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Study of Predictive Factors for The Therapeutic Success of Pulmonary Tuberculosis in The Health District of Saint-Louis (Senegal)

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Abstract

Introduction: Tuberculosis (TB) is a major public health problem and one of the main causes of death by infectious disease in the world. The object is to study the predictive factors for the therapeutic success of pulmonary tuberculosis in the health district of Saint-Louis.

Method: This was a retrospective, descriptive and analytical study of patients with pulmonary tuberculosis, declared at the level of the health district of Saint-Louis. It was conducted in all patients treated and followed in the centers and the processing unit from January 1st 2017 to December 31 2019. The data collection was made on the basis of a review of patient records including individual files and the treatment register. The data collected related to identification, personal characteristics, clinical aspects, microbiological aspects and evolutionary aspects of the disease. Descriptive and multivariate analyses were performed with R software version 3.4.4.

Results: A total of 759 patients were recruited. The mean age of the patients was 33 years (+/- 14.4 years) with a sex ratio M / F of 2.3. The therapeutic success was 92.2%. It was greater in people under 30 (ORaj = 2.1 [1.1-3.8]), individuals with a formal professional activity (ORaj = 1.8 [1.1-3.2]). Therapeutic success was also greater in people free from any HIV / AIDS infection (ORaj = 7.2 [2.2-23.3]).

Conclusion: In the health district of Saint-Louis, the therapeutic success rate is higher than that of the national level. This success is linked to age, the existence of an income-generating activity, the absence of an HIV field and to pharmacosensitivity. It is therefore important to determine all of its parameters at the start of treatment for better therapeutic results and thus prevent treatment failure.

Keywords: Tuberculosis; Therapeutic Success; Explanatory Factors; Saint-Louis

Introduction

Tuberculosis (TB) is an infectious, endemic-epidemic disease with human-to-human transmission primarily through the respiratory tract. Due to its scale and seriousness, it remains a major public health problem despite several strategic control plans [1, 2]. It is due to the complex *Mycobacterium tuberculosis* and is rife in all regions of the world, particularly where populations live in unfavorable socio-economic conditions to which the HIV pandemic has been added since 1983 [3].

According to the World Health Organization (WHO), the number of tuberculosis cases is estimated in 2018 at nearly 10 million and has remained stable in recent years. The disease burden varies considerably from country to country, ranging from less than 5 to more than 500 new cases per 100,000 population per year, with the average being around 130 new cases. Of all new TB cases, 8.6% were people living with HIV [4].

In recent years, multidrug-resistant tuberculosis has been a major problem in the response; according to the WHO in 2018 about half a million new cases of tuberculosis resistant to Rifampicin (major anti-tuberculosis drug) were recorded [4]. However, significant progress has been made. This includes, among other things, a drop in the incidence of tuberculosis for more than a decade, and in the death rate of more than 45% since 1990 [4], but also the advent of new molecular diagnostic tests such as Xpert / MTB and enzyme immunoassays [5,6].

The WHO recommends at least 90% treatment success rate for all people diagnosed and followed to treatment services [7]. Despite this recommendation, significant gaps in the success of anti-tuberculosis treatment are common. The latest data on global tuberculosis treatment outcomes for bacteriologically confirmed cases indicate an overall decline in the success rate from 86% in 2014 to 83% in 2017 [8]. The achievement of this objective in Senegal is supported by the National Tuberculosis Control Program (PNT). In practice, the tuberculosis screening and treatment centers (CDT) ensure the detection and treatment of TB in accordance with the recommendations of the PNT [9]. This care is free and decentralized up to the level of the health posts which constitute the last chain of the health system [10].

The region of Saint-Louis constitutes an area with a high burden of tuberculosis disease. During 2018, out of 1041 new cases of bacteriologically confirmed pulmonary tuberculosis expected, only 611 cases were declared, i.e. a detection rate of 60%. For the same year, the therapeutic success rate defined as the sum of cured patients and those having completed their treatment was 92% [11]. The district of Saint-Louis concentrates more than 80% of the cases of tuberculosis notified by the region of Saint-Louis. According to the Saint-Louis district report, the detection rate of new cases of pulmonary tuberculosis declined between 2017 and 2018, from 70% to 64%. The treatment success rate has remained stable at 80% and is below the regional and national target of 90% [11]. Hence the need to carry out a study on the factors contributing to the therapeutic success of the treatment of pulmonary tuberculosis. This will enable the TB control program, health authorities and policy makers to design effective strategies to reduce TB morbidity and mortality in order to improve outcomes for ending the TB epidemic in Senegal.

Method

Study framework

The study is carried out in a health district of Saint-Louis in northern Senegal on the border with the Islamic Republic of Mauritania. The district covers the entire department of Saint-Louis with an area of 879 km², or 4.6% of the regional area. The population of the district of Saint-Louis, in 2019 was estimated at 346,926 inhabitants, according to the projections of the National Agency for Statistics and Demography (ANSD), that is, approximately; 32.6% of the regional population [12].

The breakdown by age category shows a predominance of young people under 35 with 75% of the population. This population is

unevenly distributed in space. In fact, nearly 71% of it is concentrated in the commune of Saint-Louis, which only covers an area of approximately 47 km², or 5% of the departmental territory [12]. In the commune of Saint-Louis, there are large, highly populated neighborhoods with high human densities, favoring promiscuity and the development of tuberculosis. The main economic activities are agriculture, fishing, animal husbandry, trade and tourism. Each year with the advance of the sea, there are many families affected and displaced to developed reclassification sites. These populations are often exposed to environmental conditions conducive to the development of tuberculosis.

In terms of health, the district of Saint-Louis has a regional hospital, 2 health centers, 18 health posts. As part of the monitoring of tuberculosis patients, there is a treatment center and decentralized units at certain health posts. It is at the level of these structures that the administration of the directly observed treatment and the follow-up of the respect of the appointments take place. The treatment center takes care of the administration of second-line drugs and the follow-up of cases of multidrug-resistant tuberculosis.

Type of study

This was a retrospective cohort study, descriptive and analytical on the pulmonary TB patients reported to the health district of St. Louis from January 1st 2017 to December 31 2019.

Study population

The study focused on tuberculosis patients residing in the health district of Saint-Louis, with clinically diagnosed and / or bacteriologically confirmed pulmonary tuberculosis, regardless of age.

Sampling

This was an exhaustive recruitment covering all cases of pulmonary tuberculosis from the patient files registered by the care structures. These structures consisted of the health center and decentralized tuberculosis treatment units including that of the health post of Gueth-Ndar, Goxou-Mbathie and Gaston Berger University.

Data collection

A form allowing the use of the forms and the data collection registers was developed and this made it possible to collect the following information on the independent variables which are:

✓ Sociodemographic characteristics: age, sex, address, profession
✓ The clinical form of the notified pulmonary tuberculosis:
✓ The type of disease: new case, relapse, failure, re-treatment
✓ Confirmatory examinations: Microscopy, Genexpert,
✓ Administration of treatment directly observed or not
✓ Existence of comorbidity: HIV, diabetes
✓ Classification: Pulmonary tuberculosis confirmed bacteriological, Pulmonary tuberculosis confirmed clinically,
✓ Evolution of treatment: cured, failure, abandonment, treatment completed, Transfer

The dependent variable is represented by the therapeutic success which was defined as being any person declared cured of tuberculosis and / or having completed this treatment.

Data analysis

The quantitative variables were described by the mean with its standard deviation and the qualitative variables by the frequency. For

the analytical study, the Chi-square test and that of Fisher were used with an alpha risk of 5%. To take into account confounding factors, a multivariate analysis was performed. The latter used a simple binary logistic regression model with yes / no modalities of the therapeutic success variable, taking into account in the initial model all the variables whose p is less than 0.25 in the bivariate analysis. Then the descending step method was used and the comparison of the models was carried out by the likelihood ratio test. The latter used a simple logistic regression model, taking into account in the initial model all the variables whose p is less than 0.25 in the bivariate analysis.

The comparison of the models was performed by the likelihood ratio test with a top-down procedure [13]. The relevance of the model was studied by the test of Hosmer and Lemeshow. The measure of association was the adjusted odds ratio and its 95% confidence interval [14] The collected data were analyzed with R software 3.4.4 version.

Results

The study involved a total of 759 distributed tuberculosis patients. The mean age was 33 years (± years) and a median of 52 years. The extremes ranged from 3 years to 90 years. They were men in 70.4% with a sex ratio M / F of 2.3 and had an activity generating formal income in 67.2%. Almost 9 out of 10 patients were diagnosed by bacteriology and 90.3% were new cases. The decentralized treatment treatment units had taken care of 29.8% of the patients. The presence of HIV / AIDS and diabetes was 1.7% and 5.3% respectively. Those with multidrug-resistant tuberculosis accounted for less than one percent. The therapeutic success was noted in 92.2% (Table 1).

Variables		Absolute frequency (n)	Relative frequency (%)
Sex	Female	225	*29.6*
	Male	534	*70.4*
Age group	Under 30 years	380	*50.1*
	30 years and over	379	*49.9*
Generative activity income, formal	Yes	510	*67.2*
	No	249	*32.8*
Year of inclusion	2017	304	*40.1*
	2018	312	*41.1*
	2019	143	*18.8*
Type of patient	New case	685	*90.3*
	Revision	74	*9.7*
Type of structure Reference	points of public health service delivery in the health district	615	*81.0*
	Private health service points in the health district	107	*14.1*
	Health service points outside the health district	37	*4.9*
Classification	Pulmonary tuberculosis diagnosed bacteriologically,	676	*89, 1*
	Clinically diagnosed pulmonary tuberculosis	83	*10.9*
Treatment site	Health center treatment center	533	*70.2*
	Decentralized treatment units	226	*29.8*
Drug sensitivity	Multi-drug resistance tuberculosis	3	*0.4*
	Pulmonary tuberculosis drug sensitivity	756	*99.6*
HIV	No	746	*98.3*
	Yes	13	*1.7*
Diabetes	No	719	*94.7*
	Yes	40	*5.3*
Time to start treatment	24 hours	194	*25.6*
	More than 24 hours	565	*74.4*
Type of treatment directly observed	Other	517	*68.1*
	Sanitary	242	*31.9*
Therapeutic success	Yes	700	*92.2*
	No	59	*7.8*

Table 1: Personal and clinical characteristics of patients

The analytical study made it possible to identify that therapeutic success was significantly associated with age, the existence of a formal income-generating activity and the presence of HIV (Table 2). Thus, after adjustment by logistic modeling, the therapeutic success was better in young subjects aged less than 30 years (**ORaj = 2.1 [1.1-3.8]**), in those with an income-generating activity (**ORaj = 1.8 [1.1-3.2]**) and in those without HIV / AIDS immunodeficiency (**OR aj = 7.2 [2.2-23.3]**) (Table 3).

Variables		Therapeutic success					
		Yes		No		P value	OR brute
		n	%	n	%		
Sex	Female	212	*94.2*	13	*5.8*	0.183	Ref
	Male	488	*91.4*	46	*8.6*		0.6 [0.3-1.2]
Age group	Under 30	361	*95.0*	19	*5.0*	**0.004**	**Ref**
	30 years and over	339	*89.4*	40	*10.6*		**2.2[1.2-3.9]**
Income-generating activity. formal	Yes	479	*93.9*	31	*6.1*	**0.013**	**Ref**
	No	221	*88.8*	28	*11.2*		**1.9[1.1-3.3]**
Year of inclusion	2017	279	*91.8*	25	*8.2*	0.760	Ref
	2018	287	*92. 0*	25	*8.0*		1.04 [0.6-1.9]
	2019	134	*93.7*	9	*6.3*		1.3[0.6-3.1]
Type of referral	facility public health delivery points in the district health	35	*94.6*	2	*5.4*	0.327	**Ref**
	Private health service points in the health district	95	*88.8*	12	*11.2*		0.5 [0.8-1.9]
	Health service points outside the health district	570	*92.7*	45	*7.3*		0.7 [0.1-2.7]
Classification	Pulmonary tuberculosis diagnosed bacteriologically.	622	*92.0*	54	*8.0*	0.528	**Ref**
	Clinically diagnosed pulmonary tuberculosis	78	*94.0*	5	*6.0*		1.3[0.5-3.5]
Treatment site	Health center treatment center	491	*92.1*	42	*7.9*	0.866	Ref
	Decentralized treatment units	209	*92.5*	17	*7. 5*		1.3[0.6-3.1]
HIV	No	692	*92.8*	54	*7.2*	**<0.001**	Ref
	Yes	8	*6 1.5*	5	*38.5*		**0.12 [0.03-0.4]**
Diabetes	No	664	*92.4*	55	*7.6*	0.589	Ref
	Yes	36	*90.0*	4	*10.0*		0.7 [0.2-2.1]
Time to start of treatment	24 hours	181	*93.3*	13	*6.7*	0.518	Ref
	More than 24 hours	519	*91.9*	46	*8.1*		0.8 [0.4-1.5]
Type of directly observed treatment	Other	474	*91.7*	43	*8.3*	0.413	Ref
	Sanitary	226	*93.4*	16	*6.6*		1.3[0.6-2.3]

Table 2: Determinants of the therapeutic success of pulmonary tuberculosis

	Therapeutic success		P value	OR adjusted [95% CI]
	Yes %	Total N		
Sex				
Female	488 (91.4)	534	0.24	
Male	212 (*94.2*)	225		1.48 [0.77-2.82]
Age group				
30 years and over	339 (*89.4*)	379	**0.017**	Ref
Under 30 years	361 (*95.0*)	380		**2.1 [1.1-3.8]***
Income-generating activity				
No	221 (*88.8*)	249	**0.040**	Ref
Yes	479 (*93.9*)	510		**1.8 [1.1-3.2]***
HIV				
Yes	8 (*61.5*)	13	**0.001**	Ref
No	692 (*92.8*)	746		**7.2 [2.2-23.3]***

CI: Confidence Interval
OR: Odds Ratio
* **:** Significance
Hosmer & Lemeshow Test
Chi-Square DF Pr > ChiSq

2.3672 8 0.9676

Table 3: Logistic regression of factors associated with the therapeutic success of tuberculosis

Discussion

The control of pulmonary tuberculosis necessarily involves the early detection and treatment of cases. This study in the health district of St. Louis from 959 patients with pulmonary tuberculosis, is carried out from January 1st 2017 to December 31 2019. The average age was 33 years (+/- 14.4 years) and young people under 30 are equally affected by tuberculosis (50.1%). WHO also indicates that tuberculosis mainly affects the young population in Senegal (> 14 years) with a notification rate of 95% (4). The results of this study showed a high representativeness of the males sex of around 70.4% and an M / F sex ratio of 2.3. This distribution, with a predominance of male and the young, has been noted in previous studies in Senegal [15], Cameroon [16] and Morocco [17]. This shows that tuberculosis mainly affects young males and could be explained by the fact that men often perform heavy work in difficult social conditions and are the most exposed to smoking, which is a factor that may explain the vulnerability of this target. More than four out of five of the patients (81.0%) followed in the center and treatment units were referred by the public structures of the regional hospital and the health center after having made the diagnosis of pulmonary tuberculosis. A study in Morocco found the same proportions (83.9%) [17]. This can be explained by the fact that the providers of public structures benefit from training and supervision in relation to the directives of the National Tuberculosis Control Program (PNT) on the systematic request for the examination of sputum in search of AFB in all coughers over 15 days but also the existence of community relays for the orientation of people with a cough lasting more than 15 days.

The proportion of patients declared cured was 78.5% and that whose treatment ended was 13.7%, thus bringing the therapeutic success rate to 92.2%. At the national level according to the WHO, the therapeutic success rate is estimated at 87% [4]. Studies

in the sub-region have found success rates of less than 90%, this is the case in Benin (6.26%) [18], Guinea and Mali with rates of respectively 88% and 78% [4].

This success rate of the health district of Saint-Louis, exceeding the objectives of the national and international level recommended by the WHO of at least 90%, could be linked to the decentralization of care and regular monitoring of treatment. We can also consider in this success the implication of the basic community organizations OCB for the search of the irregulars and the follow-up of the treatment in community.

Therapeutic success was greater in people under 30 years of age (ORaj = 2.1 [1.1-3.8]). Similar results were found by Akilimali in DRC in a study which shows that the older the tuberculosis patient is, the more unfavorable the outcome of the treatment was observed [19]. Individuals with an income-generating activity had more therapeutic success (ORaj = 1.8 [1.1-3.2]). A study carried out in Thailand went in the same direction by showing that the rate of therapeutic success was doubled in the patients whose income is regular compared to the unemployed [20] as well as work carried out in Guinea showed that the treatment failures, lack of income was associated [21].

Today, tuberculosis is the leading cause of death from infectious diseases in people living with HIV [22]. Since death is a measure of the unfavorable outcome of anti-tuberculosis treatment, a high mortality rate in HIV-positive patients with tuberculosis contributes to a low rate of treatment success [23]. The presence of an HIV patch was a factor limiting therapeutic success. Thus, seronegative people had 7.2 times more (95% CI [2.2-23.3]) are more likely to have treatment success. This constant was found in a study in the Democratic Republic of Congo with a significant difference in favor of immunocompetent in therapeutic success [19] as well as in the rest of sub-Saharan Africa such as in Benin [24] and in Ethiopia [25,26]. In addition, HIV seropositivity was linked to an unfavorable outcome of anti-tuberculosis treatment and thus highlights the usefulness of a systematic determination of the immunological status of tuberculosis patients during diagnosis. HIV weakens the immune system and increases the likelihood of opportunistic infections such as tuberculosis in this case, the progression from latent TB to active TB and relapse of tuberculosis among those treated successfully. Conversely, tuberculosis accelerates the progression of HIV to AIDS by increasing viral replication and exacerbating mortality [27]. It also underlines the importance of adhering to supportive measures in order to improve the outcome of TB treatment in co-infected patients.

Conclusion

This study on the factors contributing to the therapeutic success of the treatment of pulmonary tuberculosis has shown that the health district of Saint-Louis has reached the WHO recommendations at the local level with at least 90% therapeutic success. This objective was achieved through the decentralization of care and the involvement of community actors. The factors found that could explain this rate of therapeutic success were mainly linked to the young age of the patients, the existence of an income-generating activity, the absence of a field of retro-virosis and the absence of multi-drug resistance to anti-tuberculosis drugs. Thus, to reduce morbidity and mortality linked to tuberculosis, interventions to reduce indirect costs, fight against multidrug resistance and strengthening preventive measures against HIV / AIDS are necessary to improve the performance of the national tuberculosis control program for the achievement of national objectives in Senegal.

Author contributions

All the authors participated throughout the process of writing the protocol, collecting, analyzing the data and writing the article.

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