings. Males (56.82%) were more affected than females (43.17%), with a sex ratio (M/F) of 1.31. The age group most frequently involved was 21-40 years (43.35%). Among the cases of tuberculosis of all forms, pulmonary tuberculosis predominates with 50.38% including 39.58% bacilloscope-positive versus 49.61% of the extrapulmonary form including 0.63% of the primary tuberculosis infection. Nodal and pleural tuberculosis accounted for 74.47% of extrapulmonary localizations. **Conclusion:** Tuberculosis represents a real health and socioeconomic problem for families and the health care structures that receive them. The incidence, evolution and severity of this infectious disease with inhuman transmission must encourage us to conduct further research on this subject in order to find the most plausible solutions to reduce the negative repercussions.

KEYWORDS: Pulmonary tuberculosis; extrapulmonary tuberculosis; incidence; Meknes.

INTRODUCTION

Tuberculosis (TB) is an airborne infectious disease caused by *Mycobacterium tuberculosis*.^[1] TB is one of the major causes of morbidity and mortality in the world.^[2,3]

In 2015, the World Health Organization (WHO) estimated that 10.4 million new cases of TB were detected worldwide, including 1.2 million deaths,^[4] and one third of the world's population carries the latent form.^[5]

Globally, the incidence of TB varies widely, from extremely high incidences of over 500 cases per 100,000 population per year in South Africa to lower incidences of 0-9.9 cases per 100,000 population per year in Western countries (North America and Europe).^[2]

In Morocco, 30.636 incident cases of TB were reported in 2015, representing an incidence of 89 cases per

100,000 inhabitants.^[6]

The analysis of the spatial distribution of TB cases shows that the most affected regions in Morocco are Grand Casablanca, Tangier-Tetouan, Rabat Salé-Zemmour-Zaër, Gharb-Chrarda-Beni-Hssen, and Fez- Boulemane. These five regions alone accounted for 58% of the TB cases notified in 2015.^[6]

The underprivileged neighborhoods of Morocco's major cities represent environments conducive to the development and concentration of this infectious disease.

At the national level, there is very little published work that rigorously addressed the epidemiology of TB. Therefore, the objective of this research is to investigate the epidemiological, evolutionary and spatial profile of TB in the city of Meknes (Morocco).

METHODS

This is a retrospective and descriptive study of patients followed at the Diagnostic Center for Tuberculosis and Respiratory Diseases (CDTMR) of the Prefecture of Meknes, over a six-year period from the 1st of January, 2010 to December 31st, 2015. Health data were collected from the CDTMR registers (age, gender, diagnosis, date of treatment initiation, type of treatment, dates and reasons for stopping treatment and address). The data collected were entered and analyzed using

Microsoft Excel 2010 and the mapping was performed using ArcGIS 9.3 software.

The city of Meknes ($33^{\circ}53'$ North, $5^{\circ}33'$ West) is located in north-central Morocco at 564 m altitude (**Figure 1**). The climate is of Mediterranean type, influenced by the Middle Atlas Mountains and the Atlantic Ocean. The city had 632,079 inhabitants in 2014.

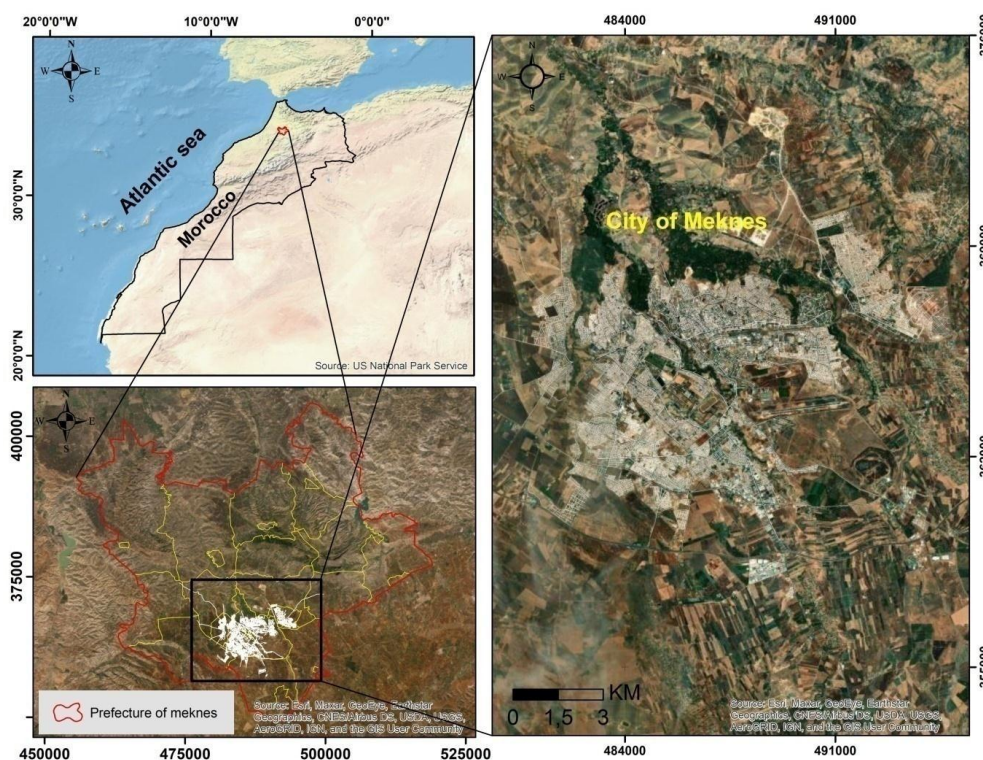


Figure 1: Geolocation of the city of Meknes.

RESULTS

Between January 2010 and December 2015, 4424 subjects were monitored at the Meknes CDTMR for TB. The average number of new cases detected each year was 737, which represented an incidence of 91 per 100,000 inhabitants during the survey period, 45.8 cases of pulmonary tuberculosis (PTB) and 45.1 cases of extrapulmonary tuberculosis (EPTB) per 100,000 inhabitants.

Males accounted for 56.82% (2514) of the subjects followed at the CDTMR for TB compared with 43.17% (1910) for females.

The mean age of patients was 35.84 ± 18.34 years; the median was 31 years with extremes ranging from six months to 94 years.

Patients under 50 years of age represented 76.01% (3363 cases) of incident cases, compared to 23.98% (1061 cases) of those less than 50 years of age. For both sexes,

the most affected age group was 21-40 years with 43.47%. Patients under 15 years of age were few in number with 7.36% for boys and 9.74% for girls.

Eighty-eight percent of patients were from urban prefecture, 83.61% of whom were from the city of Meknes (**Table 1**). The average annual incidence in urban areas was 103 cases per 100,000 inhabitants compared to 77 in rural settings.

Table 1: Epidemiological Characteristics.

Variable	Effective	Percentage
Age		
< 20 years old	927	22.17
21- 40 years old	1918	45.24
41- 60 years old	1098	23.37
> 60 years old	481	9.20
Average age (extremes)	35,84 ± 18,34 (6 months to 94 years)	
Gender		
Men	2514	56.82
Women	1910	43.17
Sex ratio	1.31	
Place of residence		
City of Meknes	3699	83.61
Nearby villages	725	16.38

In this study, 50.38% of patients had PTB, of which 39.58% had bacilloscope positive (TPM+) and EPTB accounted for 48.98% of cases. Primary tuberculosis infection (PTBI) was infrequent, with 28 cases out of 4424 in six years or 0.63%.

At Meknes, males (56.8%) were more involved by TB

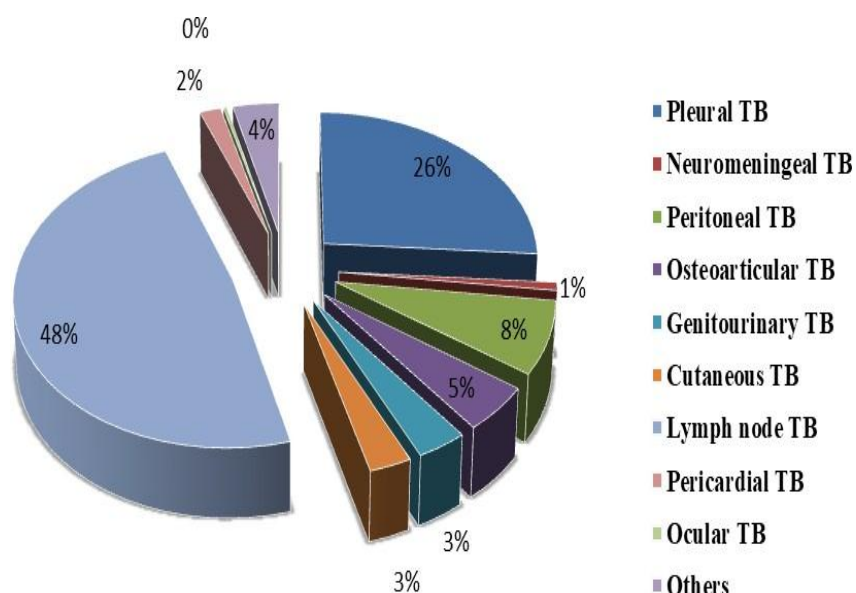
than females (43.2%), with a sex ratio (M/F) of 1.3 (2514/1910). PTB was more common in males (1578 cases versus 651) while females were more afflicted by EPTB (1259 cases versus 936). The sex ratio (M/F) of patients with PTB (2.4; 1578/651) was greater than those with EPTB (0.7; 936/1259), see table 2.

Table 2: Sex distribution of TB.

	PTB		EPTB		Total	
	N	%	N	%	N	%
Male	1578	62.8	936	37.2	2514	56,8
Female	651	34.1	1259	65.9	1910	43,2

For extrapulmonary localizations, the lymph node and pleural form have been the most commonly observed with frequencies of 48.36 and 26.11% respectively.

Other extrapulmonary forms were reported with varying frequencies (**Figure 2**).

**Figure 2: Distribution of extrapulmonary TB cases by location.**

Lymph-node TB was predominant in females (65.46%), while pleural TB was more common in males (56.97%), see figure 3.

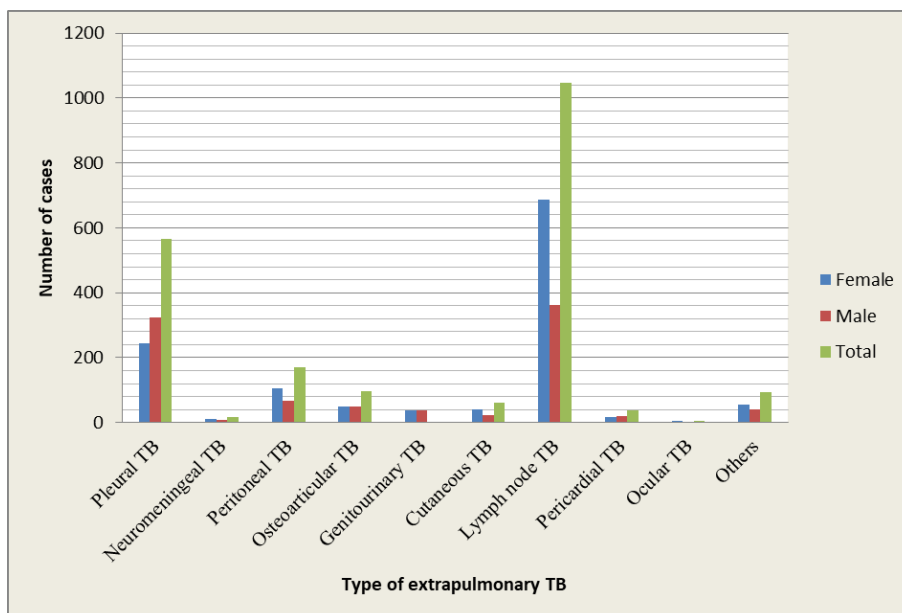


Figure 3: Distribution of types of extrapulmonary TB by sex.

The temporal distribution of incident TB cases shows that 28% of new cases were detected in the second trimester, 26% in the third trimester, and 23% in the first

trimester (**Figure 4**). The monthly average of new cases recorded was 61.44.

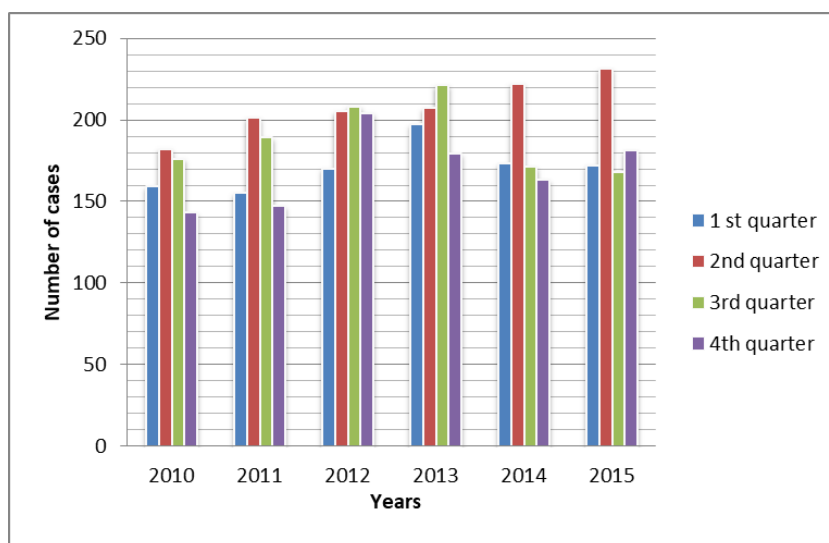


Figure 4: Distribution of TB cases by quarter per year (2010-2015).

During the study period, 3622 cases of TB were reported in the city of Meknes with average cumulative incidence (CI) of 97, 61 per 100,000 inhabitants. If we consider the number of cases recorded, it appears that the health centers that reported the highest number are: Ouislane, Marjane, Sidi Baba and Sidi Bouzekri, respectively 445, 303, 266 and 216 cases. While if we report the number of cases in relation to the population of each health center, it appears that the most affected neighborhoods are: Borj Moulay Omar (BMO), Sidi Baba, Marjane and Hay Salam, respectively 190, 170, 136 and 132 per 100,000 inhabitants (**Figure 5**).

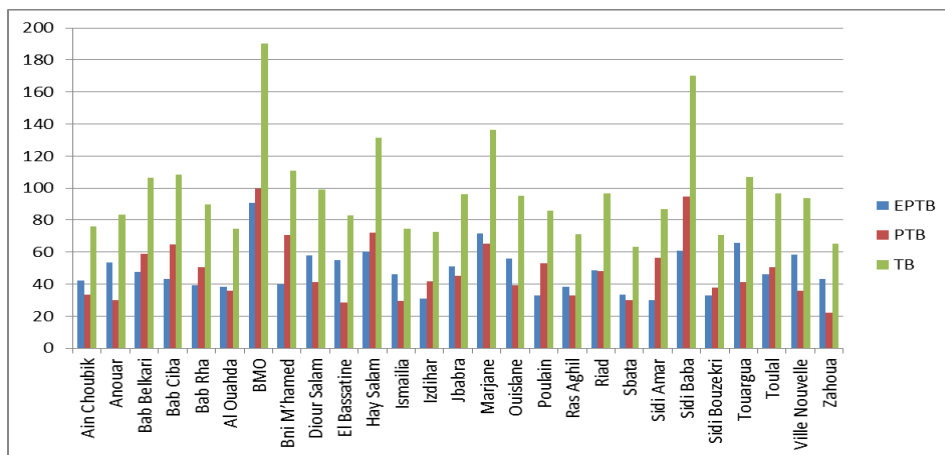


Figure 5: Distribution by health center of the average annual incidence of TB cases in Meknes city.

The cases recorded in the other health centers of the Meknes prefecture are shown in Figure 6.

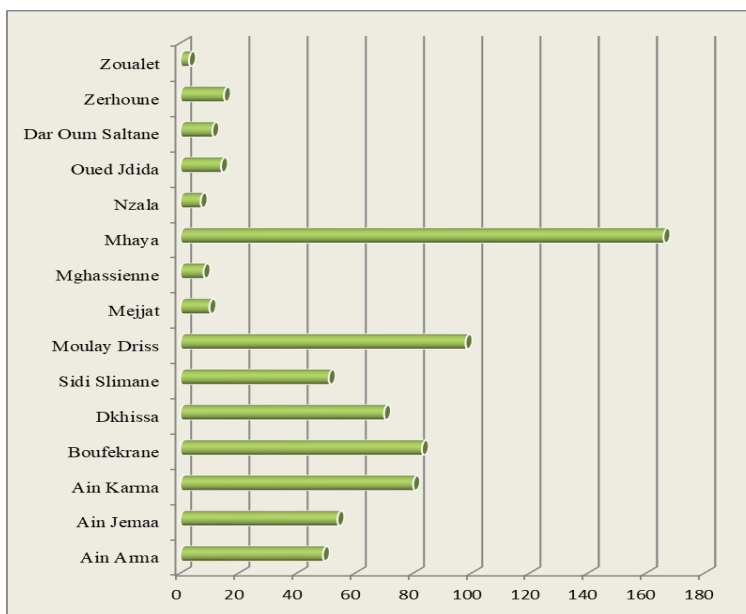


Figure 6: The cases recorded in the other health centers of the Meknes prefecture.

In this study, the treatment success rate was 84.06% and the treatment failure rate was 0.76%.

rate was 3.79% and 7.81% were lost to follow-up (Figure 7).

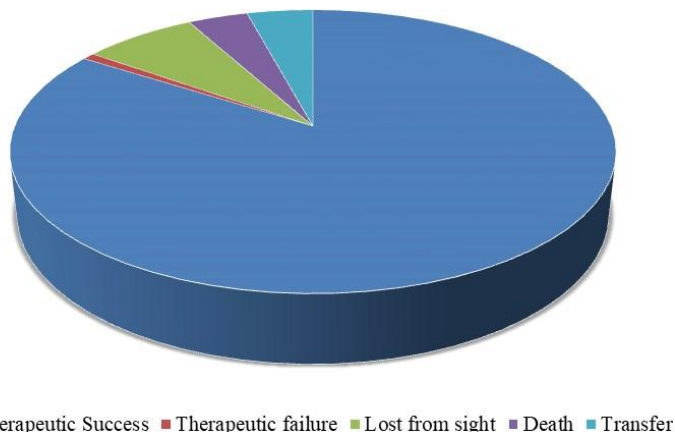


Figure 7: Evolutionary characteristics of patients.

DISCUSSIONS

In this study, 4424 TB cases were collected between 2010 and 2015, which represents an average annual incidence of 93 cases per 100,000 inhabitants (CI at the Prefectural level). This rate is higher than the national average incidence of 89 cases per 100,000 inhabitants per year.^[6] A retrospective study of TB patients hospitalized in the pneumology department of the Moulay Ismail military hospital (Meknes) over a 17-year period (1997- 2014) recorded an average annual incidence of 96 cases per year.^[7]

The male sex was predominant in this series. In the pneumology department of Moulay Ismail Military Hospital (HMMI), 79% of TB patients were male and the sex ratio (M/F) was 3.7.^[7] Male dominance has also been reported by other authors.^[3,6,8,9,10] In contrast, female dominance has been reported by Ekono *et al.*^[11] in Cameroon, Lupande *et al.*^[12] in DR Congo, and Tékpá *et al.*^[4] in Central Africa.

In Meknes, the most affected age group was 21-40 years old with 43.35%. The average age of the patients was 35.84 years. In Morocco, two-thirds of reported TB cases in 2015 were between 15 and 44 years of age.^[6] In the pneumology department of the HMMI, the average age of patients hospitalized for TB was 33 years and the most represented age group was 21-40 years with 73%.^[7] These results are also consistent with those noted by Tachfouti and colleagues who found that the average age of patients was 35 years,^[13] Bousebha who recorded in the study conducted at Avicenne Hospital (France) that the most affected age group was 21-40 years with an average age of 36 years.^[14]

In this research, the average age of women with TB was lower than that of men, 35.4 years versus 31.4 years respectively. This finding was made in Saint Louis, Senegal where the average age of women was 30.5 years compared to 33.5 years for men.^[15]

At CDTMR, 88% of the patients were from urban areas. This predominance of urban origin has been reported by several authors.^[2,3,11,13,16,17] The limited accesses of patients from rural areas to poorly equipped health care structures suggest that the number of patients may be even higher.^[16]

Fifty point thirty-eight percent of the patients followed up at CDTMR had pulmonary tuberculosis, and extrapulmonary forms represented 49.61% of cases. In the pneumology department of the HMMI, 60.29 % of patients hospitalized for TB had PTB.^[7] Similar results were observed in Algeria^[18] and France.^[8] These results differ from those noted at the national level, where PTB accounted for 48% of cases versus 52% for EPTB.^[6]

The male-to-female ratio of PTB was 2.4. This rate is close to those reported by studies on the same subject.^[19,20,21]

For extrapulmonary localizations, the lymph node and pleural forms represented 48, 36% and 26.11% respectively. These results rhyme with those reported by Mounaji *et al.*^[22] at the Ibn Rochd University Hospital Center (UHC) in Casablanca and by Morgand *et al.*^[8] at the UHC north of Paris. This predominance of lymph node TB has been found in other studies.^[17,23,24]

In Meknes, the EPTB was more frequent in women than in men with a sex ratio (F/M) of 1.34. These results have been confirmed by previous studies.^[20,21,25,26,27,28] However, other authors have found a predominance of males.^[19,29,30]

In CDTMR, females had the highest incidence of lymph node TB (65.46 %), while pleural TB was more common in males (56.97 %). The predominance of the lymph node form in females has been found in other studies.^[17,19,24] On the other hand, Ralisata *et al.*^[31] have reported a predominance of the male sex.

In this study, 54% of new cases of TB were detected in the second and third trimesters. This result differs from that observed in Saint Louis, Senegal, where the number of cases diagnosed in the third and fourth quarters was significantly higher than in the other quarters ($p < 0.001$).^[15]

At the CDTMR, the monthly average of reported cases was 61.44, higher than that recorded in Bangui in Central Africa, which was 12.22.^[4]

The average annual incidence of TB during the study period (2010-2015) in the city of Meknes was 98 cases per 100,000 inhabitants, with significant variations between neighborhoods. The highest incidence rates were recorded in BMO and Sidi Baba with 190 and 170 cases per 100,000 inhabitants per year respectively. These rates remain lower than those noted in some neighborhoods of Casablanca and Fez (CI more than 250 new cases per 100,000 inhabitants per year).^[32] BMO and Sidi Baba neighborhoods are characterized by relatively high density. In addition, poverty, unsanitary housing, high human promiscuity and smoking (active and passive) are, according to several authors, major risk factors for the development of TB.^[10,16,32,33,34,35,36] A retrospective study of 213 cases of childhood TB admitted at the UHC Mohammed VI children's hospital in Marrakech (Morocco) during a six-year period (2008-2013) noted that 87.06% of the children with TB were of low socioeconomic level while 12.8% of the patients were of a medium socioeconomic level.^[16] Furthermore, a research conducted at the Ibn Nafis hospital in Marrakech revealed that 86.5% of TB patients lived in traditional houses and 12.7% in apartments.^[37] Davies *et al.*^[38] have shown that the risk of TB development is multiplied by two or even four if the number of cigarettes consumed per day is higher than 20.

The therapeutic success rate among patients followed up at CDTMR was 84.06%, comparable to the national rate of 86%^[6], the WHO recommendations for resource-limited countries (85%), and the rate reported by Amadou *et al.*^[2] in Niger, which was 81.2%. This rate is higher than that reported by Ekono *et al.*^[11] in Cameroon which was 48.5%, but lower than that reported by Massenet *et al.*^[15] in Senegal which was 93%.

The treatment failure rate was 0.7%, close to that reported by Amadou *et al.*^[2] in Niger. This rate is lower than the national rate of 1% in 2015.^[6]

In Meknes, 7.18% of TB patients were lost from sight. This rate is superimposed on the rate reported by Amadou *et al.*^[2] in Niger, which was 7.4%. This result remains lower than those reported by Ekono *et al.*^[11] in Cameroon and Camara *et al.*^[39] in Guinea Conakry, which were 37.9% and 25.8%, respectively. In Morocco, the loss of sight rate noted in 2015 was 6%.^[6]

The case-fatality rate was 3.79%, lower than the 10.42% reported by Amadou *et al.*^[2] in Niger, the 13% reported by Ekono *et al.*^[11] in Cameroon, and the 37.5% reported by Shimazaki *et al.*^[4] in the Philippines.

During this study, the average monthly death rate was 2.33 deaths per month, comparable to that recorded in Bangui in Central Africa, which was 2.27 deaths per month.^[4]

CONCLUSION

TB represents a real health and socioeconomic problem for families and the health care facilities that receive them. The incidence, evolution and severity of this infectious disease with inhuman transmission should encourage us to conduct further research on this subject in order to find the most plausible solutions to reduce the negative repercussions.

Financement

We did not receive any external funding for this study.

Conflicts of Interest

The authors do not declare any conflict of interest in relation to this article

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