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Pulmonary Tuberculosis in Hospital Setting: Retrospective Study on Risk Factors

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ABSTRACT

Pulmonary tuberculosis is an airborne disease when people with tuberculosis cough up tuberculosis bacilli into the air. It is a serious public health problem in developing countries. In Morocco, the clinical management of pulmonary tuberculosis is often ambulatory, and hospitalization is indicated only for severe or complicated cases. This study aims to investigate the risk factors associated with pulmonary tuberculosis in patients hospitalized. A retrospective study was conducted on patients with pulmonary tuberculosis hospitalized in the pulmonology department from January 1, 2019 to June 1, 2021. Data were extracted from tuberculosis patients' records and statically analyzed using SPSS software. A total of 140 cases of pulmonary tuberculosis were identified with a predominance of the male gender (90.71%). The age category between 15 and 34 years was the most affected by the disease ($p=0.017$). The bivariate analysis showed that there are apparent risk factors for the disease. Most of the patients who developed the disease were smokers ($p=0.035$) of the male gender ($p=0.003$). There was a significant association between the disease and HIV-positive status ($p=0.001$). In addition, diabetic patients were also predisposed to develop the disease ($p=0.002$). In conclusion, young and male patients were more likely to be affected by the disease. Smoking, contact with a person with tuberculosis, and co-morbidity with the disease were found to be risk factors for developing lung disease. This calls for intensified screening activities for tuberculosis in active patients.

Keywords: Pulmonary tuberculosis; Public Health; Risk factors; Hospital; Morocco

Introduction

Pulmonary tuberculosis is the most contagious form of tuberculosis and is one of the deadliest infectious diseases in the world. According to the World Health Organization (WHO), pulmonary tuberculosis is classified as the second leading cause of mortality and morbidity from infectious diseases.[1] This disease is transmitted by air when people with tuberculosis cough up tubercle bacilli into the air.[1-3] It is caused by an infection with Mycobacterium tuberculosis (*Koch*'s bacillus) that can affect all organs of the body. However, it is the lungs that are most often affected, this is why this disease is known as pulmonary tuberculosis.[1, 4]
According to the World Health Organization (WHO) report of 2022, pulmonary tuberculosis alone results in one to three million deaths each year.[1] WHO estimates that more than 10.6 million people worldwide have developed tuberculosis in 2021, i.e. an increase of 4.5% with respect to 2020. This situation has worsened by the increase also in cases of TB resistant to anti-tuberculosis drugs. The burden of drug-resistant tuberculosis has increased by 3% between 2020 and 2021.[1]

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A significant number of patients die from TB worldwide despite good control programs in many countries.[5, 6]
In Morocco, tuberculosis is a real public health problem and a social scourge, but the risk factors associated with pulmonary tuberculosis infection in the Moroccan population are very limited.
Tuberculosis surveillance in Morocco is essentially done through a passive case detection system whereby patients go to government health facilities to seek health care. Similarly, private physicians normally refer all their patients to public health facilities.
Unfortunately, most people who develop tuberculosis are working age adults.[1] The disease is strongly influenced by social, economic, and environmental determinants of health. The disease is complicated by the emergence of immunodeficiency virus (HIV), unsanitary conditions, and the lack of health services, especially in poor countries, where each year about 90% of new TB cases are recorded in underdeveloped countries.[1]
In addition, most of the information that is available on the risk factors associated with pulmonary tuberculosis comes from the ambulatory setting in outpatient settings.[7-10] However, the situation in clinical settings is not explored. With this in mind, the present study aims to investigate the risk factors associated with pulmonary tuberculosis in hospitalized patients. To the best of our knowledge, this is the first study in Morocco that takes into account hospitalized patients in the study of risk factors.
Indeed, in the absence of such data, it is difficult for health officials and health professionals to achieve the goals of the National Tuberculosis Control Program and to implement actions to control risk factors.
The results of this study will be of great importance for health decision-makers as such results could help us formulate proposals for the early management of patients and avoid their hospitalization, and also because those results would also be used in the planning of control

activities and in the implementation of health education activities in favor of the vulnerable populations.

Materials and methods

Design and location of the study
This retrospective study was conducted at the pneumology service at the reference hospital located in the center of Morocco. Medical files of all admitted and hospitalized patients due to pulmonary tuberculosis between January 1, 2019 and June 1, 2022 were reviewed and studied to analyze the socio-demographic and clinical characteristics as well the risk factors related and associated with the disease.

Study sample collection and inclusion criteria
We reviewed all the medical records of patients with pulmonary tuberculosis admitted and hospitalized in the pneumology service of the referral hospital of Meknes, which has a large technical and logistical platform for the specialized care of tuberculosis patients.
To meet our goals, inclusion and exclusion criteria were established beforehand. Only the medical records of patients with pulmonary tuberculosis were included and analyzed in this study. The records of patients with other forms of tuberculosis (extrapulmonary forms) were excluded.
Thus, an exploitation form of the medical files of pulmonary tuberculosis patients was used to extract the variables under study: sex, age, living environment, income, existing chronic disease, origin, and comorbidity, the notion of contagion, family status, occupation, and life habits (smoking, alcoholism).

Analysis and processing of data
The collected data were entered and organized in an Excel file, then transferred to SPSS for a possible in-depth statistical treatment. The analysis of quantitative variables was conducted by calculating the percentage and the mean ± standard deviation whereas the analysis and search for correlation between categorical variables are carried out using Student's t-test and Q2. The *P*-value <0.05 was retained and considered statistically significant.

Ethics approval
This was a retrospective study of the patient's medical records. To ensure the confidentiality of the information collected, the identification numbers and names of the TB patients were not included in the checklist. Therefore, none of the participants could be recognized, and we respected the principle of objective treatment of the information collected throughout the study.

Results and Discussion

Pulmonary tuberculosis is a highly contagious infectious disease and is one of the main causes of death in the world population, particularly in developing countries. In Morocco, the diagnosis, bacteriological confirmation, and follow-up of pulmonary tuberculosis cases are mainly ambulatory, and the therapeutic management takes place in basic health facilities according to the patient's place of residence[11], while recourse to hospitalization is indicated only for severe or complicated cases of tuberculosis.[11] The system of detection and surveillance of tuberculosis is strictly state-run. It is carried out in the Centers for Diagnosis of Tuberculosis and Respiratory Diseases (CDTRDs) and in Integrated Health Centers (IHCs).

Sociodemographic and clinical characteristics of the patients
One hundred and forty patients with pulmonary tuberculosis were admitted and hospitalized in the pneumophysiology department of the HMMI hospital in Meknes during the study period (Table 1). There were 127 (90.71%) men and 13 (9.29%) women with a male/female ratio of 9.76. The mean age was 36.8±18.3 years with a range of 14 years to 85 years. While the most affected age bracket was the 15 to 34

years bracket who were 86 individuals (61.43% of the total cohort). Most of the patients were military officials 95 (67.86%) and military retirees 35(25.0%). As far as spouses are concerned, they were 7 (5%) and children represented 3 (2.14%). Thus, almost half of the patients, who were 69 indivodiuals (49.29% of the total population) had a secondary education level and 33 (23.57%) had a primary education level.
The results of our study revealed that the age bracket between 15 and 34 years was the most affected by the disease (61.43%; *p*=0.017). These results are consistent with other national studies that have shown that working age adults are more affected by this disease.[8, 12] However, recent studies have shown that the burden of tuberculosis increases among the elderly population.[12,13] Indeed, Furuuchi and colleagues stated that the elderly are at high risk of developing TB due to age-related immunosuppression.[14]
In our study, a significantly large proportion of pulmonary tuberculosis was diagnosed in male patients (90.71%, *p*=0.003, 95% CI [-42.65,-14.34]). This is perfectly in line with the results of recent studies that revealed that the frequency of pulmonary tuberculosis cases is higher in male subjects than in female subjects.[8,15]
The same results were achieved in 2021, nationwide where males represented 56.5% of all tuberculosis cases, females 32.5%, and children 11% of cases[1], which confirms our results.
In addition, according to the latest data from the Moroccan Ministry of Health, tuberculosis was responsible for 1.2% of deaths with a male predominance (1.5%) versus (0.7%) in women.[16] Pulmonary tuberculosis alone was responsible for 2.0% of deaths in people aged 15-64 years [gender: M (2.5%), F (1.2%)] and 0.7% of deaths in people aged 65 years and over [gender: M (0.9%), F (0.4%)].[16]

Risk factors associated with pulmonary tuberculosis in patients
Table 2 presents the different risk factors that have been identified as being associated with pulmonary tuberculosis. Gender has been shown to be a related risk factor for the disease in men. In fact, a significantly large proportion were male patients (90.71%, *p*=0.003, 95% CI [-42.65,-14.34]). Environment was not revealed as a risk factor among patients (*p*=0.191), whereas the age bracket between 15 and 34 years was found to be significantly associated with the disease (*p*=0.017).
In fact, tuberculosis is one of the deadliest communicable diseases in the world. In TB patients, HIV accelerates the progression of infection from latent to active disease[13], which is consistent with the results of our study where the association was significant between HIV and pulmonary TB (*p*=0.001, 95% CI [17.77, 46.22]). In fact, of the five HIV-positive TB patients, one patient had an unfavorable outcome and died. This is consistent with other studies.[6, 12]
In addition, the "Health in Figures" official data of the Ministry of Health indicate that tuberculosis continues to register more cases among HIV-positive people. In fact, in 2020, 231 tuberculosis patients were HIV-positive compared to the year 2019, when there were 81 cases of tuberculosis who were HIV+.[16]
The results of our study also show that most of the TB patients were smokers (70%, *p*=0.035, 95% CI [1.32, 26.67]). Indeed, smoking has been identified also in other studies as one of the main significant joint factors in pulmonary TB.[13] In Morocco, smoking has also been found to be associated with TB treatment failure in Morocco.[9]
Diabetic patients were predisposed to develop pulmonary TB (*p*=0.002, 95% CI [12.27, 32.72]). This result is in agreement with other studies.[17]
In the hospital setting, recent retrospective studies of the clinical features of pulmonary tuberculosis in patients at a general hospital in Tokyo, Japan by Hikone *et al*. and by Wang and colleagues in a hospital in southern Taiwan which revealed that diabetes represents the most frequent risk factor for pulmonary tuberculosis infection.[18, 19] In this context, WHO says that new cases of tuberculosis are attributable to five risk factors, namely: diabetes, smoking, HIV infection, and disorders related to alcohol consumption and undernutrition.[1]
As reported by the World Health Organization of 2022, pulmonary tuberculosis is the most contagious form of the disease, and exposure to a person with pulmonary tuberculosis increases the risk of acquiring

Table 1: Sociodemographic and clinical characteristics of the patients

Variables		Frequency (n=140)	Percentage (%)
Gender	F	13	9.29
	M	127	90.71
Environment	R	57	40.71
	U	83	59.29
Occupation	Military Child	3	2.14
	Spouse Military	7	5.00
	Military	95	67.86
	Retired Military	35	25.00
What is your education level?	Illiterate	3	2.14
	Primary	38	27.14
	Secondary	64	45.71
	Universe	35	25.00
What is your family situation?	Single	66	47.14
	Mary	69	49.29
	Divorced	5	3.57
Age category	≤ 14 years old	3	2.14
	[15 and 34 years old]	86	61.43
	[35 and 54 years old]	14	10.00
	$\geq$ to 55 years	37	26.43
What is your income?	$\leq$ à 300 $	49	35.00
	Between $300-$500	65	46.43
	Between $500-$1000	24	17.14
	$\geq$ à 1000$	2	1.43
Exposure to pulmonary tuberculosis	No	124	88.57
	Yes	16	11.43
Diabetes	No	115	82.14
	Yes	25	17.86
HIV	No	135	96.43
	Yes	5	3.57
	Yes	98	70.00
Smoking	No	42	30.00
	Assets	75	53.57
	Liabilities	23	16.43
Are you vaccinated?	No	51	36.43
	Yes	89	63.57

Mycobacterium tuberculosis infection. This corroborates our findings according to which people with a history of contact with a person with pulmonary tuberculosis were predisposed to developing the disease (p=0.001, 95% CI [15.43, 38.56]). In addition, recent studies have shown that contact with a person infected with pulmonary TB increases the likelihood of contracting the disease.[8, 20, 21]

Interestingly, several studies have shown that people living in urban areas, and also people with low income, have an increased tendency to get *Mycobacterium tuberculosis* infection.[22, 23] Unfortunately, this was not confirmed by our study. Our results show that there was no significant association between disease and income (p=0.051), nor with the environment (p=0.191).

In sum, Most patients in our study who developed the disease were smokers (70%, p=0.035, 95% CI [1.32, 26.67]). People with a history of contact with a person with pulmonary tuberculosis were predisposed to develop the disease (p=0.001, 95% CI [15.43, 38.56]). Patients with diabetes were also predisposed to develop the disease (p=0.002, 95% CI [12.27, 32.72]). HIV-positive status was found to be significantly associated with the disease (p=0.001, 95% CI [17.77, 46.22]). Indeed, of the five HIV-positive TB patients, one patient had an unfavorable outcome and died. It should also be noted that there was no significant association between disease and vaccination status (p=0.364, 95% CI [-51.60, 21.20]) or income (p=0.051). As a consequence, the fight against pulmonary tuberculosis begins with the fight against related risk factors through the promotion of a healthy lifestyle without tobacco use, the sensitization of people[5, 24] at risk and also through the continuous training and development of the skills of health professionals.[25]

Table 2: Risk factors associated with pulmonary tuberculosis

Variable	*T-student*	95% Confidence Interval of the Difference		*P*-value	Variable	*Chi-Square*	*P*-value
		Lower	Upper				
Gender	-4,927	-42.65	-14.34	0.003	**Age**	60	0.017
HIV	4.369	18.775	46.226	0.001			
Smoking	4.595	-24.552	-1.447	0.033	**Income**	40	0.051
Diabetes	5.385	12.276	32.723	0.002			
Vaccination status	- 0.963	-51.604	21.204	0.364	**Occupation**	42	0.028
Exposure to pulmonary tuberculosis	5.713	15.436	38.563	0.001			

Conclusion

This study revealed that most of the infected patients were adult men of working age. An in-depth analysis of the variables revealed the existence of risk factors associated with pulmonary tuberculosis, particularly smoking, contact with a person infected with *Mycobacterium tuberculosis*, diabetes, and HIV seropositivity. In addition, early management and education of the population at risk can limit the spread of infection and avoid hospitalization.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

Acknowledgements

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