Is there gender inequality in the epidemiological profile of tuberculosis?

L'épidémiologie de la tuberculose diffère-t-elle selon le genre ?

Maissa Ben Jmaa[1,3], Houda Ben Ayed[3,4], Makram Koubaa[2,3], Fatma Hammami[2,3] , Jamel Damak[1] , Mounir Ben Jemaa[2,3]

1- Community Health and Epidemiology Department, Hedi Chaker University Hospital, University of Sfax, Tunisia
2- Infectious Diseases Department, Hedi Chaker University Hospital, University of Sfax, Tunisia
3- Extra-pulmonary Research Unit, University of Sfax, Tunisia
4- Department of Preventive Medicine and Hospital Hygiene, Hedi Chaker University Hospital, Sfax, Tunisia

RÉSUMÉ

Introduction : La tuberculose (TB) touche et tue plus d'hommes que de femmes dans le monde. Notre objectif était d'analyser les particularités épidémiologiques, cliniques et pronostiques de la TB selon le genre dans le sud tunisien.

Méthodes : Notre étude était rétrospective ayant inclus les nouveaux cas de TB, tous âges confondus, diagnostiqués entre Janvier 1995 et Décembre 2016.Le recueil des données était fait à partir des registres du centre de lutte contre la tuberculose du gouvernorat de Sfax.

Résultats : Nous avons inclus 2771 nouveau cas de TB.Le sex ratio était de 1,2.Nous avons noté 1160 nouveaux cas de TB pulmonaire (TBP) (41.9%).La TBP était significativement plus fréquente chez les hommes (Odds Ratio (OR)=2.5;p<0.001),tandis que la TB extra pulmonaire (TBEP) était plus fréquente chez les femmes (OR=0.4;p<0.001).Les femmes étaient significativement plus touchées par la TB ganglionnaire (OR=2.6;p<0.001), cutanée(OR=2.3;p<0.001) et abdominale (OR=2;p<0.001). La TB pleurale était plus notée chez les hommes (OR=1.2;p<0.001). Le taux de létalité était plus important chez les hommes (OR=1.7;p=0.02). Les femmes avaient un taux de guérison plus élevé (OR=1.3;p=0.04) avec une durée de traitement significativement plus élevée (8.88±3.6months vs.8.41±3.2months; p<0.001). Entre 1995 et 2016, le taux de notification standardisé de TB (Rho=0.68;p<0.001) et de TBEP (Rho=0.59 p=0.003) a significativement augmenté chez les femmes tandis qu'il n'a pas changé chez les hommes.

Conclusion : Notre étude a mis en exergue une morbidité plus importante de la TB chez le sexe masculin dans le sud tunisien.Les programmes nationaux de TB devraient se focaliser sur le diagnostic de routine et le dépistage ciblant les hommes.

Mots clés : Epidémiologie ; Extra pulmonaire ; Genre ; Inégalités ; Pulmonaire ; Tuberculose

SUMMARY

Background: Worldwide, many more males than females were diagnosed with tuberculosis (TB) and died from it globally. In light of this, examining the gender differences among patients with TB is crucial to institute effective prevention, coverage and treatment.

Aim: To analyze gender differences in the epidemiological, clinical and evolutionary specificities of TB in Southern Tunisia.

Methods: We conducted a retrospective study including all new cases of TB of any age, diagnosed between January 1995 and December 2016. Data were collected from the regional register of TB at the Center of Tuberculosis Control of Sfax, Southern Tunisia.

Results: We recorded 2771 new cases of TB. The sex ratio was 1.2. We noted 1160 new cases with pulmonary TB (PTB) (41.9%). Males were more likely to have PTB than females (Odds Ratio (OR)=2.5;p<0.001), while extra-pulmonary TB (EPTB) was more common in females (OR=0.4;p<0.001). Lymph node (OR=2.6;p<0.001), cutaneous (OR=2.3;p<0.001) and abdominal TB (OR=2;p<0.001) were significantly more frequent in females. Pleural TB was significantly more common in males (OR=1.2; p<0.001). Case fatality rate was significantly higher in males (OR=1.7;p=0.02). Females experienced recovery more frequently (OR=1.3;p=0.04). Treatment duration was significantly higher in females (8.88±3.6months vs.8.41±3.2months; p<0.001). Between 1995 and 2016, the age standardized notification rate (ASNR) of TB (Rho=0.68; p<0.001) and EPTB (Rho=0.59 p=0.003) had significantly increased in females, while it had not significantly changed in males.

Conclusion: Our study highlighted higher burden and morbidity in males in TB cases in Southern Tunisia. National TB programs should actively focus on these facts with more routine diagnostic and screening targeting males.

Keywords : Disparities; Epidemiology; Extra-pulmonary; Gender; Pulmonary; Tuberculosis

Correspondance

Maissa Ben Jmaa
Community Health and Epidemiology Department, Hedi Chaker University Hospital, University of Sfax, Tunisia
Extra-pulmonary Research Unit, University of Sfax, Tunisia
maissabenjmaa@live.fr

INTRODUCTION

Tuberculosis (TB) is of a public health concern with 10 million new cases and an estimated 1.6 million deaths in 2017 (1). TB presents the highest cause of death among infectious disease exceeding human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS)(1).Effective chemotherapy could cure a vast majority of cases and, in combination with high case detection rates, lead to eventual elimination from the community of *Mycobacterium tuberculosis* as a major pathogen. However, low detection and poor cure rates have prevented approaching this achievement in many developing countries (2-4). Understanding factors that impact on case notification and the disease prognosis is therefore a key in effective disease control. Gender has been reported as a conspicuous factor, which has a significant impact on TB diagnosis and outcomes in many settings worldwide (5). According to the World Health Organization (WHO), many more males than females were diagnosed with TB and died from it globally (6). In 2017, TB affected approximately 6 million adult males and killed around 840.000 of them, whereas an estimated 3.2 million adult females contracted TB and almost 500.000 died from it (6). Moreover, many studies showed that there were differences between males and females in prevalence of infection, incidence of clinical disease, disease progression and mortality due to TB (7). In light of this, examining the gender disparities among patients with TB is important to institute effective prevention, coverage and treatment. Although Tunisia is an intermediate endemic area for TB with a recorded incidence of 29 / 100,000 in 2017 (8), gender disparities in TB has been a neglected research area. Little attention has been paid to gender in TB control in Tunisia, particularly in Southern Tunisia, which is a highly endemic region (9). Hence, we carried out this study to analyze gender differences in the epidemiological, clinical and evolutionary specificities of TB in Southern Tunisia.

METHODS

Study design

We conducted a retrospective study including all new cases of TB diagnosed between January 1995 and December 2016 in South of Tunisia. Mandatory TB case notification in Tunisia is highlighted as an integral element for continuous surveillance and monitoring of the disease. The national surveillance system in Tunisia is in turn an effective part of the National TB Control Program implemented since 1959, which aimed to detect TB cases and treat them to disrupt transmission, decrease mortality and avert the emergence of drug resistance. This program is continuously updated and adapted to the epidemiological situation and scientific progress of our country (8).

Population study and inclusion criteria

Data were collected from the regional register of TB at the Center of Tuberculosis Control of Sfax, Southern Tunisia. This center received diagnosed cases from both private and public health-care structures, in rural and urban districts of Southern Tunisia, and then notified them to the national directorate of primary health-care. We included all new cases of TB, all ages combined.

Data collection and case definition

The database variables included patients' socio-demographic, clinical (anatomical site of TB) and therapeutic characteristics, as well as the disease evolution. An area located more than 11 kilometers away from the city center was defined as a rural area. We followed the WHO Classification of TB cases based on anatomical site of disease for both pulmonary tuberculosis (PTB) and extra pulmonary tuberculosis (EPTB) as follows: (10). Multifocal defined as having two or more non-contiguous sites of tuberculosis involvement (11). A good prognosis of the disease was defined as a recovery from TB after treatment completion without relapse or complication occurrence during the follow-up. In the remaining cases, the prognosis was considered poor.The case fatality rate (CFR) was defined as the proportion of TB deaths among all notified TB cases. The crude notification rate (CNR) and the crude mortality rate (CMR) were calculated based on the Tunisian National Institute of Statistics data and were expressed as numbers/100 000 inhabitants/year (12).

Statistical Analysis

Statistical analysis was performed using IBM SPSS.23.0. Categorical variables were presented as numbers and percentages. Continuous variables with normal distribution were carried out by means ± standard deviation (SD). We used Chi square test to compare two frequencies and T-test to compare two means in independent samples. The measure of association was performed using the Odds Ratio (OR) and its 95% confidence interval (95%CI). We applied the direct method of age-standardization

using the World Standard Population to compute the age standardized notification rate (ASNR) per 100 000 inhabitants (13). To analyze TB chronological trends of ASNR over time, Spearman's correlation coefficient (Rho) was calculated. The difference between the groups was considered significant when p<0.05.

RESULTS

Patients' characteristics

During a 22-year study period, we recorded 2771 new cases of TB, yielding a CNR of 13.9/100 000 inhabitants/ year. The sex ratio (Male/Female) was 1.2. The mean age of our population study was 40.7±19.4 years. Of all eligible patients, 2068 cases (74.6%) were in the young and productive age group [15-59[. According to the urbanity of residence, 1612 new cases came from urban areas (58.2%). We recorded 1160 new PTB cases (41.9%) among whom 72.3% (n=839) were bacteriologically confirmed. Treatment regimen was based on fixed drugs combination in 584 patients (21.1%). The mean duration of treatment was 8.6±3.4 months. The disease prognosis was mainly good (96.6%) (Table1). We identified 79 deaths, accounting for a CFR of 2.8%.

Table 1. Description of the study population and comparison of patients' socio-demographic, therapeutic and evolutionary characteristics by gender

Variables	N (%)	Males N (%)	Females N (%)	Odds Ratio [95% CI]	p-value
Total	**2771 (100)**	1508 (100)	1263 (100)		
Age groups (years)					
[0- 15[	167 (6.1)	91 (6)	76 (6)	1 [0.7-1.4]	0.9
[15-59[	2068 (74.6)	1144 (75.9)	924 (73.2)	1.1 [0.97-1.4]	0.1
≥ 60	536 (19.3)	273 (18.1)	263 (20.8)	0.8 [0.7-1.0]	0.07
Urbanity of residence					
Urban areas	1612 (58.2)	887 (58.8)	725 (57.4)	1.0 [0.9-1.2]	0.4
Rural areas	1159 (41.8)	621 (41.2)	538 (42.6)		
Type of institution initially registering patient					
Public health institution	2465 (89)	1355 (89.9)	1110 (87.9)	1.2 [0.9-1.5]	0.1
Private health institution	306 (11)	153 (10.1)	153 (12.1)		
Sites involved					
Lungs	1160 (41.9)	784 (52)	376 (29.8)	2.5 [2.2-3]	***<0.001****
Extrapulmonary sites	1652 (59.6)	750 (49.7)	902 (71.4)	2.5 [2.1-2.9]	***<0.001****
Lymph nodes	754 (45.6)	280 (18.6)	474 (37.5)	2.6 [2.2-3.1]	***<0.001****
Pleura	232 (14)	152 (10.1)	80 (6.3)	1.65 [1.25-2.1]	***<0.001****
Urogenital tract	188 (11.4)	100 (6.6)	88 (7)	0.9 [0.7-1.3]	0.7
Abdomen	183 (11.1)	69 (4.6)	114 (8.9)	2 [1.5-2.8]	***<0.001****
Bone and joints	122 (7.4)	61 (4)	61 (4.8)	0.8 [0.6-1.2]	0.3
Brain	71 (4.3)	37 (2.5)	34 (2.7)	0.9 [0.6-1.4]	0.7
Skin	45 (2.7)	16 (1.1)	29 (2.3)	2.2 [1.2-4]	***0.01****
O.R.L sphere	23 (1.4)	15 (1)	8 (0.6)	1.6 [0.6-3.7]	0.3
Eye	18 (1.1)	13 (0.9)	5 (0.4)	2.2 [0.8-6.1]	0.1
Mediastinum	7 (0.4)	4 (0.3)	3 (0.2)	1.1 [0.2-5]	1
Multifocal	75 (2.7)	41 (2.7)	34 (2.7)	1.0 [0.6-1.6]	0.9
Bacteriologically confirmed PTB	839 (72.3)⁑	606 (40.2)	233 (18.4)	2.9 [2.5-3.5]	***<0.001****
Bacteriologically confirmed EPTB	53 (3.2)⁑⁑	39 (2.6)	14 (1.1)	2.4 [1.3-4.4]	**0.005***
Treatment regimen					
Separate tablets	2187 (78.9)	1214 (80.5)	973 (77)	1.23 [1.02-1.5]	***0.03****
Fixed-dose combinations	584 (21.1)	294 (19.5)	290 (23)		
Disease prognosis					
Good prognosis: Recovery	2677 (96.6)	1447 (96)	1230 (97.4)	1.3 [1.01-1.6]	***0.04****
Poor prognosis	94 (3.4)	61 (4)	33 (2.6)		
Death	79 (2.9)	53 (3.5)	26 (2.1)	1.7 [1.1-2.8]	***0.02****
Relapse	15 (0.5)	8 (0.5)	7 (0.6)	0.9 [0.3-2.6]	0.9

N: number; O.R.L: Oto-Rhino-Laryngology; *: Statistically significant difference; CI: Confidence Interval; PTB: pulmonary tuberculosis; EPTB: extra pulmonary tuberculosis; ⁑: The proportion of bacteriologically confirmed PTB among PTB new cases; ⁑⁑: The proportion of bacteriologically confirmed EPTB among EPTB new cases

Epidemiological, clinical and evolutionary gender disparities in tuberculosis

The gender-specific CNR of TB was 14.96/100 000 inhabitants/year in males and 12.81/100 000 inhabitants/year in females. The mean age at diagnosis was significantly higher in males for EPTB (41.67±18 years vs 41.69±21.13 years; p=0.03).

Gender specific univariate analysis of the disease sites showed that males were more likely to present with pulmonary involvement than females (OR=2.5; p<0.001), while EPTB was more common in females (OR=0.4; p<0.001). The prevalence of both bacteriologically confirmed EPTB (OR=2.4; p=0.005) and PTB (OR=2.9; p<0.001) was significantly greater in males than females (Table 1). According to the sites involved in EPTB, lymph node (OR=2.6; p<0.001), cutaneous (OR=2.3; p<0.001) and abdominal TB (OR=2; p<0.001) were significantly more frequent in females. Pleural TB was significantly more common in males (OR=1.2; p<0.001). CMR was 0.52/100 000 inhabitants/year in males and 0.27/100 000 inhabitants/year in females. CFR was significantly higher in males (OR=1.7; p=0.02). Recovery rates were significantly higher in females (OR=1.3; p=0.04) (Table 1). Males had a treatment duration significantly shorter than females (8.41±3.2 months vs 8.88±3.6 months; p<0.001). Multivariate analysis showed that gender was independently associated with both PTB and EPTB (Table 2).

Table 2. Predictors of pulmonary tuberculosis and extra pulmonary tuberculosis: results of univariate and multivariate analysis

Variables	PTB				EPTB			
	Univariate analysis		Multivariate analysis		Univariate analysis		Multivariate analysis	
	COR [95% CI]	**p**	**AOR [95% CI]**	**p**	**COR [95% CI]**	**p**	**AOR [95% CI]**	**p**
Gender								
Females	1	<0.001*	1	<0.001*	1	<0.001*	1	<0.001*
Males	2.5 [2.2-3]		1.6 [1.2-2]		0.4 [0.3-0.5]		0.37 [0.3-0.4]	
Age groups (years)								
[0- 15[	1	<0.001*	1	<0.001*	1	<0.001*	1	<0.001*
[15-59[	3.2 [2.1-4.7]	<0.001*	1.3 [0.8-2.1]	0.3	0.3 [0.2-0.5]	<0.001*	0.3 [0.2-0.4]	<0.001*
≥ 60	3.4 [2.3-5.2]	<0.001*	2.5 [1.5-4.2]	<0.001*	0.3 [0.2-0.4]	<0.001*	0.25 [0.2-0.4]	<0.001*
Urbanity of residence								
Urban areas	1	0.003*	-	-	1	0.005*	1	0.02*
Rural areas	1.2 [1.5-1.1]				0.8 [0.7-0.9]		0.8 [0.7-0.9]	
Type of institution initially registering patient								
Private health institution	1	<0.001*	1	0.004*	1	<0.001*	1	<0.001*
Public health institution	2.1 [1.6-2.8]		1.9 [1.2-2.8]		0.4 [0.3-0.6]		0.4 [0.3-0.6]	
Treatment regimen								
Separate tablets	1	0.1	1	<0.001*	1	0.1	1	0.03*
Fixed-dose combinations	1.1 [0.9-1.4]		2.5 [1.9-3.2]		0.8 [0.7-1.03]		0.8 [0.6-0.9]	
Bacteriological documentation								
No	1	<0.001*	1	0.9	1	<0.001*	1	0.9
Yes	1.6 [1.1-2.7]		1.3 [0.6-3]		1.8 [1.6-2.7]		1.05 [0.8-1.4]	

N: number; PTB: pulmonary tuberculosis; EPTB: Extra pulmonary tuberculosis; CI: Confidence interval; COR: Crude Odds Ratio; AOR: Adjusted Odds Ratio;*: Statistically significant difference

Chronological trends of tuberculosis notification by gender

Between 1995 and 2016, the ASNR of TB (Rho=0.68; p<0.001) and EPTB (Rho=0.59 p=0.003) had significantly increased in females, while it had not significantly changed in males (Figure 1 and 2).A significant increase in the lymph node tuberculosis (LNTB) ASNR occurred for both genders from 1995 to 2016 (Figure 4).The PTB ASNR didn't change in both males and females over the 22 -year –period (Figure 3).

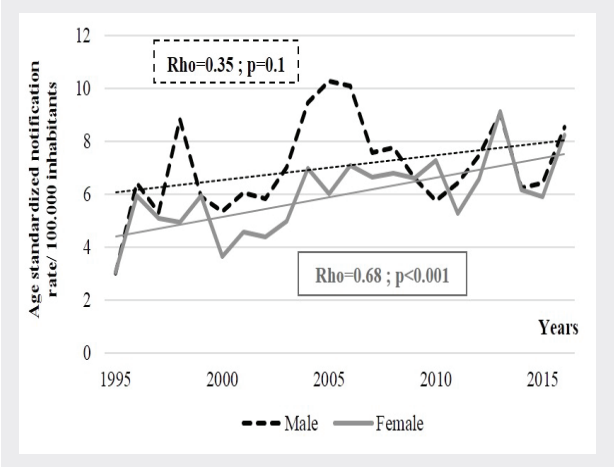

Figure 1: Chronological trends of tuberculosis age standardized notification rate between 1995 and 2016 by gender

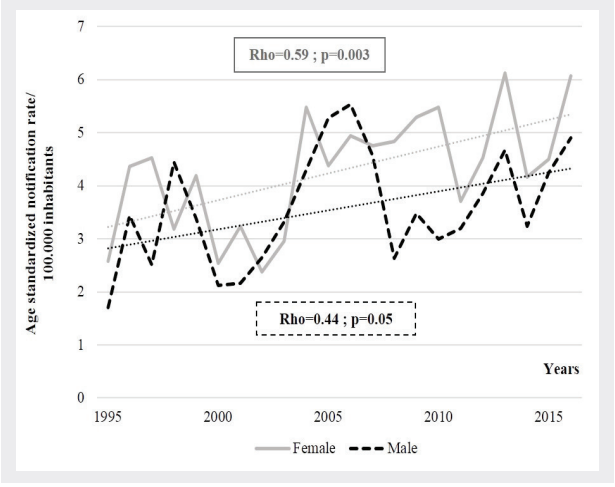

Figure 2: Chronological trends of extra pulmonary tuberculosis age standardized notification rate between 1995 and 2016 by gender

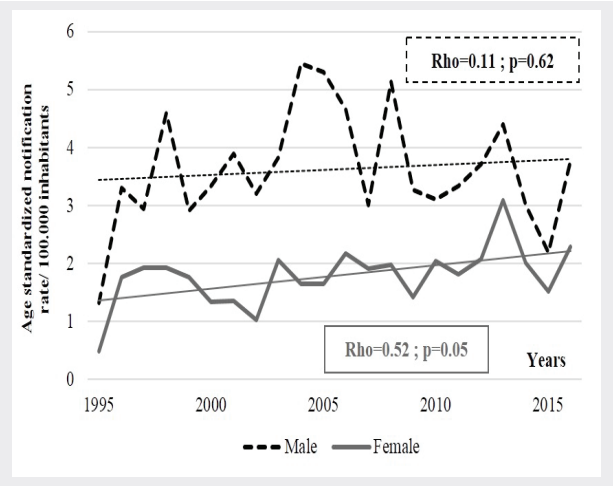

Figure 3: Chronological trends of pulmonary tuberculosis age standardized notification rate between 1995 and 2016 by gender

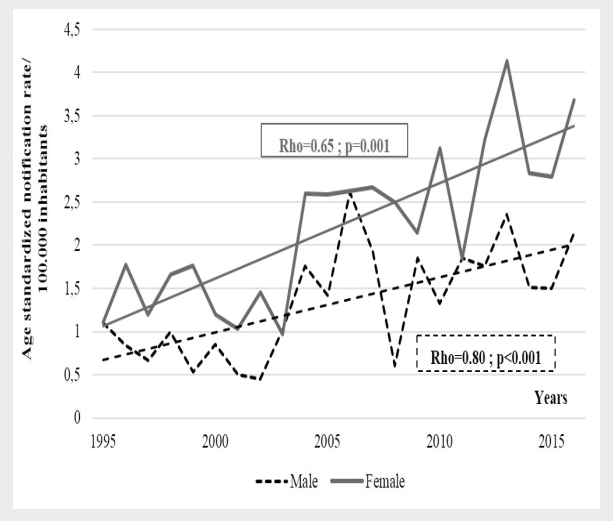

Figure 4: Chronological trends of lymph node tuberculosis age standardized notification rate between 1995 and 2016 by gender

DISCUSSION

Using TB surveillance data of 2771 patients, we analyzed gender differences in the epidemiological, clinical and evolutionary specificities of TB in Southern Tunisia in the last two decades. This study reported that males were more likely to have PTB than females, while EPTB was more common in females. According to the sites involved

in EPTB, lymph node and abdominal TB were significantly more frequent in females. Pleural TB was significantly more common in males. Case fatality rate was significantly higher in males. However, females experienced recovery more frequently with a significantly higher treatment duration. Between 1995 and 2016, ASNR of TB and EPTB had significantly increased in females, while it had not significantly changed in males.

Our study pointed out gender disparities in the epidemiological, clinical and evolutionary specificities of TB in Southern Tunisia. According to the WHO, males seem to be more affected than females with a male/female ratio of incident TB cases of any age ranging from 1.3 in the WHO Eastern Mediterranean Region to 2.1 in the WHO Western Pacific Region (6).Some studies reported ratios below 1 which mostly correspond to very small populations of patients such as Afghanistan, parts of Pakistan bordering Afghanistan and Iran (14,15). Indeed, biological mechanisms may account for most of this gender disparity. Moreover, socioeconomic factors such as disproportionate poverty, low social status, less education which impedes seeking diagnosis and cultural factors such as stigma and discrimination could act as major obstacles for females in seeking care. All these factors would lead to an underreporting of TB in females, a situation which is often seen in developing countries (15,16).

Age-wise distribution of our patients showed that TB mainly affected females and males in the young and productive age group (15-59 years). Regarding females, this might be explicated by the burden of housework, childcare and employment that allow them very little time to access health care, to visit Directly Observed Treatment - Short course (DOTS) center and to have TB care for themselves. Otherwise, the impact of the disease is also strongly felt by their children and families (15): females in this period of life would be a higher risk of transmitting infection to the child at times attributed to nursing, at a higher risk of complications because of attendant antenatal and postnatal morbidity, especially in developing countries (17). Regarding males, many socioeconomic reasons, especially in developing countries, would make them at high risk of TB when they are economically active. In fact, males are usually the sole breadwinners or employed in the unorganized sectors and have lesser chances to attend DOTS centers because of their work timings. Thus, all of these aspects should be looked into to develop appropriate TB control strategies.

In our study, we found that pulmonary involvement occurred more commonly in males than in females, while the opposite was true for EPTB involvement. Several studies corroborated this gender difference in the incidence rates of PTB and EPTB (18-20). This finding most likely reflected the overrepresentation of males in the various PTB risk groups, notably the homeless, prisoners, seasonal migrant workers, people living with HIV (21) as well as alcoholic, tobacco and shisha smokers. On the other hand, females, who generally remain indoors for most of the time, have less extensive social activity and fewer exposure opportunities to active PTB. Among the new PTB patients notified in the present study, 72.3% were bacteriologically confirmed. This finding was within the same range as those reported in the global tuberculosis report published by WHO in 2018. In fact, the percentage of PTB cases with bacteriological confirmation accounted for 56% worldwide, 59% in the WHO South-East Asia Region, 66% in the WHO African Region and 64% in the WHO European Region. However, the prevalence of bacteriologically confirmed EPTB in this study was much lower than those reported in developing countries: It was 41.3% in Cameroon (22) and 12.8% in China (23). Reasons for that could be attributed to the low prevalence of HIV in our country. Indeed,Tunisia was classified among the african countries which had the lowest HIV/AIDS prevalence rates (<0.3%) (24). Furthermore, bacteriological confirmation of EPTB is a very challenging issue in our national tuberculosis program because of the pauci-bacillary nature of the disease, the difficulty to obtain an adequate sample as well as the variable clinical presentation and need for invasive procedures to secure appropriate sample (25). All these limitations cause poor contribution of bacteriological techniques in the establishment of EPTB diagnosis (26).

In agreement with previous studies, males tend to have more bacteriologically confirmed TB than females (17,27-29). The reason for this gender imbalance is still unclear but is likely to be a complex mixture of biological, epidemiological and socio-cultural determinants (30). Moreover, it has been reported that males tend to produce a better quality sputum than females (29,31), yet specimen quality is a critical determinant of smear microscopy performance, and poor quality specimens (as judged macroscopically) are associated with lower concentrations of acid-fast bacilli (30).

This association between the quality of sputum specimen and the performance of smear-microscopy could explain partially the gender discrepancy of the prevalence of bacteriologically proven TB.

The difference in the occurrence of EPTB by site between males and females was statistically significant for lymph node, cutaneous, abdominal and pleural tuberculosis. These findings were consistent with previous studies that found that LNTB was more common among females (32). The reason for the association of female gender with LNTB could be due to lymphocyte counts, endocrine factors (32,33) or the difference in tumor necrosis factor and interleukin-10 production between both genders (32,34). Moreover, females in developing countries, notably in Tunisia, represent a crucial resource in agriculture through their roles as farmers. Therefore, they are more exposed to cattle infected with *Mycobacterium bovis* and then consume more frequently unpasteurized dairy products. Similar to our results, previous studies reported significantly higher number of abdominal tuberculosis cases involving females than males (35-38). Our results contrasted with those reported in Moscow and India, which found greater number of males than females with abdominal tuberculosis (39,40) .While, male and female patients were nearly equally affected by abdominal TB in Pakistan and Taiwan (41,42). Possible explanations for these discordant results may be the variation in gender composition between the study populations, as well as biological, cultural and socio-economic particularities of each country.

Our study analyzed the impact of gender on treatment outcomes. Indeed, the case-fatality rate was significantly higher in males, whereas recovery rate and treatment duration were significantly higher in females, which was in line with previous studies (43-45). Paradoxical association of a more favorable outcome in females, despite facing more socioeconomic and cultural adversities, could be attributed to the fact that more female than male patients who underwent treatment completed cure. Additionally, the lack of education and knowledge among females TB patients probably make them more dependent on their DOT providers, which ensure better adherence to treatment and hence better prognosis. On the other hand, males who had better access to TB treatment from a DOT facility, are usually reported as having a higher unsuccessful treatment rate. Reasons for that could be explained by the need to earn a livelihood which acts as a barrier to completing treatment. Furthermore, the role of biological factors in causing the differences in treatment outcome among males and females constitutes a further area of research.

Over the 22-year study period, TB epidemic in Southern Tunisia has become increasingly feminized. The role of the HIV epidemic, as well as parallel increasing other risk factors in females such as alcohol use, tobacco smoking and chicha (46), were explored as potential explanations for the increasing representation of females with tuberculosis (47). Other plausible explanation is that incidence rate of lymph node TB, which was the most common extra pulmonary manifestation of TB (48), has recently increased among females. Furthermore, males who have a higher prevalence of TB and remain infectious in the community for a longer period of time than females are therefore likely to increase the risk of TB transmission mainly to females. Addressing males' burden of disease and disadvantage in TB care is therefore an issue not only for males' health but for achieving the ambitious targets of the End TB Strategy.

Our study provided accurate and exhaustive data including a large number of TB notified cases from both public and private health institutions over the last two decades. It also categorized high-risk groups where gender had an impact on the disease and its control. Thus, it can be used as a referent document by policy makers to address prioritized curative and preventive action plans. However, this study had some limitations. Firstly, because of its retrospective design, patients were not followed-up during the study period and the treatment outcome as well as the therapeutic response could not be assessed accurately. Secondly, deficiencies in the databases included possible missing or incomplete data, and potential biases and errors during data entry. Furthermore, because of passive surveillance system for TB control program, the under reporting of the notified cases may under-estimate the real incidence rate of TB. Therefore, additional nation-wide and prospective studies are needed to better estimate the TB burden in this region as well as clinical and therapeutic advance in TB management among men and women. Another limitation of the study is the lack of data dealing HIV status, clinical signs and individual's socioeconomic status, which were widely reported as related factors to TB control in both genders. This is an area that may be of a great interest to better understand the sex-specific differences in TB epidemiology and clinical forms. Evidence from different cultural settings

regarding health seeking behaviors among men and women TB suspects when using private and public health sectors differently is also needed to be analyzed.

CONCLUSION

Our study underlined gender disparities in TB burden with almost higher burden of morbidity and poorer prognostic in males, notably in the young and economically productive age group. Therefore, TB could result in increased poverty by reaching higher economic and social costs among infected males and their household members. The alarming upward trends of lymph node TB in females necessitate urgent interventions targeting both cattle and humans, especially female farm works. Consequently, there is an utmost need to strengthen the efforts for effective strategies including animal tuberculosis control programs such as bovine screening and milk pasteurization.

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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None

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