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Epidemiological Profile and Diagnosis of Pulmonary Tuberculosis in the Commune of Ntoum, Northwest Gabon

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ABSTRACT

Pulmonary tuberculosis remains a major public health problem in Gabon. The aim of this study was to determine the epidemiological profile of pulmonary tuberculosis in patients from the commune of Ntoum and its surrounding area. This was a cross-sectional study from January 2024 to March 2025. The study enrolled patients who attended the Tuberculosis Diagnostic and Treatment Centre (CDT) of the Ntoum Departmental Hospital (Northwest Gabon) for consultation or therapeutic follow-up. A total of 146 patients were enrolled. Males predominated (54.2%), with a sex ratio of 1.21. The mean age of the study population was 34.94 years, with an age range 8-77. Ntoum 6 and Mebba neighbourhoods had the highest rate of tuberculosis patients (8.6% each) in the Ntoum commune. TB/HIV co-infection accounted for 2.2% of patients, with a therapeutic success rate of 77.6%. The mycobacterial strains detected by GeneXpert were all sensitive to Rifampicin. In order to achieve the WHO's goal of eliminating tuberculosis by 2030, tuberculosis diagnosis and treatment centers in most of Gabon's health regions play an important role. Despite the relatively high rate of therapeutic success observed, efforts are still needed in the area of case management. The diagnosis of HIV in all tuberculosis patients, or the molecular diagnosis of tuberculosis in all HIV-positive patients, must be spontaneous. In addition, tuberculosis patients must be monitored clinically and biologically on a regular basis. If these recommendations are put into practice, the number of cures will increase nationwide.

INTRODUCTION

Tuberculosis, which is both preventable and curable, is an infectious, contagious disease that mainly affects the lungs (Abdelmalek *et al*., 2013). It is transmitted mainly by air from a sick person to a healthy person, through the emission of salivary droplets containing Koch's bacillus (BK) when the patient speaks, coughs, sneezes, si, or spits (Swalehe *et al*., 2024). Worldwide, it represents a major public health problem. In 2023, an estimated 10.8 million people worldwide contracted tuberculosis and 1.25 million died, including 161,000 co-infected with the AIDS virus. HIV infection has accentuated the burden of tuberculosis, particularly in sub-Saharan Africa where the prevalence of the disease is high. According to the same report, 55% of tuberculosis sufferers were men, 33% women and 12% children and adolescents. Of all the continents, Africa continues to bear the heaviest burden (Organization, 2023). To combat this disease effectively, early diagnosis of presumptive cases of tuberculosis and regular monitoring of tuberculosis patients on treatment are important. The absence of any study of tuberculosis in the commune of Ntoum lead us to conduct this study. The aim was to determine the epidemiological profile of pulmonary tuberculosis in the diagnostic and treatment center of the commune of Ntoum, in north-west Gabon.

MATERIAL AND METHODS

Type, location and period of study

A cross-sectional study was conducted at the Ntoum departmental (ND) hospital over a 15-month period from January 2024 to March 2025. Ntoum, chief town of this department is located in north -west Gabon in the Estuaire province and had 11,813 inhabitants in 2012 (DGS, 2015). Is a fast-growing town favored by the construction of road infrastructures such as national highway n°1, which links the capital Libreville to the interior of the country. The town's economy is largely based on agriculture, fishing and broiler chicken farming.

Sampling

Over a 15-month period, the ND hospital mycobacteriology laboratory performed molecular tuberculosis diagnostics on all patients from Gabon's diagnostic and treatment centers (CDT) suspected of suffering from pulmonary tuberculosis. Control microscopic examinations were carried out on bacteriologically confirmed patients undergoing treatment to assess the bacillary load at each appointment. All results were recorded in the laboratory register provided by the TB National Control Program. This document was used as the basic tool for collecting data from the study sample. The study variables were:

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sex, age, district of origin, HIV status and HIV/TB co-infection.

Inclusion and non-inclusion criteria

All diagnostic and microscopic control results of patients in the laboratory register during the study period were eligible for inclusion. Tuberculosis patients registered in the laboratory register outside the study period were excluded, as were unregistered patients.

Biological material

Sputum was collected in the morning on an empty stomach, after rinsing the mouth with water and coughing. A volume of 2 ml was sufficient.

Diagnostic methods

Detection of DNA from Mycobacteria belonging to the Mycobacterium tuberculosis complex, as well as mutations in the rpoB gene associated with rifampin resistance, was performed on all patients with suspected pulmonary tuberculosis using Cepheid's GeneXpert® systems, based on real-time nested PCR. Control of the bacillary load in tuberculosis patients undergoing antibiotic therapy was carried out using LED (Light Emitting Diode) fluorescence microscopy on auramine-stained smears, based on the acid-fast properties of bacilli linked to the structure of their cell wall.

Statistical analysis

The data collected were entered into a database using Microsoft Excel version 2016. All statistical analyses were performed using R software version 1.4.2. The Chi2 test was used to compare proportions, with a statistical significance level set at 5%.

Study approval and ethical considerations

The study has been approved by the General Management of ND Hospital. All procedures contributing to this project comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Declaration of Helsinki of 1975, as revised in 2008.

RESULTS AND DISCUSSIONS

Between January 29, 2024 and March 27, 2025, 146 sputum samples were analyzed at the ND hospital mycobacteriology laboratory. The male sex was the most represented with 80 cases (54.8%) for a sex ratio equal to 1.21.

The 15-29 age group was the largest, with 54 cases (37%). The mean age of the study population was 34.94 years, with an age range 8 - 77.

Examination requests came mostly from the Ntoum CDT, with 87 cases (59.6%). The Nkembo and Kango CDTs followed with 54 cases (37%) and 2 cases (1.3%) respectively. Other examination requests came from three hospitals located in the capital city Libreville namely the Omar Bongo Army Hospital (HIAOBO), Melen regional hospital (CHREM), and Chinese and Gabonese friendship hospital (HASG); each of them reported one case (0.7%).

The largest number of presumptive pulmonary TB patients resided in the town of Ntoum, with 98 cases (67.2%), followed by Libreville and Kango, with 36 cases (24.6%) and 12 cases (8.2%) respectively. For those living in Ntoum, the Ntoum 6 district was home to the most presumptive patients, with 21 cases (14.4%). The Okolassi, Meyang and Soleil districts followed with 7 cases (4.8%) each (Table 1).

Table 1: Socio-demographic characteristics of patients

Sex	**n**	**%**
Male	80	54,8
Female	66	45,2
Age (year)		
0 – 14	8	5,5
15 – 29	54	37,0
30 – 44	47	32,2
45 – 59	26	17,8
60 – 74	9	6,1
>75	2	1,4
Health facilities		
CDT Ntoum	87	59,6
CDT Nkembo	54	37
CDT Kango	2	1,4
HIAOBO	1	0,7
CHREM	1	0,7
HASG	1	0,7
City of residence		
Libreville	36	24,6
Ntoum	98	67,2
Kango	12	8,2
Ntoum districts		
Mebba	5	3,4
Okolassi	7	4,8
Ntoum 6	21	14,4
Nkoltang	5	3,4
Soleil	7	4,8
Essassa	4	2,7
Ayeme	2	1,4
Dame –Oyem	4	2,7
Meyang	7	4,8
Assora	6	4,1
TP	2	1,4
Akoneki	6	4,1
Venez-voir	2	1,4
Nkan	5	3,4
Alarmitang	4	2,7

PK 27	3	2,0
Cimenterie	2	1,4
PK 11	2	1,4
Dubai	1	0,7
2 lions	1	0,7
Bikele	1	0,7
Bidzango Rails	1	0,7
Total	146	100

Clinical symptoms such as a persistent cough lasting more than 2 weeks, whether or not associated with cachexia, were the most common motive for physicians to request the Xpert MTB/RIF test. Real-time PCR was performed on 88 (60.3%) sputum samples. Mycobacterium tuberculosis complex DNA was detected in 22 samples (25%). All these bacterial strains were sensitive to Rifampicin (100%). To assess the efficacy of anti-tuberculosis treatment, microscopic examination of sputum was requested for all tuberculosis patients undergoing treatment, in accordance with the national protocol for monitoring patients on treatment. A total of 58 samples (39.7%) were examined by fluorescence optical microscopy (F.O.M.), and more than a fifth (22.4%) of these showed acid-fast bacillus (Table 2).

Table 2: Biological diagnoses of tuberculosis at ND hospital

Diagnostics	**n**	**%**
Xpert MTB/RIF		
Mt detected	22	25
Mt no detected	66	75
Total	88	100
Resistance to Rifampicin		
Detected	00	00
No detected	22	100
Total	22	100
Microscopy		
Presence of acid-fast bacillus	13	22,4
Absence of acid-fast bacillus	45	77,6
Total	58	100

Legend: Mt = Mycobacterium tuberculosis

Distribution of tuberculosis patients by city of residence More than half the tuberculosis patients (51.4%) lived in the town where the study took place (Ntoum). The others came from Libreville, the country's political capital (37.1%), followed by the town of Kango, capital of the Komo-Kango Department (11.5%) (Figure 1).

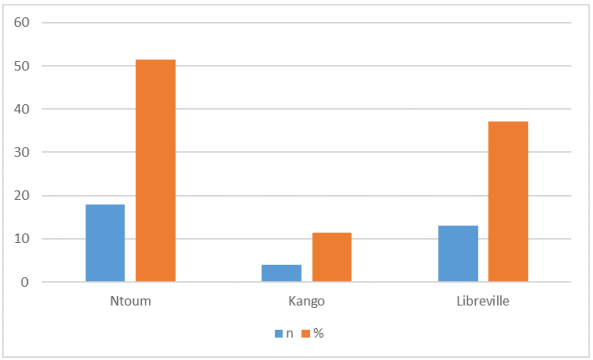

Figure 1: Distribution of tuberculosis patients by city of residence

As for the Ntoum neighborhoods with the highest number of tuberculosis cases, Mebba and Ntoum 6 were the most representative, with 3 cases each (16.8%), followed by Meyang and Assora with 2 cases each (11.2%) (Figure 2).

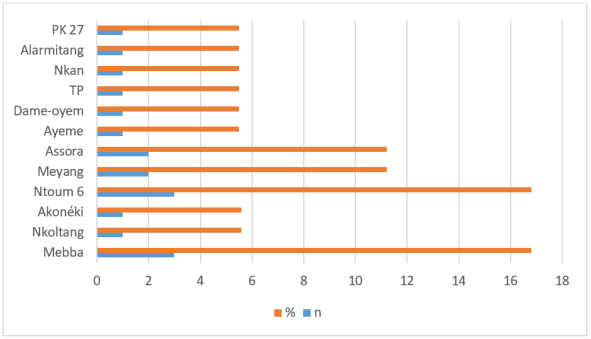

Figure 2: Distribution of tuberculosis patients by Ntoum district

HIV infection was found in 14 people, bringing the rate to 9.6% of HIV cases in the study population. HIV+/TB+ co-infection was found in 3 patients (2.2%). However, a large number of participants (n=115; 78.7%) were unaware of their HIV status (Table 3).

Table 3: HIV/Tuberculosis co-infection in patients seen at ND HOSPITAL

Variables	**n**	**%**
HIV+/TB+	3	2,2
HIV+/TB-	11	7,5
HIV-/TB-	12	8,2
HIV-/TB+	5	3,4
Inc/TB+	25	17,1
Inc/TB-	90	61,6
Total	146	100

Legend: TB =Tuberculosis; Inc = Unknown; + = Positive; - = Negative.

Discussion

Of the 146 sputum samples analyzed, 54.8% came from male patients. The sex ratio was one female to 1.21 males. These results confirm those of several studies showing a male predominance in patients infected with Koch's bacillus (Tékpa *et al.,* 2019; Kalidou *et al.,* 2021). This is probably due to the fact that men have social contacts which probably contribute to the burden of tuberculosis disease compared with women (Horton *et al.,* 2020; Ozsahin *et al.,* 2011). Consumption of alcohol, tobacco and illicit substances, are other risk factors that increase TB susceptibility in men (Narasimhan *et al*., 2013).

In this study the mean age of our patients was 34.94 years. These results are in line with those found in the Pneumo-phtisiology departments of the CHU-RN of N'Djamena and that of Zinder in Niger, where the mean ages were 34.1 and 33.5 years respectively (Ngakoutou *et al*., 2024; Hamidou *et al*., 2024). These results underline the fact that tuberculosis strikes with predilection young adults because of their multiple activities and their carelessness in the face of microbial infections.

More than half the tuberculosis sufferers (51.4%) lived in Ntoum (study site), which justifies this high prevalence compared with other towns. On the other hand, the city of Libreville (Gabon's political capital) had more tuberculosis patients than the city of Kango (capital of the Komo-Kango Department), with 37.1% and 11.5% of cases respectively. The results of this comparison confirm the idea that tuberculosis is more prevalent in urban than in rural areas, as shown by studies carried out at the Zinder National Hospital in Niger (Hamidou *et al*., 2024) and those carried out in Morocco, at the Settat Diagnostic Center for Tuberculosis and Respiratory Diseases located in the Casablanca-Settat region. (Chahboune *et al*., 2022).

In this study, the prevalence of TB-HIV co-infection was 2.2%. These results are similar to those obtained in Niger and the Republic of Guinea, where prevalences were 2.4% and 2.5% respectively (Hamidou *et al*., 2024; Kolamou *et al*., 2023). HIV infection and tuberculosis form a lethal pair, as each of these diseases accelerates the progression of the other. HIV-positive people are 16 times more likely to develop tuberculosis than others, due to their compromised immune systems (Organization, 2023). The discovery of tuberculosis should be systematically followed by an HIV test, which was not the case in the Komo-Mondah department, where 17.1% of tuberculosis patients did not know their HIV status.

The therapeutic success rate in this study was 77.6%. This result is close to that recorded in work carried out in Niger (84.2) (Hamidou *et al*., 2024) and to that found in the Pneumo-phtisiology department of the CHU-RN in N'Djamena (83.8%) (Ngakoutou *et al*., 2024). This therapeutic success rate is the result of the efficacy of the pharmacological regimen adopted by the NTP of our country, Gabon, on Rifampicin-sensitive mycobacterial strains.

The WHO recommends GeneXpert as the first-line diagnostic test for tuberculosis in all presumptive cases in adults and children (Organization, 2013). Among the 88 samples analyzed, the Mycobarium tuberculosis genome was detected 22 times, bringing the prevalence rate to 25%. Our results are similar to those found in southern Ethiopia and Nigeria, where the reported prevalences were 26.8% and 22.9% , respectively (Diriba *et al*., 2022; Tahiri *et al*., 2014). In contrast to our study, the results found in the Internal Medicine Department of the National Hospital Donka in Guinea Conakry (31.03%) (Wann *et al*., 2024) and the Central Army Hospital Mohamed Seghir Nekkache in Algiers (34, 6%) (Yamouni *et al*., 2024) were higher than in our study, and the results found in Addis Ababa (15.1%) (Nugussie *et al*., 2017) and South Africa (13%) (Nicol *et al*., 2011) were lower than ours. These differences in prevalence are probably due to the study design, sample size and TB control and prevention practices adopted in each country.

CONCLUSION

Tuberculosis diagnosis and treatment centers in Gabon's health regions play an important role in the national eradication of tuberculosis. HIV infection further weakens the immune system of tuberculosis patients. Systematic HIV screening is therefore essential for all tuberculosis patients, and molecular diagnosis of tuberculosis must also be systematic for all HIV-positive subjects. According to the WHO standard, the high presence of acid-fast bacillus in the sputum of tuberculosis patients in the first-line treatment phase, as measured by fluorescence microscopy, has a negative impact on therapeutic success. Rigorous case follow-up combined with a community-based anti-tuberculosis treatment strategy will certainly increase therapeutic success in Gabon.

Study limitations

This study was limited by the lack of data on the HIV status of a large number of tuberculosis patients (25/115 cases; 17.1%). This lack of information may have biased the number of HIV+/TB+ co-infections.

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