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Epidemiology and impact of *Mycobacterium tuberculosis* on haematological parameters in patients in the city of Kindia (Republic of Guinea)

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Abstract

Introduction: Pulmonary tuberculosis is an infectious disease of bacterial origin caused by the bacillus Koch or BK or *Mycobacterium tuberculosis*. It is a contagious disease that usually attacks the lungs, but also other organs of the human body.

Objective: To contribute to the improvement of health care for patients with pulmonary tuberculosis in the city of Kindia.

Methods: This is a prospective and descriptive cross-sectional study lasting 3 months, from 03 February to 03 May 2021.

Results: Out of 301 patients received at the Leprosarium laboratory, 51 patients were diagnosed positive, i.e. 17%, against 250 negative cases, i.e. 83%. All 51 TB patients had low haemoglobin, i.e. 100%, 45% had low MCHT, 21% hyponeutrophilia versus 49% hyperleukocytosis, 35% hyperlymphocytosis and 10% hyperneutrophilia. However, all other haematological parameters were normal with the following anaemic typology: 59% frustrated anaemia and 41% moderate anaemia; 41% of patients had Microcytic and Hypochromic anaemia, compared to 59% patients with Normocytic and Normochromic anaemia. The male sex is the most represented with 71% against 29% for the female sex, the married are the most represented with 57% followed by the single with 43%, the workers are the most affected with 37% followed by the commercial agents with 21% and the pupils/students with 10%. Administrative staff are the least represented with 4%. All age groups are affected by the disease, but with a high rate among those aged between 21 and 40 years, i.e. 57%, followed by those aged 20 years or less, i.e. 23%. The age group least affected is 41 years and over, i.e. 10%. Almost all of Kindia's neighbourhoods are affected by the disease but with different rates. The districts of Manquepas and Abattoir with 8 cases each, i.e. 16%, are the most affected. They are followed by the districts of Sambaya with 11%, the rural commune of Friguiagbé with 9% and the districts of Foulémodouyah and Yéwolé with 7% each. The other districts each have 4%.

Conclusion: Pulmonary tuberculosis is a major public health problem and to improve patient management, haematological profiling is necessary.

Keywords: *Mycobacterium tuberculosis*; Haematology; Epidemiology; Leprosarium; Kindia

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1. Introduction

Tuberculosis (TB) is a common and deadly infectious disease despite the availability of effective treatment. It is now a major global public health problem. In 2015, 10.4 million new cases of TB were recorded worldwide, of which 1.2 million (11%) were co-infected with the human immunodeficiency virus (HIV). In the same year, TB-related mortality was estimated at 1.4 million. HIV infection has increased the burden of TB, especially in populations with high TB prevalence, mainly in sub-Saharan Africa and South-East Asia [1]. On the African continent, Nigeria, South Africa and the Democratic Republic of Congo, which recorded more than 2,000 cases for the first time in 2020, are the most affected countries. On the occasion of World TB Day on 24 March 2021, the WHO has emphasised the urgency [2]. In developing countries, the diagnosis of pulmonary tuberculosis is essentially based on the isolation of Acid-Resistant Bacilli (ARB) by direct examination of sputum. The diagnosis of extra-pulmonary tuberculosis is less easy, depending on the difficulty of obtaining material through invasive procedures (bone biopsy, cerebrospinal fluid, liver biopsy, etc.) and the sometimes difficult bacteriological documentation (lesser bacterial inoculum) [3]. The COVID-19 pandemic has reversed years of global progress in TB control and, for the first time in more than a decade, TB deaths have increased, according to the World Health Organization's (WHO) Global TB Report 2021 [2]. In 2020, more people died from TB, with far fewer people diagnosed, treated or receiving preventive treatment for the disease compared to 2019, and overall spending on essential TB services has decreased [2]. According to WHO estimates, approximately 4.1 million people currently have TB but have not been diagnosed or officially notified to national authorities. This figure is up from 2.9 million cases reported in 2019 [2]. The countries that contributed most to the global reduction in TB case notifications between 2019 and 2020 were India (41%), Indonesia (14%), the Philippines (12%) and China (8%). These and 12 other countries accounted for 93% of the total global decline in notifications [2]. Diagnosis of TB is often difficult and delayed, especially in resource-limited settings, leading to high mortality [4]. In the Republic of Guinea, according to the Global Tuberculosis Report 2019, the incidence rate decreased steadily between 2000 and 2018 from 228 to 176 cases per 100,000 inhabitants. While the global incidence rate increased at an annual rate of 1.6% between 2000 and 2018 and 2% between 2017 and 2018, Guinea's incidence rate decreased at an annual rate of 1.3% and 0% during the same periods [5]. According to the report of the National Tuberculosis Control Programme (PNLAT) Republic of Guinea, in 2018, 14248 new and relapsed cases were notified, the total number of notified TB cases was 14476. The notification rate per 100,000 inhabitants is 118 cases. A significant difference was noted between the TB case notification rate (new cases and relapses) of 118 cases per 100,000 population and the incidence rate of 176 cases per 100,000 population. In the absence of an efficient system for recording causes of death in Guinea, TB mortality cannot be measured directly. TB mortality (excluding HIV+) in Guinea has been estimated at 22 (13-34) deaths per 100 000 population [5]. The number of suspected TB cases submitted for bacteriological examination in 2018 was 43734 for all of Guinea, of which 8790 were positive on bacteriological examination, a positivity rate of 20% [5]. In the field of haematology, there is some difference between the frequency of pathologies in different regions of the world [6].

2. Methodology

2.1. Study setting: The Leprosy Clinic of Damakhania (Kindia Urban Commune) and the Gamal Abdel Nasser University of Conakry. The bio-material consists of sputum and blood from patients. It is a prospective study of cross-sectional and descriptive type with a duration of three (3) months, from February 3rd to May 3rd 2021. The target population was all patients received at the Damakhania Leprosarium during the period of our survey. Sampling was simple random and the sample size (N=301) was calculated according to the Schwartz formula using the national prevalence of TB. All patients received at the Damakhania Leprosarium laboratory with an Examination Report Card or a Health Card requesting sputum bacteriological and haematological examinations and patient information were included in our study.

2.1. Biological variables

- BAAR,
- THb,
- VGM,
- HDAC and
- CBC.

2.2. Epidemiological variables

- Age,
- Sex,
- Marital status,

- Occupation and
- Residence.

2.3. Data collection, processing and analysis

The data collection was done using a survey form elaborated according to the objectives and variables through the collection of information and samples taken from the patients followed by the analysis of the sputum and blood samples of each patient. Finally, the data collected was entered into Word 2007, processed and analysed by Excel of the office pack 2007 and SPSS version 21.

3. Results

In order to know the impact of pulmonary tuberculosis on the haematological parameters of the patients, a study was carried out in the laboratories and the results are given in the tables below.

3.1. Determination of biological parameters in patients

Table 1 Overall prevalence of pulmonary TB in patients

No	Bacteriological examination of lung secretions	Workforce	Percentage
1	Positive	51	17
2	Negative	250	83
Total		301	100

According to this table, we note that out of 301 patients received at the laboratories, 51 cases were diagnosed positive with a number of ARB varying between 1 and 9 ARB, i.e. 17%, compared to 250 negative cases, i.e. 83%. This high prevalence could be explained by the precarious socio-economic conditions of the population of Kindia, the promiscuous lifestyle and the lack of information on the mode of transmission of the disease.

3.1.1. Variation in haematological parameters in patients with pulmonary TB

Table 2 Hemoglobin variation in patients with TB

Total		hemoglobin level variation					
		Low		Normal		High	
Number	%	Number	%	Number	%	Number	%
51	100	51	100	-	-	-	-

In this table we notice that all pulmonary TB patients have haemoglobin levels below 12g/dL. This means khat all TB patients are anaemic.

Table 3 Typology of anemia in patients with pulmonary tuberculosis

Total		Typology of anaemia					
		Rough (10-11 g/dL)		Moderate (8-9 g/dL)		Severe (≤7 g/dL)	
Number	%	Number	%	Number	%	Number	%
51	100	30	59	21	41	-	-

In this table, we note that all 51 patients with pulmonary TB are anaemic with the following anaemic typology: 30 patients had TB levels between 10 and 11 g/dL (sign of frustrated anaemia), i.e. 59% and 21 patients had levels between 8 and 9 g/dL (sign of moderate anaemia), i.e. 41%. However, no cases of severe anaemia were recorded.

This shows that in patients with pulmonary tuberculosis, the haemoglobin parameter must be monitored. In frustrated and moderate anaemic patients, this situation could be corrected by a good, rich and balanced diet.

Table 4 Leukocyte variation in pulmonary TB patients

Total		**Variation of Leukocytes**					
		Low		Normal		High	
Number	%	Number	%	Number	%	Number	%
51	100	1	2	25	49	25	49

In this table, we note that of the 51 patients with pulmonary tuberculosis, the leukocytes vary greatly: one patient has a low value, i.e. 2%, 25 patients have normal values, i.e. 49%, and 25 patients have leukocytosis, 49%.

Table 5 Lymphocyte variation in pulmonary TB patients

Total		**Variation of Lymphocytes**					
		Low		**Normal**		**High**	
Number	%	Number	%	Number	%	Number	%
51	100	2	4	31	61	18	35

In this table we notice that of the 51 patients with pulmonary tuberculosis, the lymphocytes also vary: 2 patients have low values, i.e. 4%, 31 patients have normal values, i.e. 61% and 18 patients have high values (lymphocytosis), 35%.

Table 6 Variation of Basophils, Eosinophils and Monocytes in pulmonary TB patients

Total		**Variation of Basophils, Eosinophils and Monocytes**					
		Low		Normal		High	
Effectif	%	Number	%	Number	%	Effectif	%
51	100	-	-	51	100	-	-

In this table we note that all 51 patients with pulmonary tuberculosis have normal values for Basophils, Eosinophils and Monocytes, which is 100%.

Table 7 Neutrophil variation in pulmonary TB patients

Total		**Variation des Neutrophiles**					
		Low		**Normal**		**High**	
Number	%	Number	%	Number	%	Effectif	%
51	100	11	21	35	69	5	10

In this table we note that of the 51 patients with pulmonary tuberculosis, Neutrophils also vary: 11 patients have low values, i.e. 21%, 35 patients have normal values, i.e. 69% and 5 patients have high neutrophil values (hyperneutrophilia), i.e. 10%.

Table 8 Physiological variation of GMV in pulmonary TB patients

Total		**Physiological variation of MCVs**			
		Microcytic (MCV < 80 fl)		Normocytic (100 < VGM > 80)	
Number	%	Number	%	Number	%
51	100	21	41	30	59

Analysis of this table shows that of the 51 patients with pulmonary tuberculosis and anaemia that the Mean Globular Volume varied between 36.40 and 88.60 femtolitres with a standard deviation of 8.61. 21 had GMV levels < 80 fl (sign of Microcytic anaemia), i.e. 41% against 30 patients who had levels varying between 100 < GMV > 80 (sign of Normocytic anaemia), i.e. 59%. Microcytic anaemia is in fact caused by a deficit in iron intake. This would explain the drop in haemoglobin levels.

Table 9 Pathophysiological variation of MCHCs in pulmonary TB patients

Total		**Variation de la CCMH**			
		Hypochromic		Normochrome	
Effectif	%	Number	%	Number	%
51	100	21	41	30	59

In this table, we see that of the 51 patients with pulmonary tuberculosis, the Mean Corpuscular Haemoglobin Concentration varied between 26.4 and 32.0 g/dL with a mean of 29.30 g/dL and a standard deviation of 2.02. Twenty-one patients had a MCHC<32 (sign of Hypochromic anaemia), i.e. 41%, as opposed to 30 patients who had a MCHC of between 36<MCHC>32 (sign of Normochromic anaemia), or 59%.

Table 10 Pathophysiological variation of MCHT in pulmonary TB patients

Total		**Variation of MCHCs**					
		Low		**Normal**		**High**	
Number	%	Number	%	Number	%	Number	%
51	100	23	45	28	55	-	-

In this table, we see that of the 51 patients with pulmonary tuberculosis, the Mean Globular Haemoglobin Content (MGHC), which is the average weight of haemoglobin contained in a haematopoietic cell, varies: 23 patients have low levels, i.e. 45% and 28 patients have normal levels, i.e. 55%.

3.2. Distribution of pulmonary TB patients according to epidemiological parameters

This graph shows that out of the 51 patients with pulmonary tuberculosis, the male sex is the most represented with 36 cases, i.e. 71% against 29% for the female sex for a sex ratio of 0.71 in favour of the male sex. This high prevalence in males could be explained by the fact that they are more exposed to factors that encourage contamination such as tobacco and alcohol.

This graph shows that of the 51 patients with pulmonary TB, all age groups are affected by the disease. The youngest patient was 10 years old, the average age of the patients was 33.27 years and the maximum age was 65 years with a standard deviation of 13.33. The largest number of patients belonged to the age group between 21 and 40 years with 29 cases, i.e. 57%, followed by subjects with an age of 20 years or less with 12 cases, i.e. 23%. The age group least affected is that between 41 years and over with 5 cases, i.e. 10%.

This high prevalence in the 21 to 40 age group could be explained by the fact that it corresponds to the age group of the most active population, and therefore exposed to all the risks of contamination.

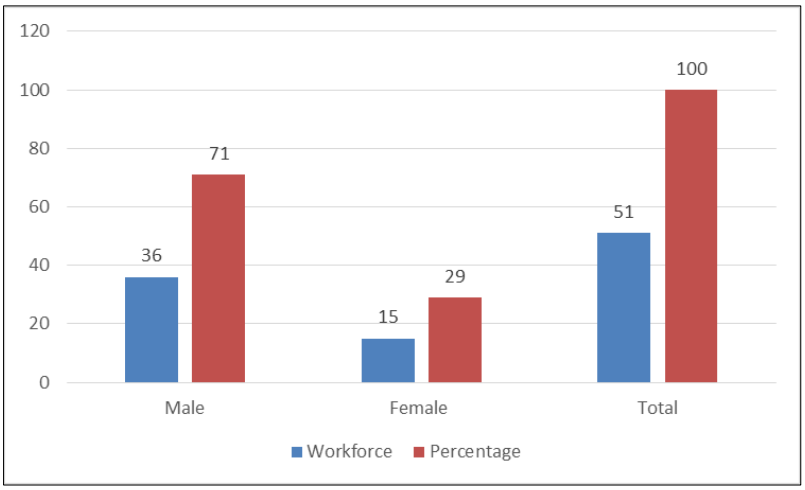

Figure 1 Distribution of pulmonary TB patients by gender

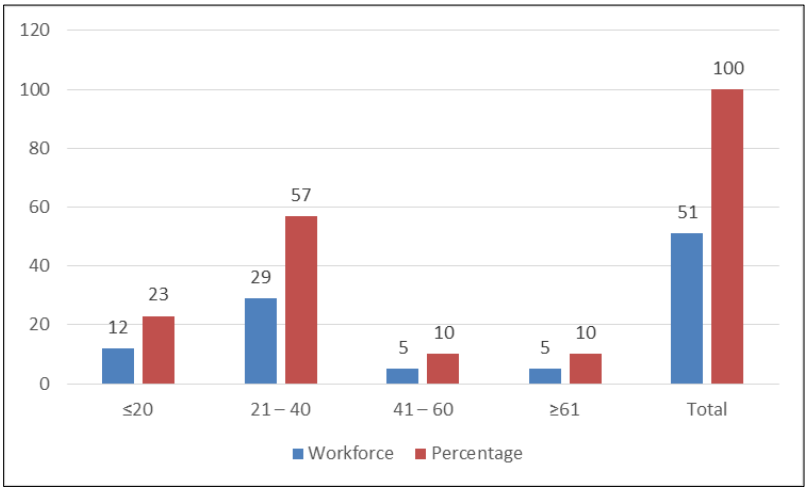

Figure 2 Distribution of pulmonary TB patients by age group

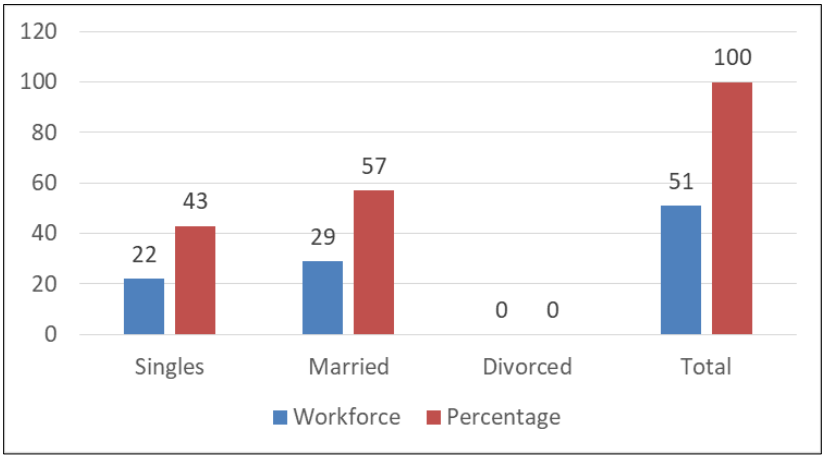

Figure 3 Distribution of pulmonary tuberculosis patients by marital status

With regard to marital status, this graph shows that out of the 51 patients with pulmonary tuberculosis, married people are the most represented with 29 cases, i.e. 57%, followed by single people with 22 cases, i.e. 43%. This situation can be explained by the greater frequency of visits to the centre by married people during our study period.

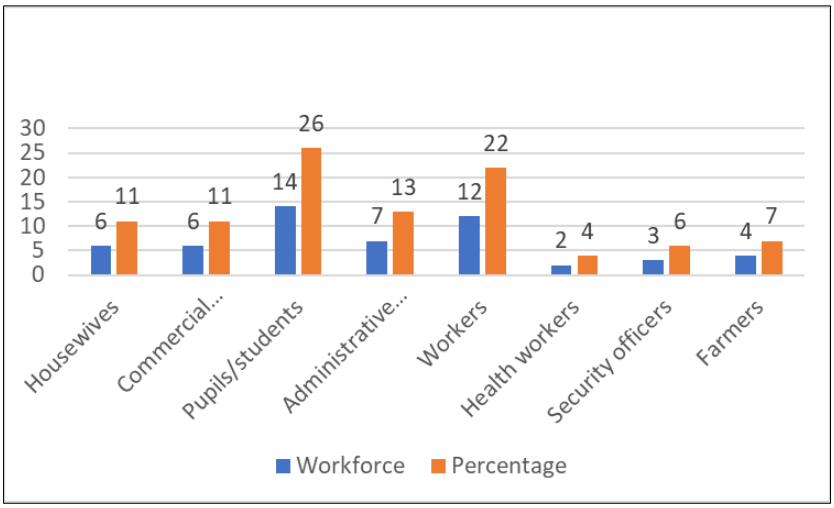

Figure 4 Distribution of pulmonary tuberculosis patients by socio-professional categories

This graph shows that out of the 51 patients with pulmonary tuberculosis, workers are the most affected with 19 cases, i.e. 37%, followed by pupils/students with 11 cases, i.e. 21%, farmers with 8 cases, i.e. 16%, housewives with 6 cases, i.e. 12%, commercial workers with 21% and pupils/students with 5 cases, i.e. 10%. Administrative staff are the least represented with 4%. The high prevalence in these socio-professional categories could be explained by their daily activity, promiscuity and poor living and working conditions.

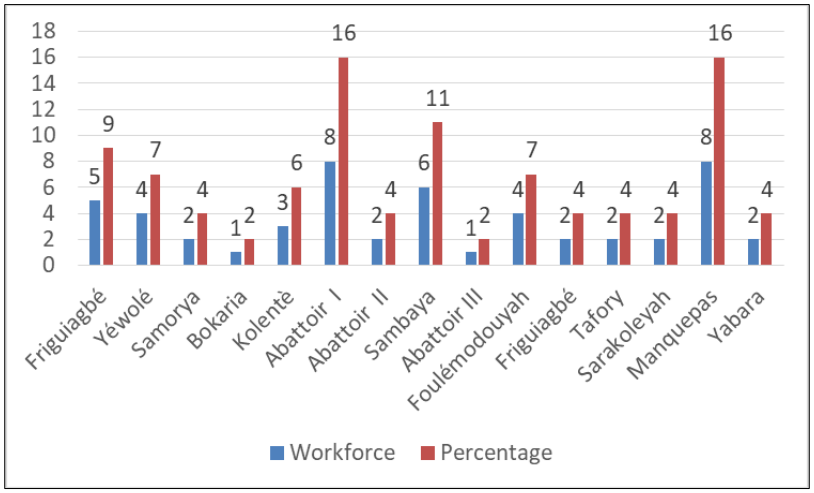

Figure 5 Distribution of pulmonary TB patients by Residence

From this graph, we can see that of the 51 patients with pulmonary tuberculosis, almost all the districts of Kindia are affected by the disease but with different rates. The Manquepas and Abattoir districts with 8 cases each, i.e. 16%. They are followed by the districts of Sambaya with 11%, the rural commune of Friguiagbé with 9% and the districts of Foulémodouyah and Yéwolé with 7% each. The other districts each have 4%.

This high prevalence in the Manquepas and Abattoir neighbourhoods could be explained by the fact that they are the most densely populated neighbourhoods in the urban commune, with promiscuity.

4. Discussion

In our research on the epidemiology and impact of *Mycobacterium tuberculosis* on haematological parameters of patients with pulmonary tuberculosis, we received 301 patients and 51 patients were diagnosed as positive for tuberculosis, i.e. 17%, compared to 250 negative cases, i.e. 83%.Our results are comparable to those reported by some authors.

4.1. Biological parameters

F.E. Elyassir et al (2019) in the phthisiology department of Moulay Youssef hospital, Rabat university hospital, pulmonary tuberculosis represented 83% of cases, it was extra pulmonary in 27% of cases and multifocal in 15% of cases, haematopoietic tuberculosis involvement was noted in 3 cases.

The diagnosis was most often based on bacteriological evidence. 93% of patients were anaemic with a mean haemoglobin level of 9.3 g/dl, hyperleukocytosis was noted in 52% of cases, thrombocytosis and lymphopenia were found in 35% of cases, leukopenia in 3% and hypereosinophilia in 3 cases [7].

Zagaouch and Jamal Eddine (2021) reported that 75% of the patients had haematological disorders. these haematological abnormalities were dominated by hyperleukocytosis in 37.5% of the cases, thrombocytosis in 32.7% of the cases, and anaemia in 25% of the cases, which was inflammatory in 75% of the cases, with a haemoglobin of less than 7 in 4 cases, requiring a transfusion. Lymphopenia in 12.5% of cases, thrombocytopenia in 7.5% of cases. However, they did not note an increase in eosinophil or monocyte levels [8].

4.2. Epidemiological parameters

Elyassir F.E. et al (2019) reported that the mean age was 39 years, with a predominance of the male sex with 53% [7]. Zagaouch and B.Jamal Eddine (2021) in their study of 220 patients of which 128 were women, i.e. 58.18% with a sex ratio of 0.71 (in favour of women). The mean age of the patients was 35.69 ± 10.65 years; the median was 34 years with extremes of 16 and 75 years. Of these, 120 patients, or 54.54%, were single, 87 patients, or 39.55%, were married, widowers represented 4.10% and divorcees 1.81%. Administrative staff accounted for 25.90% and commercial staff for 13.2%. Unemployed persons (including housewives, pupils/students) represented 51.81% [8].

Boulahbal F and Chaulet P., in 2004 reported that tuberculosis seems to affect women earlier than men. The age group most affected in women was 25 to 34 years (46.09%); in men, 36.96% were between 35 and 44 years. Most of the patients were women (128 women out of 220 patients, or 58.18%). This high proportion of females would appear to be related to the population of hospitalised patients, which is characterised by a predominance of HIV-infected women. However, a male predominance has been described by most African authors [9]. On the other hand, in a study carried out in Cotonou in 1997 [10], the authors recorded an equal number of men and women, giving a sex ratio equal to 1. All social strata were concerned by tuberculosis. Unemployed people represented 42.70%. The proportion of wage earners was low (15.45%). Senegalese authors found a slightly higher proportion of unemployed people at 47.50% [5]. These results are in line with the literature according to which tuberculosis is a poverty-related disease [11].

Limitations

This study had limitations. While the sample size of 301 patients, the number of tuberculosis patients is 51, which makes it possible to draw acceptable conclusions. Nevertheless, this work has conceptual merit and could serve as a reference for future studies. It demonstrated the impact of tubercle bacilli on variations in haematological parameters.

5. Conclusion

The results of our research on the haematological aspects of tuberculosis patients at the Leprosy Centre of Damakhania (Kindia Urban Commune) and the Microbiology Laboratory of the Gamal Abdel Nasser University of Conakry, with a prevalence of 17%, and the haematological disturbances, morbidity and mortality that it causes, prove that pulmonary tuberculosis is a major public health problem and that in order to improve the management of patients, the determination of the haematological profile is necessary.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest.

Statement of ethical approval

Confidentiality was respected throughout the data collection process and the results were used for strictly scientific purposes

Statement of informed consent

Prior to the study, patients gave their consent to participate in the study.

Authors' contributions

All authors contributed to this work. They have read and approved the final version of the manuscript.

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